The use of automated agents to aid consumer decisions

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Outline

- Consumer Choice with Intelligent Agents and Shopbots
- Current State of Shopbots
- Marketing Research on Intelligent Agents

- Applications:
  - Shopbot design
  - Empirical models of choice at shopbots
  - Embedding recommender agents for adaptive web design

Consumer Choice with Intelligent Agents and Shopbots

What is an intelligent or automated agent?

- **The Maes Agent** [Maes 1995, page 108] *"Autonomous agents are computational systems that inhabit some complex dynamic environment, sense and act autonomously in this environment, and by doing so realize a set of goals or tasks for which they are designed."*
- **The IBM Agent** [http://activist.gpl.ibm.com:81/WhitePaper/ptc2.htm] *"Intelligent agents are software entities that carry out some set of operations on behalf of a user or another program with some degree of independence or autonomy, and in so doing, employ some knowledge or representation of the user's goals or desires."*
- **Franklin and Graesser** [http://www.msci.memphis.edu/~franklin/AgentProg.html]

  *An **autonomous agent** is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future.*
- **The Wooldridge-p;Jennings Agent** [Wooldridge and Jennings 1995, page 2] *"... a hardware or (more usually) software-based computer system that enjoys the following properties:*
- *autonomy: agents operate without the direct intervention of humans or others, and have some kind of control over their actions and internal state;*
- *social ability: agents interact with other agents (and possibly humans) via some kind of agent-communication language;*
- *reactivity: agents perceive their environment, (which may be the physical world, a user via a graphical user interface, a collection of other agents, the INTERNET, or perhaps all of these combined), and respond in a timely fashion to changes that occur in it;*
- *pro-activeness: agents do not simply act in response to their environment, they are able to exhibit goal-directed behaviour by taking the initiative."*

Qualities

Property	Other Names	Meaning
Reactive	(sensing and acting)	Responds in a timely fashion to changes in the environment
Autonomous		Exercises control over its own actions
Goal-oriented	Pro-active purposeful	Does not simply act in response to the environment
Temporally continuous		Is a continuously running process
Communicative	Socially able	Communicates with other agents, perhaps including people
Learning	Adaptive	Changes its behavior based on its previous experience
Mobile		Able to transport itself from one machine to another
Flexible		Actions are not scripted
Character		Believable "personality" and emotional state

Source: Franklin and Graesser (1996)

Example: Shopbots

Shopping Ro**bot**'s automatically search a large number of stores for a specific product

Makes search quick and simple. Average range in prices is $12, and Amazon is lowest only 5% of time (data from 2001).

Example:

John Grisham's *The Brethren*, list price $27.95, prices range between $13.49 (buy.com) and $50.75 (totalinformation.com)

Shopbots as Choice Problems

Price

Logo

Order

Price		Item Price	US Sales Tax	Shipping Costs	Shipping Time	Shipping Service	Delivery Time
US$ 43.98	amazon.com. Amazon.com, USA, WA/NV *Earth's Biggest Selection*	US$ 35.00	US$ 0.00	US$ 8.98	2 days	Second Day Air	5 days
US$ 45.95	buy.com Buy.com, USA, CA/TN *The Internet Superstore*	US$ 35.00	US$ 0.00	US$ 10.95	1 day	Next Day Air	n/a
US$ 46.00	a1 BOOKS A1Books, USA, NJ *Making Knowledge affordable...*	US$ 32.25	US$ 0.00	US$ 13.75	2 days	UPS 2nd Day (Blue)	n/a
US$ 48.95	alibris alibris, USA, CA/CT/MI/NV/WA	US$ 46.00	US$ 0.00	US$ 2.95	3-14 days	U.S. Postal Service	n/a
US$ 48.98	amazon.com. Amazon.com, USA, WA/NV *Earth's Biggest Selection*	US$ 35.00	US$ 0.00	US$ 13.98	1 day	Next Day Air	4 days
US$ 49.95	alibris alibris, USA, CA/CT/MI/NV/WA	US$ 46.00	US$ 0.00	US$ 3.95	1-6 days	UPS	n/a
US$ 36.75	1 Bookstreet.com, USA, CA	US$ 36.75	US$ 0.00	US$ 0.00	3-14 days	USPS Parcel Post	6-21 days
US$ 38.88	AlphaCraze.com, USA	US$ 35.00	US$ 0.00	US$ 3.88	4-14 days	USPS Special Rate	5-15 days
US$ 40.48	AlphaCraze.com, USA	US$ 35.00	US$ 0.00	US$ 5.48	2-3 days	Express Priority Mail	3-4 days
US$ 40.75	Page1Book, USA, NM *New Mexico's Largest Independent Bookstore*	US$ 35.00	US$ 0.00	US$ 5.75	2-6 days	Federal Express Ground	n/a
US$ 42.70	1 Bookstreet.com, USA, CA	US$ 36.75	US$ 0.00	US$ 5.95	4-6 days	UPS Ground	7-13 days
US$ 43.70	1 Bookstreet.com, USA, CA	US$ 36.75	US$ 0.00	US$ 6.95	2-3 days	Priority Mail	5-10 days

