Consumer Decision Making and Configuration Systems

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Contents

- Decision Biases

- Conclusions & Research Issues

Heatmap Visualization of Modeling Sessions
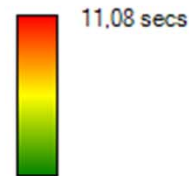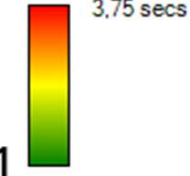
- Overview of areas, knowledge engineers looked at.
- Can be used, for example, for constraint ranking.

Goal …

☞ Basic introduction to <u>example cognitive biases</u>
(100's exist …)

☞ Cognitive (decision) biases:
  – "tendency to decide in certain (simplified) ways"
  – can lead to suboptimal decision outcomes

☞ Bottum-up approach (testing individual biases)

Why Cognitive Biases?

risk [1..10]?
fun[1..10]?
food [1..10]?
credit[1..10]?
…

**Human brains were not primarily designed for the present time
but rather for stone-age conditions**

Also: tradeoff between effort and accuracy, maximizers vs. satisficers

Frequent Assumptions ...

- Preferences are known/defined beforehand

- Preferences are stable, users don't change them

- Users have an optimization function in mind

☞ **However, preference stability does not exist!**

full HD films

5 pics per sec.

WLAN data transfer

maxprice 1.500€

waterproof

max resolution 20MPix
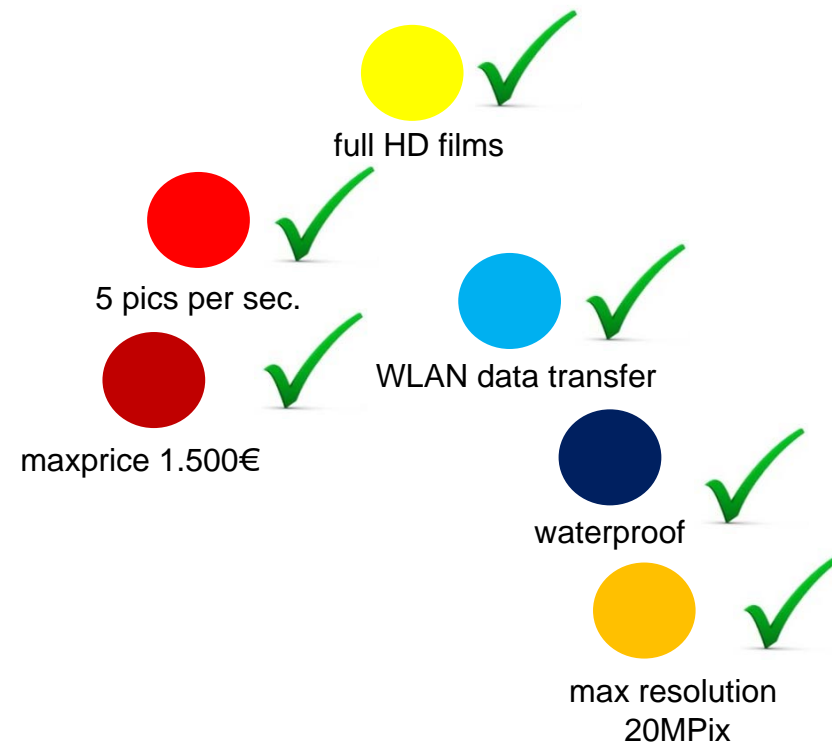
Preferences Are Constructed ...

- Not known beforehand

- Often changed

- <u>No</u> optimization function used

- Decision heuristics applied (e.g., elimination by aspects)

☞ "Door opener" for **<u>cognitive biases</u>** (tendency to decide in certain ways)!

> **J. Payne, J. Bettman, and E. Johnson. The Adaptive Decision Maker, Cambridge University Press, 1993.**

Example Influence Factors for Decisions
with Configuration Systems

ordering of attributes/ questions

ordering of configurations

configuration of result sets

social context

Decision

explanation of configurations

presentation context
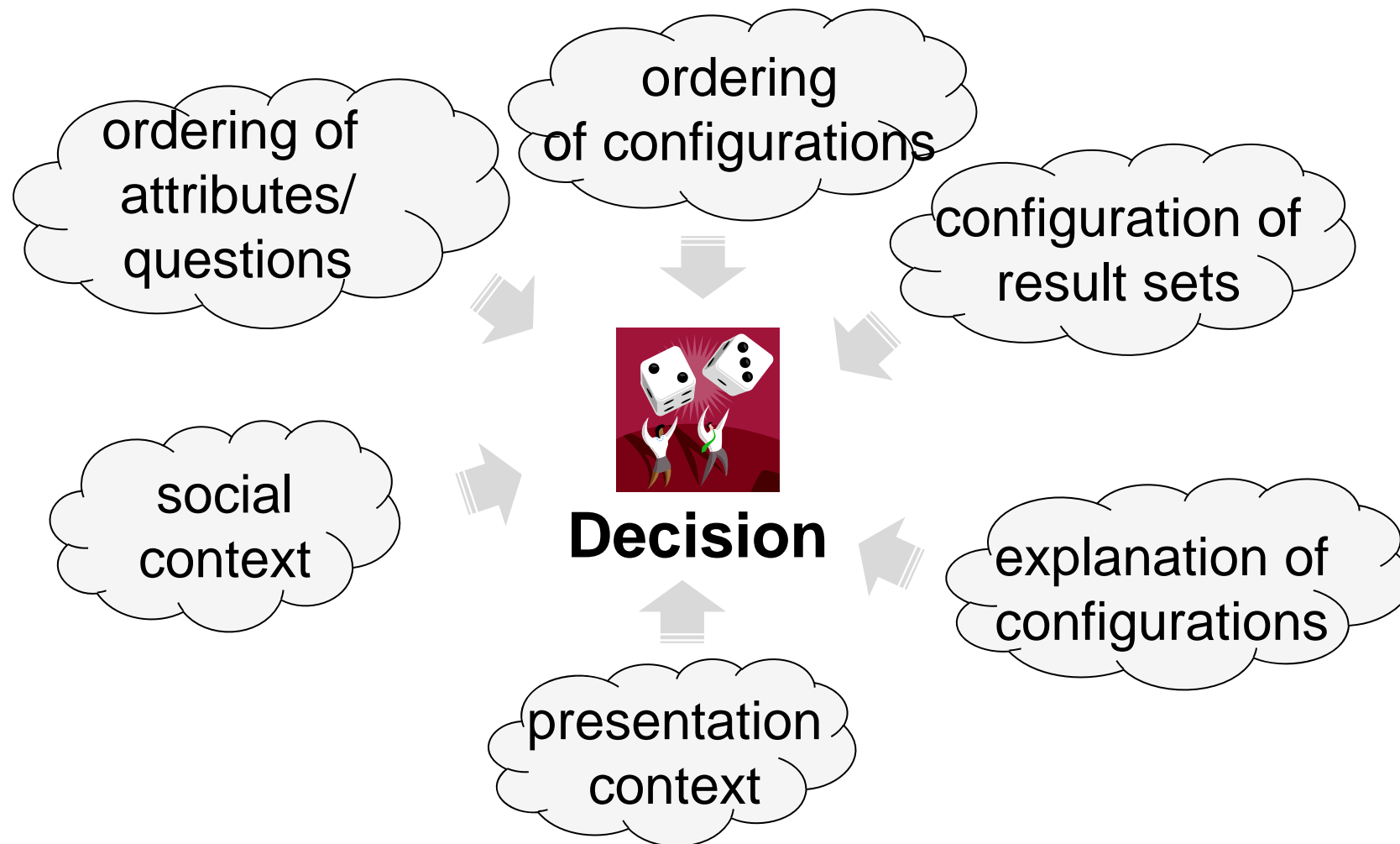
Examples of Cognitive Biases

Theory	Description
Context effects (decoy effects)	Additional irrelevant (inferior) items in an item set significantly influence the selection behavior
Primacy/recency effects	Items at the beginning and the end of a list are analyzed significantly more often than items in the middle of a list
Framing effects	The way in which different decision alternatives are presented influences the final decision taken
Priming	If specific decision properties are made more available in memory, this influences a consumer's item evaluations
Defaults	Preset options bias the decision process

Context Effects
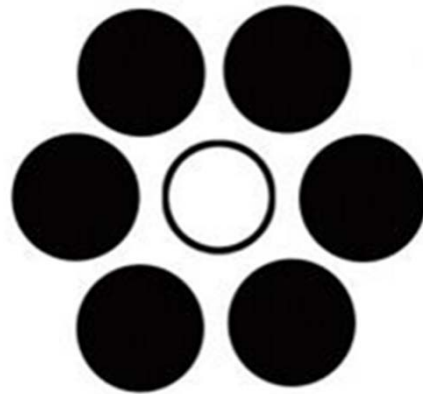
Context Effects

- A decision is always made depending on the context in which item alternatives are presented

- For example, completely inferior item alternatives can trigger significant changes in choice behaviors

- Example context effects are discussed in the following

Short Note: Ebbinghaus Effect
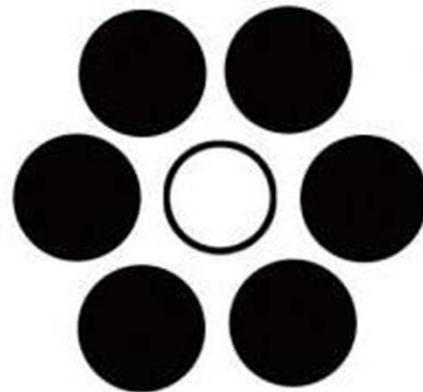
- Illusion of relative size perception

- Triggered by context in which objects are shown

- Commonalities with context effects

Context Effects: Overview
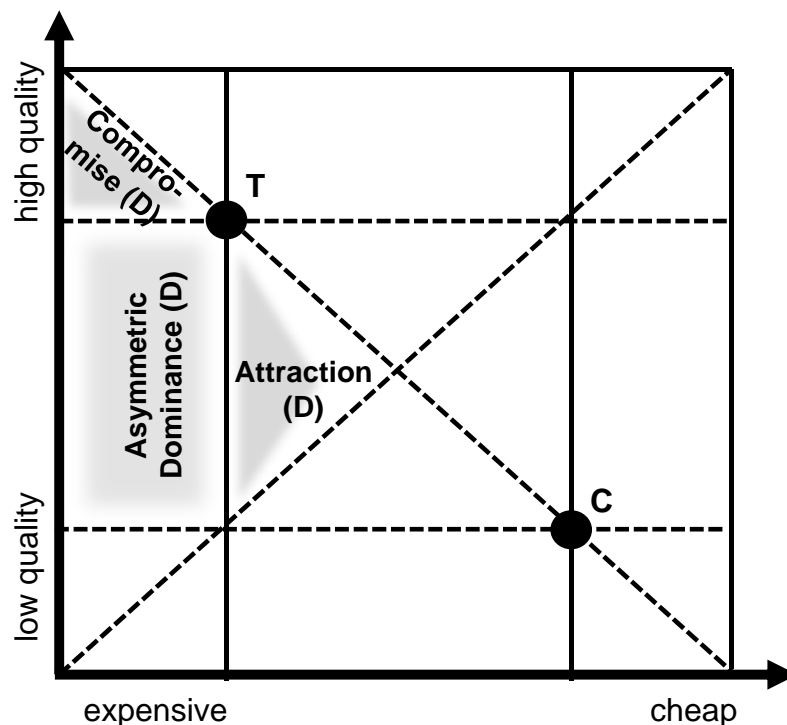
- **Compromise** : Target (T) is a compromise to decoy item D (T is **less expensive** and has **slightly lower quality**)