Unique Choice Aspects

- Choice is many from many
  - Usual multinomial logit/probit models consider only the problem of one from N, here we observe M from N; Requires a multivariate probit model
  - Potentially could model sequential choice problem
- Search behavior is dynamic
  - The amount of search could depend upon the price of the book, when the search is made, the expertise of the user, …
- Ordering is very important
  - Shelf Design information is frequently not known in scanner choice data, here we know the exact tabular format

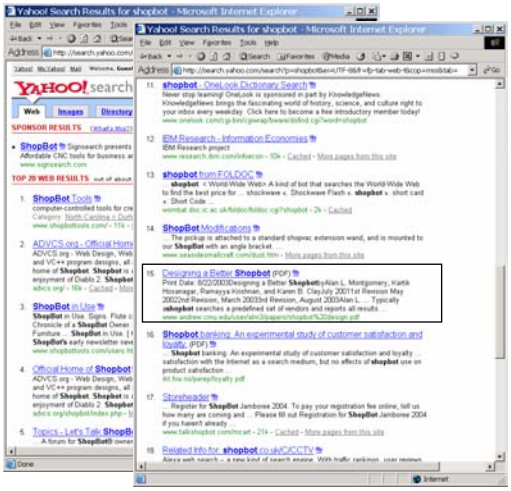
Research Questions

- Propose a methodology to model evoked consideration sets
  - Multivariate Probit Model with a new twist on the threshold
- What drives customer evoked consideration set?
  - Price, brand, position in table, logos, …
  - How does this differ across consumer groups?
  - How does learning change customer behavior?
- How should a manager choose the choice set?

Analogous Choice Problems: Retail Shopping

- Purchase Multiple Items
- Arrangement impacts choice
- Assortment and shelving decisions change slowly

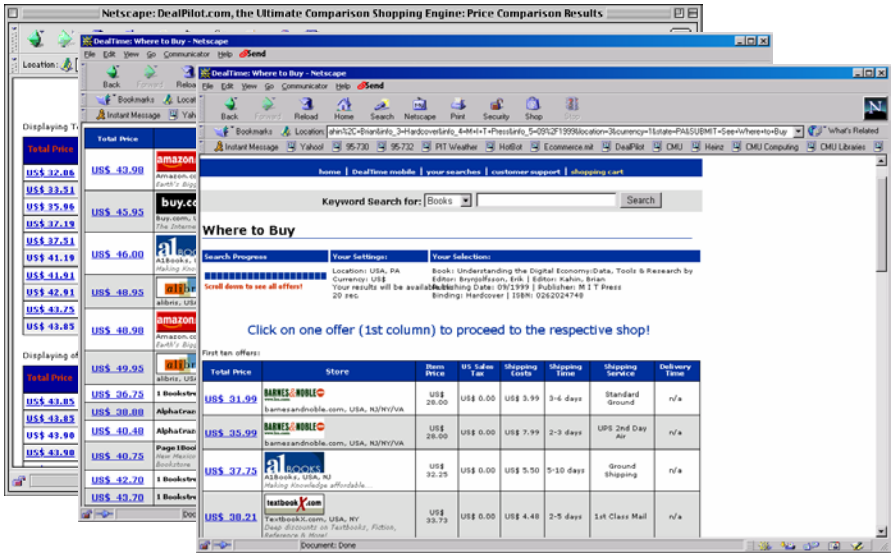
Analogous Choice Problems: Search Engine Design & Choice