- **Asymmetric Dominance**: T dominates D (T is **cheaper** and has a **higher quality**)

- **Attraction**: T is more attractive than D (T is **slightly more expensive** but has a **higher quality**)

Compromise Effect

Product	A (T)	B	D
price per month	30	15	50
download limit	10GB	5GB	12GB

The addition of alternative *D* (the decoy alternative) increases the attractiveness of alternative *A* because, compared with product *D*, *A* has only a slightly lower download limit but a significantly lower price

D is a so-called decoy product, which represents a solution alternative with the lowest attractiveness

Compromise Effect in Financial Services Domain

Study performed with real-world products (konsument.at).
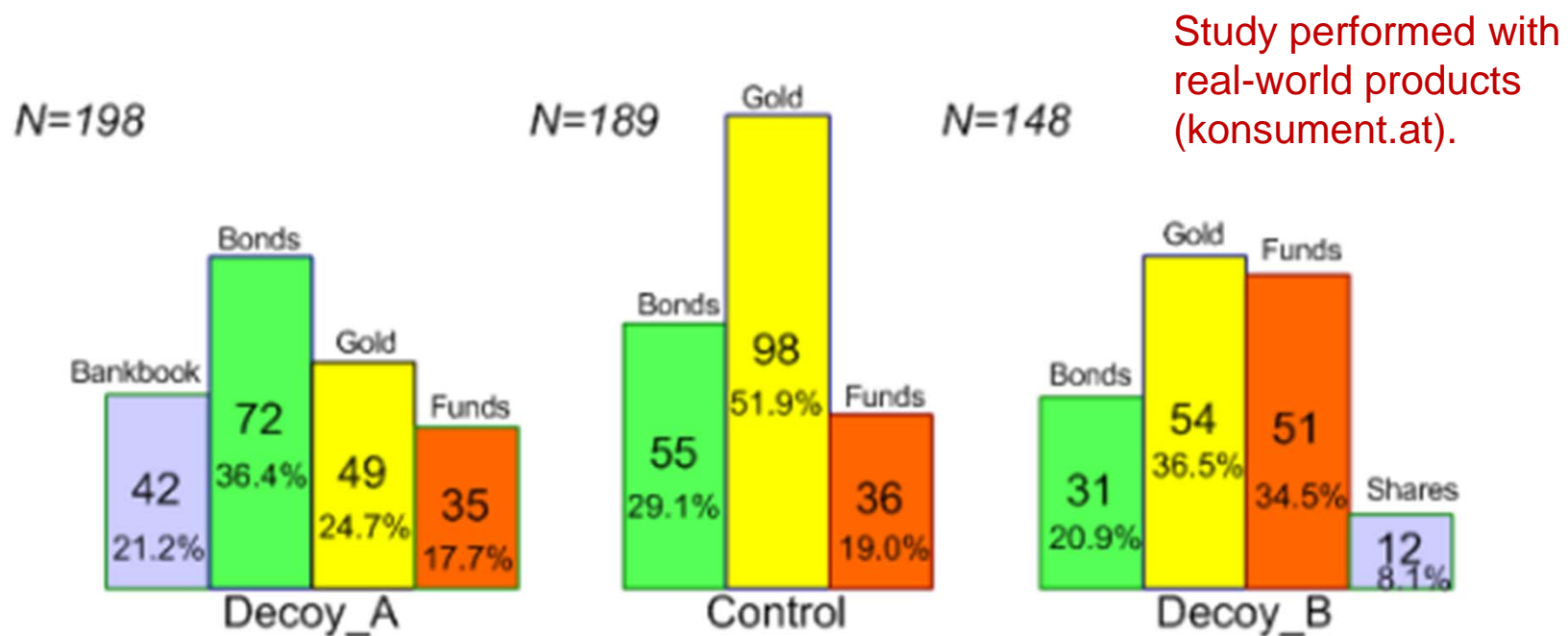
A. Felfernig, E. Teppan, and K. Isak. Decoy Effects in Financial Service e-Sales Systems, ACM Recommender Systems Workshop on Human Decision Making and Recommender Systems (Decisions@RecSys), Chicago, IL, 2011.

Asymmetric Dominance Effect

Product	A (T)	B	D
price per month	30	15	50
download limit	10GB	5GB	9GB

Product *A* dominates *D* in both dimensions (price and download limit)

Product *B* dominates alternative *D* in only one dimension (price)

The additional inclusion of *D* into the choice set could trigger an increase of the selection probability of *A*

Asymmetric Dominance Effect

	MP3 Player A	**MP3 Player B**	**MP3 Player C**
Price	€400	€300	€450
Storage	30GB	20GB	25GB
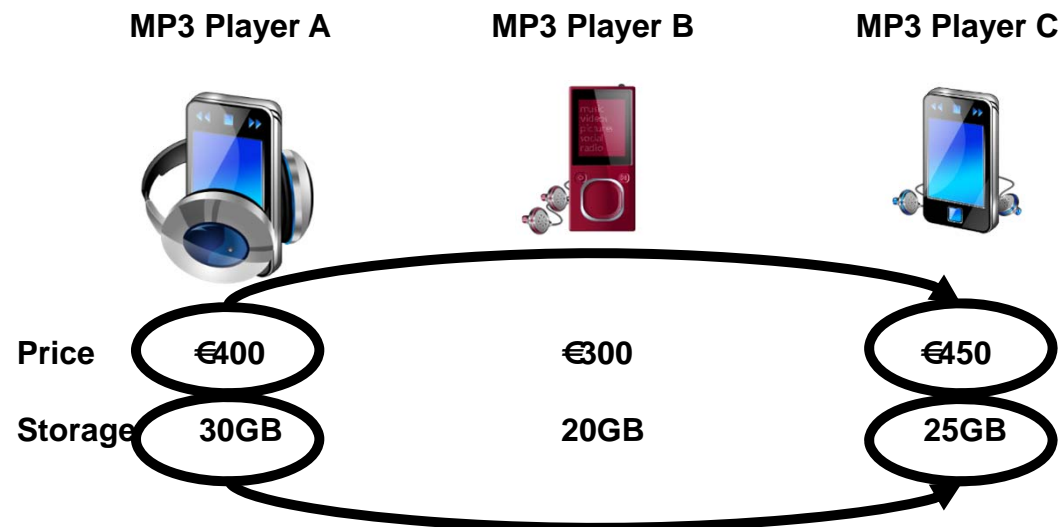
Attraction Effect

Product	A (T)	B	D
price per month	30	90	28
download limit	10GB	30GB	7GB

Product *A* is a little bit more expensive but of significantly higher quality than *D*

The introduction of product *D* would induce an increased selection probability for *A*
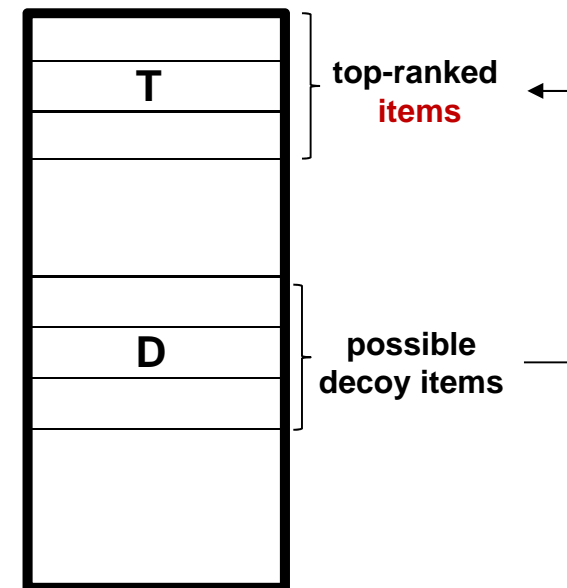
Calculation of Dominance Values

- Dominance value (DV) of d $\in$ Items (includes a decoy D for target item T).

$$DV_{d \in Items} = $$

$$\frac{\sum_{i \in \{Items-d\}} \sum_{a \in Attributes} weight_a * \sqrt{\left|\frac{a_d - a_i}{\max_a - \min_a}\right|} * sign(a_d - a_i)}{\#Items - 1}$$

- Reconfiguration problems, e.g., reduce the dominance of T

T	top-ranked **items**
D	possible decoy items

A. Felfernig, B. Gula, G. Leitner, M. Maier, R. Melcher, S. Schippel, E. Teppan. A Dominance Model for the Calculation of Decoy Products in Recommendation Environments. AISB Symposium on Persuasive Technologies, Vol. 3, pp. 43-50, Aberdeen, Scotland, Apr. 1-4, 2008.

Impacts on Configuration Systems

- **Faster decisions**: decoys help to resolve cognitive dilemmas in the case of items with the same utility

- **Increased confidence**: decoys serve as a basis for explaining a decision

- **Increased share of specific items**: systematic "push" of target configurations (solutions)

- **Diagnosis support**: figuring out which configurations are responsible for the low share of a target

- **Interferences between decoy configurations** in a set

A. Felfernig, B. Gula, G. Leitner, M. Maier, R. Melcher, S. Schippel, E. Teppan. A Dominance Model for the Calculation of Decoy Products in Recommendation Environments. AISB Symposium on Persuasive Technologies, Vol. 3, pp. 43-50, Aberdeen, Scotland, Apr. 1-4, 2008.