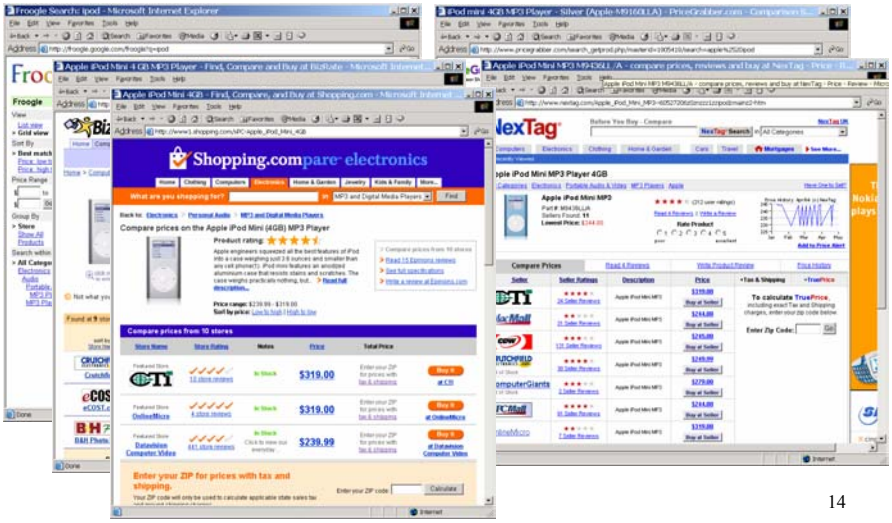
- Select multiple pages to browse
- Arrangement impacts choice
- Assortment and arrangement decisions are dynamic
- Potential compensation for placement

Current State of Shopbots

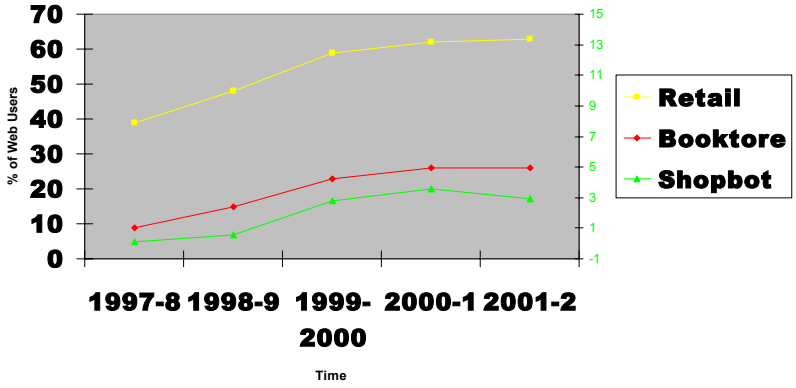
Progression of Design Changes



Leading Shopbots



Shopbot Usage Trends



Source: Media Metrix Home Panel

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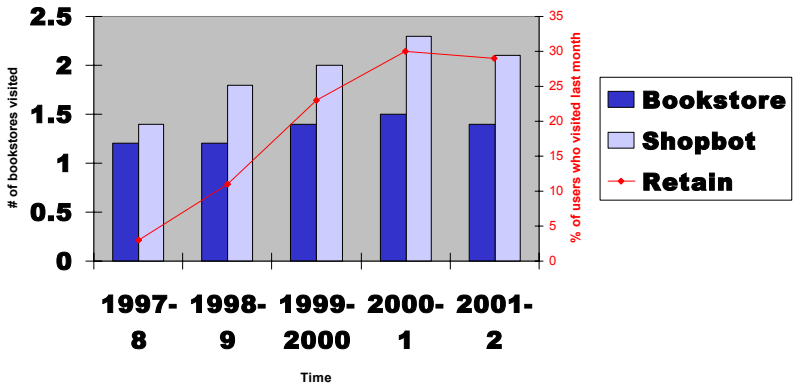
Bookstores Visited



Source: Media Metrix Home Panel

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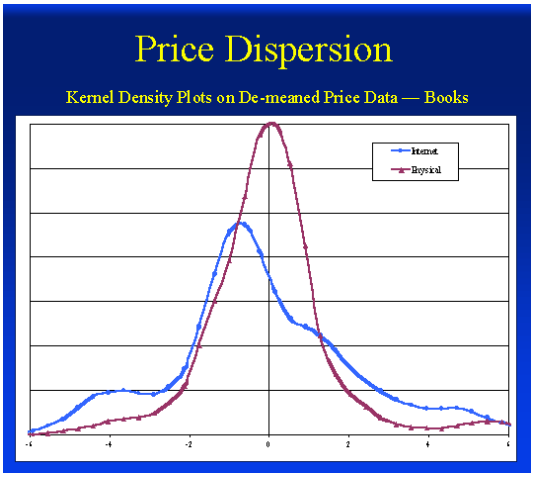
Problems with Shopbots