Primacy/Recency Effects

P   **R**

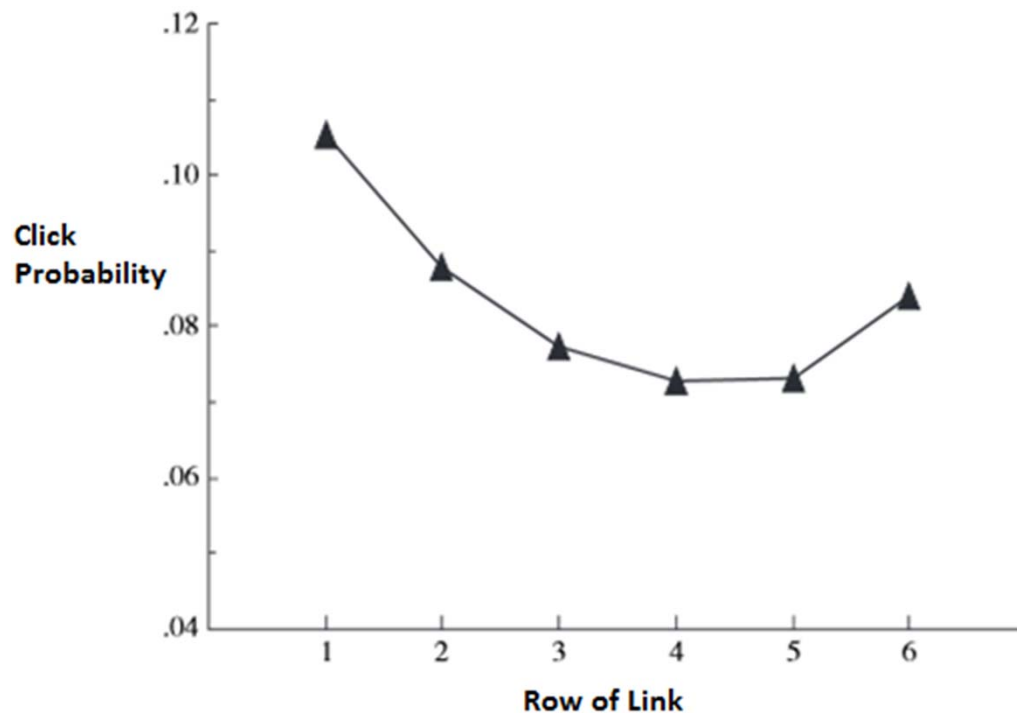# Primacy/Recency Effects
as a Decision Phenomenon

- Describe situations in which items presented at the beginning and at the end of a list are evaluated significantly more often than others

- Typically, users are not interested in evaluating large lists to identify those that best fit their preferences

- The same phenomenon exists as well in the context of web search scenarios

Item Selection Behavior (Web Links)

- Primacy effect

- Efficacy of the first link

- But also recency

- Tendency to click links at the end

J. Murphy, C. Hofacker, and R. Mizerski. Primacy and Recency Effects on Clicking Behavior. Computer-Mediated Communication, 11:522-535, 2012.

Primacy/Recency Effects
as a Cognitive Phenomenon

- Describe situations in which information units at the beginning (primacy) and at the end (recency) of a list are recalled more often than information units in the middle of the list

- Primacy/recency effects in recommendation dialogs must be taken into account because different dialog sequences can potentially change the selection behavior of consumers

A. Felfernig, G. Friedrich, B. Gula, M. Hitz, T. Kruggel, R. Melcher, D. Riepan, S. Strauss, E. Teppan, and O. Vitouch. Persuasive Recommendation: Exploring Serial Position Effects in Knowledge-based Recommender Systems, Second International Conference of Persuasive Technology (Persuasive 2007), Springer Lecture Notes in Computer Science, Vol. 4744, pp.283-294, Stanford, California, Apr. 26-27, 2007.

Primacy/Recency Effects
as a Cognitive Phenomenon
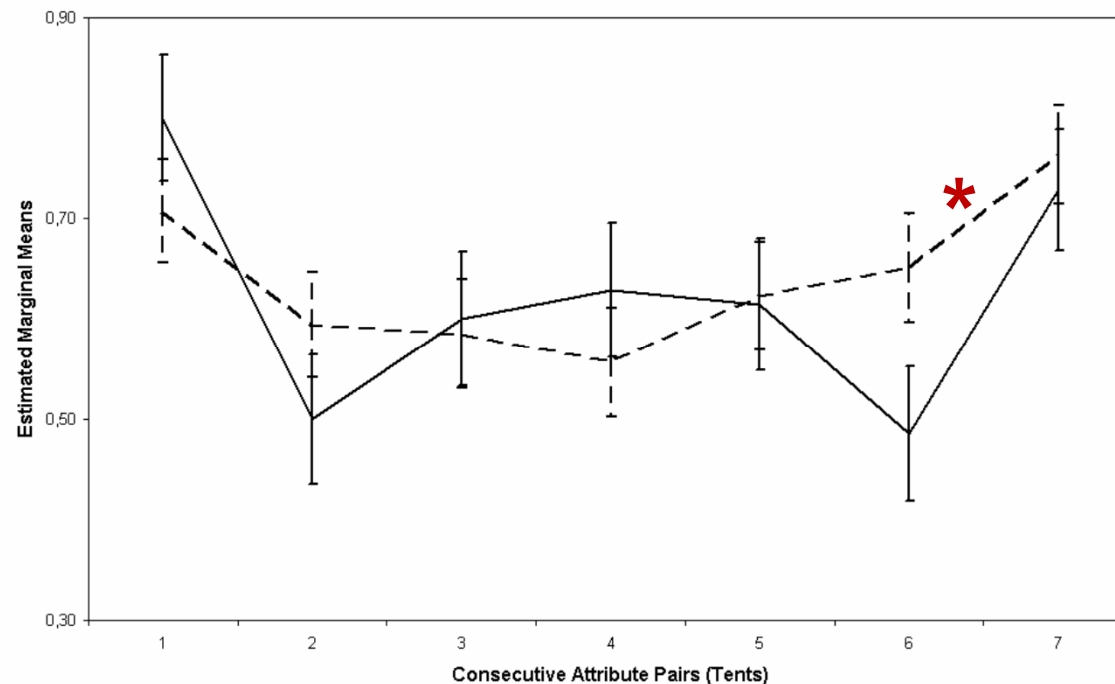
- Descriptions at beginning/end of dialog are recalled more often

- Also in the case "unfamiliar salient" (*), e.g. flyscreen vs. price or weight.

A. Felfernig, G. Friedrich, B. Gula, M. Hitz, T. Kruggel, R. Melcher, D. Riepan, S. Strauss, E. Teppan, and O. Vitouch. Persuasive Recommendation: Exploring Serial Position Effects in Knowledge-based Recommender Systems, Second International Conference of Persuasive Technology (Persuasive 2007), Springer Lecture Notes in Computer Science, Vol. 4744, pp.283-294, Stanford, California, Apr. 26-27, 2007.

Impacts on Configuration Selection

Questions Q_i regarding Item Attributes
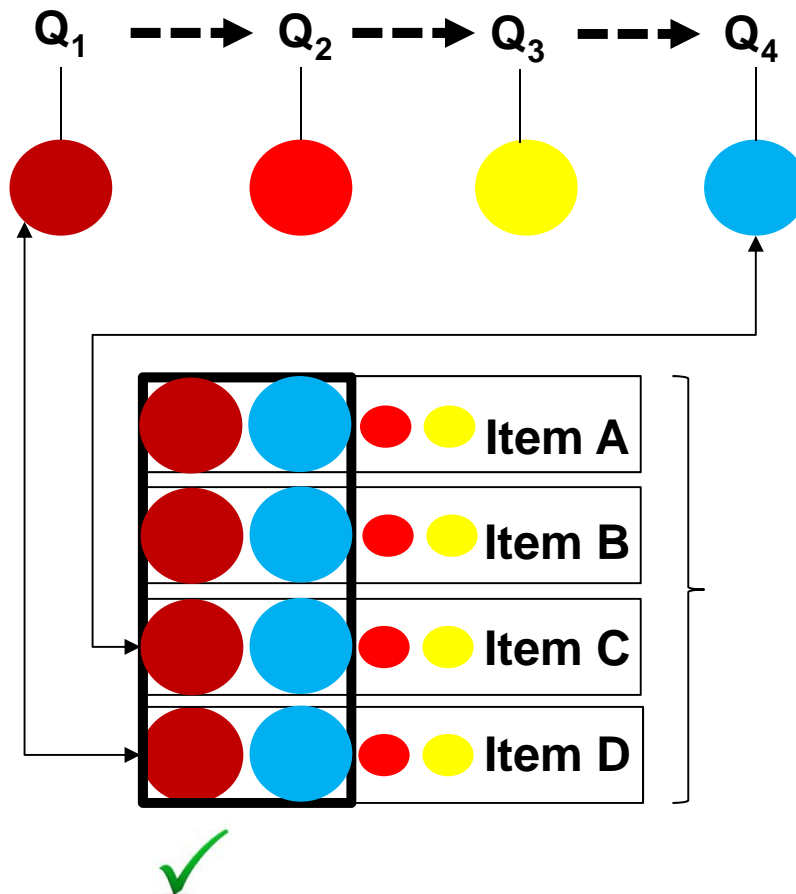
Q_1 ----▶ Q_2 ----▶ Q_3 ----▶ Q_4

A. Felfernig, G. Friedrich, B. Gula, M. Hitz, T. Kruggel, R. Melcher, D. Riepan, S. Strauss, E. Teppan, and O. Vitouch. Persuasive Recommendation: Exploring Serial Position Effects in Knowledge-based Recommender Systems, 2nd International Conference of Persuasive Technology (Persuasive 2007), Springer Lecture Notes in Computer Science, Vol. 4744, pp.283-294, Stanford, California, Apr. 26-27, 2007.

Item A

Item B

Item C

Item D

Attribute order has an impact on perceived attribute importance (e.g., price, weight, …)!

Impacts on Configuration Systems

- **Control of item selections** on the basis of attribute orderings in dialogs

- **Control of diagnosis & repair and critique selection**

- **Users rate items differently** depending on the ordering of argumentations in reviews (ongoing work)

- Question of **debiasing effects** in group decision making (also holds for other biases)

A. Felfernig, G. Friedrich, B. Gula, M. Hitz, T. Kruggel, R. Melcher, D. Riepan, S. Strauss, E. Teppan, and O. Vitouch. Persuasive Recommendation: Exploring Serial Position Effects in Knowledge-based Recommender Systems, 2nd International Conference of Persuasive Technology (Persuasive 2007), Springer Lecture Notes in Computer Science, Vol. 4744, pp.283-294, Stanford, California, Apr. 26-27, 2007.

Framing
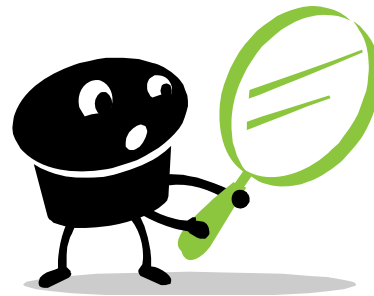
Framing

- **Framing Effect**: the way a decision alternative is presented influences the decision behavior of the user