- Less than a quarter of shoppers use shopbots (upward trend)
- Why don't more people use shopbots?
  - Lack of awareness
  - Lack of benefit (not enough price variation)
  - Lack of information about book (no reviews), you must already know the book
  - Lack of trust
  - Slow response time (the modal time for pricescan and dealpilot was 45 seconds, amazon is <2 seconds)
  - Poor interface, displays too much information

The returns of search



Source: Brynjolfsson and Smith (2000)

Revenue Sources for Shopbots

Purchase	• Commissions: Retailer affiliate program
Consideration	• Referral: Pay per click
Awareness	• Ordering: Pay to be at the top of the list • Logos: Standout compared to other products • Banner Ads: Unrelated to purchase
Other	• User subscription fees • Retailer pays to have site crawled

Marketing Research on Intelligent Agents

Behavioral

- Ariely, Lynch, Aparicio (2004), "Learning by Collaborative and Individual-Based Recommendation Agents", *Journal of Consumer Psychology*
  - Agent learns about consumers from choices, performs better in the long-run than collaborative filters and more fault tolerant if utility changes or threshold errors
- Diehl, Kornish, and Lynch (2003), "Smart Agents: When Lower Search Costs for Quality Information Increase Price Sensitivity", *Journal of Consumer Research*
  - Selection by agents increases apparent price sensitivity
- Haubl and Murray (2003), "Preference Construction and Persistence in Digital Marketplaces: The Role of Electronic Recommendation Agents", *Journal of Consumer Psychology*
  - Recommendation agents can influence attribute importance
- Haubl and Trifts (2000), "Consumer decision making in online shopping enviornments: The effects of interactive decision aids"
  - Recommender agents reduce search effects and improve decisions

Analytical/Simulations/Empirical

- Montgomery, Hosanagar, Krishnan, Clay (2004), "Designing a Better Shopbot", *Management Science*
  - Agent must anticipate the benefits to the consumer of when and where to search. Naïve designs that search everywhere/present everything do poorly.
- Yuan (2003), "A personalized and integrative comparison-shopping engine and its applications", *Decision Support Systems*
  - Construct an agent that differentiates suppliers/consumers through time using personalization technology
- Smith and Brynjolfsson, "Consumer decision-making at an Internet shopbot: Brand still matters", *The Journal of Industrial Economics*
  - Actual shopbot consumers appear highly sensitive to tax, shipping, price, and brand effectives

Other Research

- Survey (Jennings, Sycara, and Woolridge 1998)
- Technical design elements (Jennings et al 1998)
- Knowledge representation and learning (Poole 1997)
  - How to store and represent information, draw inferences and make decision autonomously
- Agent adapting (Doorenbos et al 1997)
  - Automatic extraction of information from web sites, mobile agents in low bandwidth (Pham and Karmouch 1998)
- Multi-agent communication (Chavez and Maes 1996)
  - Kasbah agent based marketplace for buying and selling. However the utility model is quite simplistic
- Information retrieval: Menczer (2003), "Complementing search engines with online Web mining agents", *Decision Support Systems*
  - Compares search engines with a multiagent system design for information discovery that query the Web online at query time

Future research directions

An improved shopbot?

- Ask users for filtering questions about preferences or use information from previous history
- Appropriately balance the cost of asking for the information with its benefits
- Allow further search
- Better understand how consumers perceive waiting time based on expectations, provide 'filler' tasks

Future Directions

- Learning from past purchases and designing active shopbots (versus the passive design presented)
- Need better understanding of how to quantify cognitive costs and effects of waiting
- Train shopbots to be proactive in seeking out good deals.
- Identify baskets of products or more complex products like travel (airline tickets, car rental, hotel, etc.)
- Applications to information goods (e.g., news stories, recommender systems, search engines)
- Sequential search versus batch search
- Consumer trust of shopbots
- Endogeneize consumer preference building as consumer searches for the product.
- Search for products that the consumer is not aware of (really new products)
- Learn consumer preferences
- Consider shopbot profits
- Do not explicitly consider shopbot profits
- Recommendation of information and search method and not just product

Adaptive Web Design

- Hypertext
- User modeling
- Machine learning
- Natural language generation
- Information retrieval
- Intelligent tutoring systems
- Cognitive Science
- Web-based education

See Brusilovsky (2001), "Adaptive Hypermedia",
User Modeling and User-Adapted Interaction

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Applications

My Research

- Shopbot Design
- Empirical model of choice at a shopbot
- Adaptive design: Path Analysis