- **Example**: 80% lean vs. 20% fat meat

- **Prospect theory**: suggests that potential purchases are evaluated in terms of **gains** or **losses** (see "price framing" …)
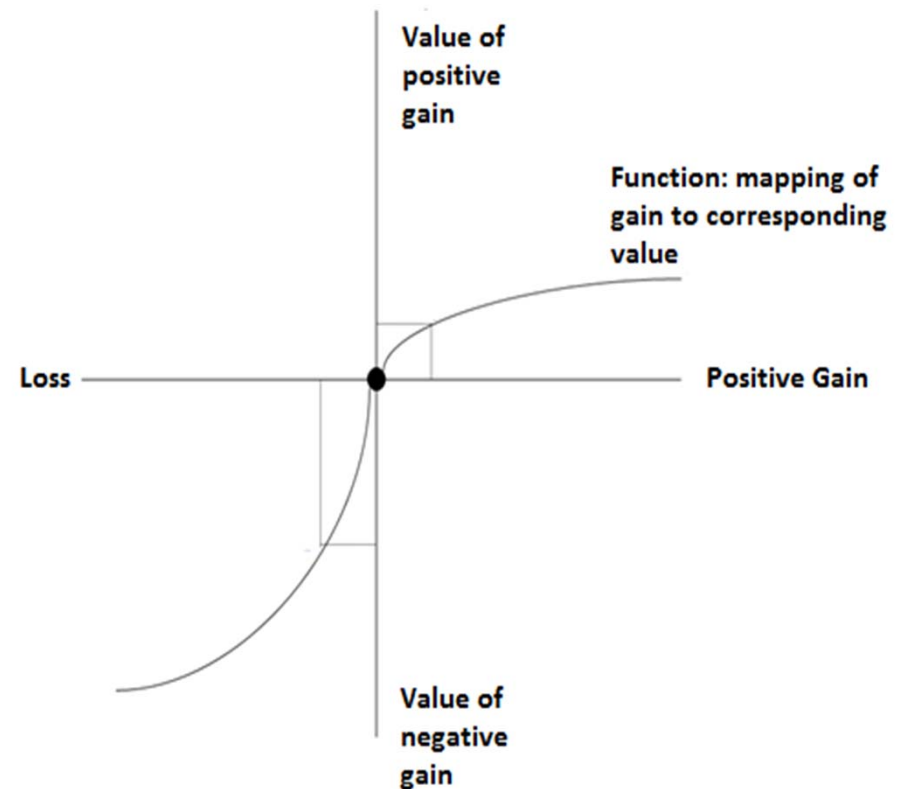
D. Kahneman und A. Tversky (1979): Prospect theory: An analysis of decision under risk, Econometrica, Vol. 47, No. 2, S. 263-291.

Price Framing: Example

Which company would you purchase wood pellets from, X or Y?

- Company X sells pellets for **€24.50** per 100kg, and gives a **€2.50 discount** if the customer pays with cash

- Company Y sells pellets for **€22.00** per 100kg, and charges a **€2.50 surcharge** if the customer uses a credit card

☞ Company **X rewards buyers** with a discount, which is considered a gain (we want to avoid losses …)

> **M. Bertini and L. Wathieu. The Framing Effect of Price Format. Working Paper, Harvard Business School, 2006.**

Impacts on Configuration Systems

- **Positive framing** increases selection probability (e.g., 95% no loss vs. 5% loss) $\rightarrow$ use graphical representation …

- **Price framing**: potential shift from quality to secondary attributes (e.g., payment services)

- **Low impact of secondary attributes in all-inclusive offers**

- **Not every item property is equally salient** at decision time

Priming
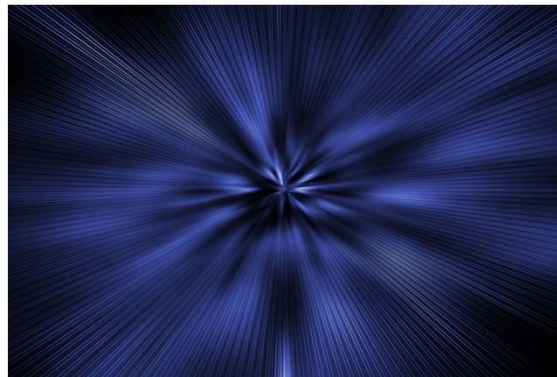
Priming

- Idea of making some properties of a decision alternative more accessible in memory such that this setting will directly influence user evaluations

- Def. Influencing of the processing of a current stimulus by the activation of already memorized knowledge by a precedent stimulus

- Example: background priming exploits the fact that different page backgrounds can directly influence the decision-making process

Background Priming
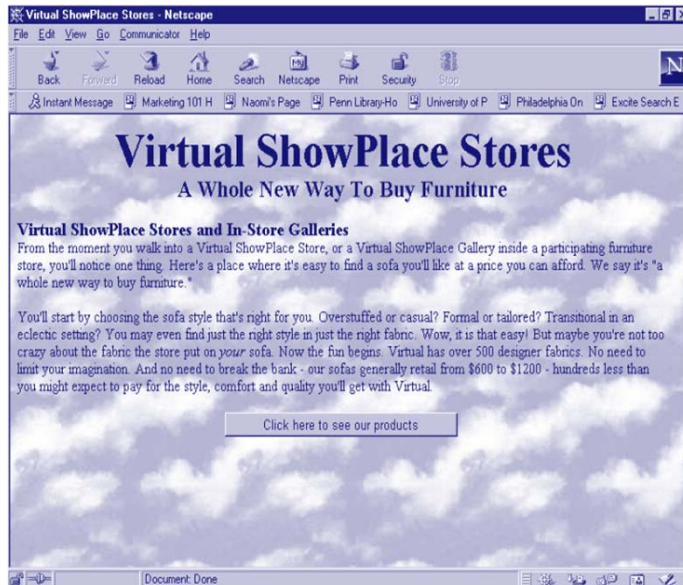
☞ Cloudy background triggered user feelings of comfort and caused users to select more expensive products (focus on quality attributes)

N. Mandel and E. Johnson. Constructing Preferences online: Can Web Pages Change What You Want? Association for Consumer Research Conference, Montreal, pp. 1-37, 1998.

A. North, D. Hargreaves, and J. McKendrick. In-store music affects product choice. Nature 390:132, 1997.

Further Effects

Defaults

- People tend to favor the status quo compared to other decision alternatives ("status quo bias")

- People are typically loss-averse (prospect theory)

- If defaults are used, users are reluctant to change predefined settings (mistakes, additional effort, …)

- Defaults can be used, for example, to …

  - Influence decisions (ethical issues!)

  - Reduce the overall interaction effort and actively support consumers in the product selection process

Defaults: Example
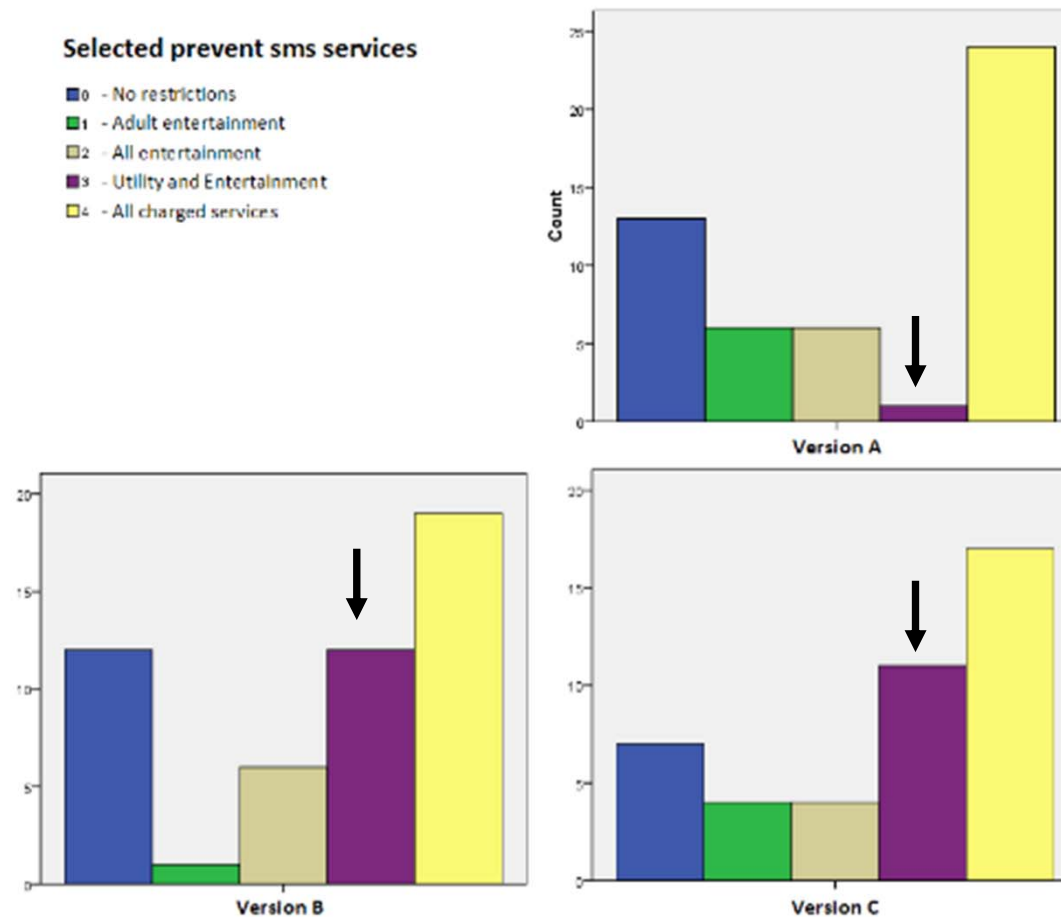
M. Mandl, A. Felfernig, and J. Tiihonen: Evaluating Design Alternatives for Feature Recommendations in Configuration Systems. CEC 2011, pp. 34-41, 2011.

Anchoring

- Tendency to rely too heavily on the first information (anchor) within the scope of decision making

- Ratings biased to be higher result in higher ratings of the current user

- Example: ratings in collaborative filtering, preferences articulated by the first group member

G. Adomavicius, J. Bockstedt, S. Curley, and J. Zhang. Recommender Systems, Consumer Preferences, and Anchoring Effects, Decisions@RecSys'11, pp. 35-42, Chicago, IL, USA, 2011.

A. Felfernig, C. Zehentner, G. Ninaus, H. Grabner, W. Maaleij, D. Pagano, L. Weninger, and F. Reinfrank, Group Decision Support for Requirements Negotiation, LNCS, 7138, pp.105-116, 2012.

Group Decision Support in Requirements Engineering (RE)

- Study @ TU Graz: 40 Software teams with ~ 6 members.

- Group recommendation support for RE processes

- Group recommendations significantly increase the degree of information exchange between users

- Hidden preferences increase disense between stakeholders but increase perceived decision support quality

A. Felfernig, C. Zehentner, G. Ninaus, H. Grabner, W. Maalej, D. Pagano, L. Weninger, and F. Reinfrank. Group Decision Support for Requirements Negotiation, LNCS 7138, pp. 105-116, 2012.

Conclusions

- Preferences are not known beforehand and often changed (☞ "preference construction")

- Decisions are <u>not</u> based on optimization functions but on different types of decision heuristics (also occur in patterns of choosing)

- Different decision biases can occur (decoy effects, serial position effects, framing, etc.)

- Have to be taken into account in Configuration System development

- Many open research issues …

Research Issues

- Investigation of decision biases in groups

- Consensus-fostering configurations

- Debiasing candidate sets (e.g., in CF)

- Fairness in decision processes in the long run

- Choicla decision support based on recommendation technologies (www.choicla.com)

Exercises

1. Explain the terms "Decision Heuristic" and "Decision Bias" and explain their dependencies

2. Provide an example of a decision heuristic

3. Provide an example for a decoy effect

4. Provide an example for the framing effect

5. Explain in detail the concept of primancy/recency

Thank You!

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Consumer Decision Making and Configuration Systems

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