



Securities Trading of Concepts (**STOC**)

Professors: Ely Dahan, Andrew Lo, Tomaso Poggio

Students: Adlar Kim, Nicholas Chan

*Presented at the DARPA workshop on
Markets and Decisions
Arlington, Virginia*

June 12, 2002

Today's Agenda - Questions about STOC

- What is STOC? How does it work?
- Does it perform well?
- Is it accurate at identifying winners?
- What does it actually measure?
- How do traders behave? Do they learn?
- For what categories does it work?
- Does it work with fully integrated concepts? Attributes?
- Are real outcomes absolutely necessary?

The Virtual Customer:

Web-Based Conjoint Analysis (WCA)



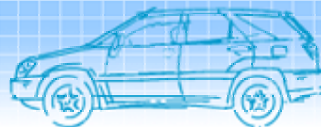
Ely Dahan
Rob Hardy
Limor Weisberg

Fast Polyhedral Conjoint Estimation (FastPace)



Ely Dahan
John R. Hauser
Duncan Simester
Olivier Toubia

User Design (UD)



Ely Dahan
Rob Hardy
Limor Weisberg

Virtual Concept Test (VCT)



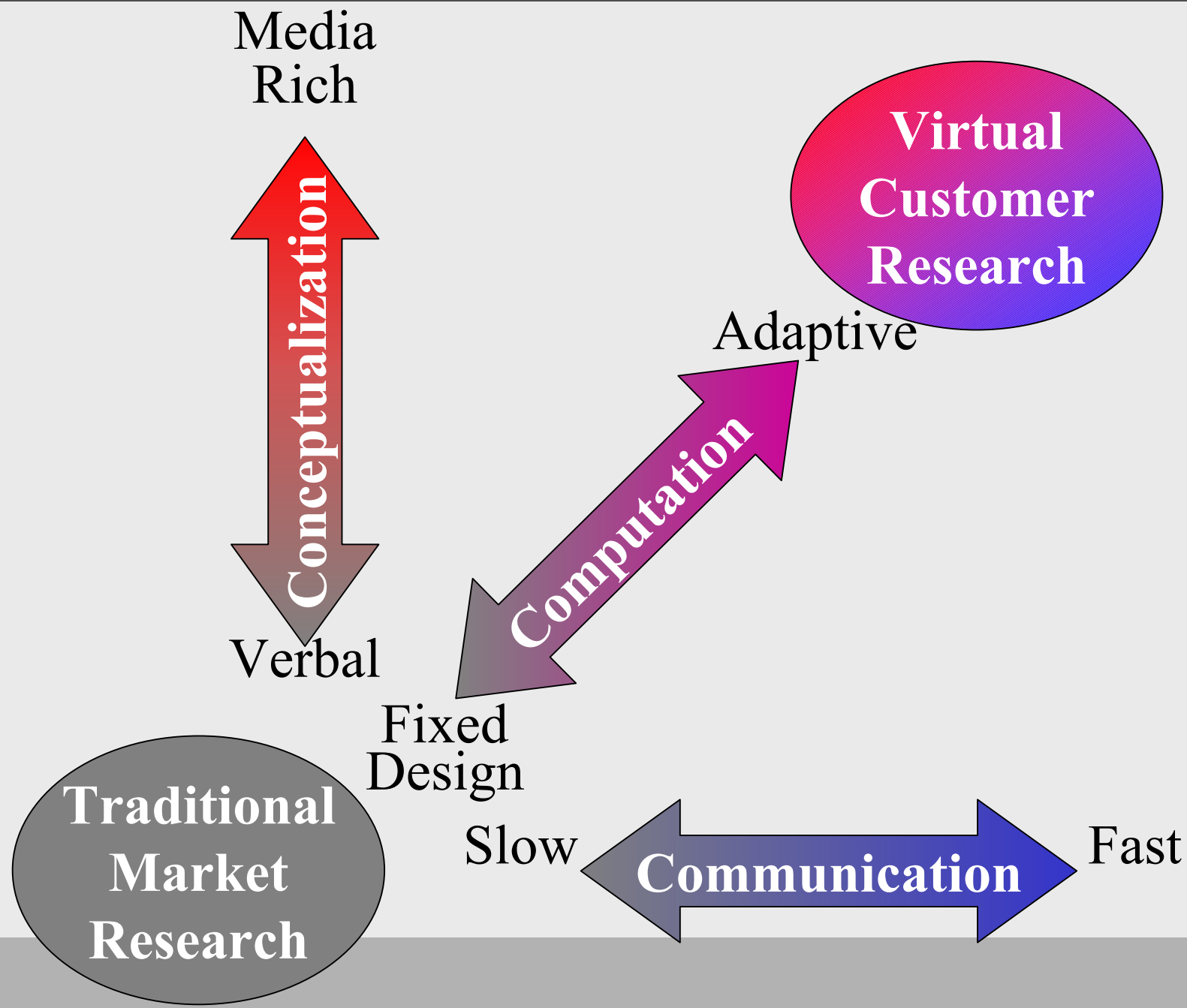
Ely Dahan
V. Seenu Srinivasan
Leonard Lee

Securities Trading of Concepts (STOC)

-MDX-ML-XS-AZTEK-

N. Chan, Ely Dahan
Andrew Lo, Tomaso Poggio,
Adlar Kim

Impact of the WEB on Market Research



Are Web Respondents Representative?

Pre-recruited Web Panels

- NFO Interactive Balanced 500,000 respondents
- DMS, Inc. (AOL) “Opinion Place” 1,000,000
- Knowledge Netwk. Rand. Digit Dialing 100,000
- Greenfield Online 3,000,000 online panel
- Harris Interactive 6,500,000 online panel
- *Representativeness looks promising*
e.g. Willkie, Adams, and Girnius (1999)

Game Markets

- Iowa Electronics Markets (<http://www.biz.uiowa.edu/IEM>)
- Foresight Exchange (<http://www.ideosphere.com/FX>)
- Hollywood Stock Exchange (<http://www.HSX.com>)

UD Allows Complex Interactions

MIT WOW - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Links »

Please select ONE in each row

Size ▶ ☐ compact ☒ Full-size

Screen color ▶ ☐ monochrome display ☒ color display

Memory ▶ ☐ 16 MB ☐ 32 MB ☒ 64 MB

Palm vs. Pocket PC ▶ ☐ Palm OS ☒ Pocket PC

Please select as many as you want

<input checked="" type="checkbox"/> cell phone	<input checked="" type="checkbox"/> hands free	<input checked="" type="checkbox"/> extended battery
<input checked="" type="checkbox"/> wireless	<input checked="" type="checkbox"/> blue tooth	<input checked="" type="checkbox"/> Thumb keyboard
<input checked="" type="checkbox"/> CF slot	<input checked="" type="checkbox"/> SD slot	<input checked="" type="checkbox"/> GPS

Click on an icon for a description of that feature.

GPS

Pocket PC

12:52

Full-size color display 64 MB Pocket PC

cell phone hands free extended battery wireless

blue tooth Thumb keyboard CF slot SD slot

Bluetooth

My Device:

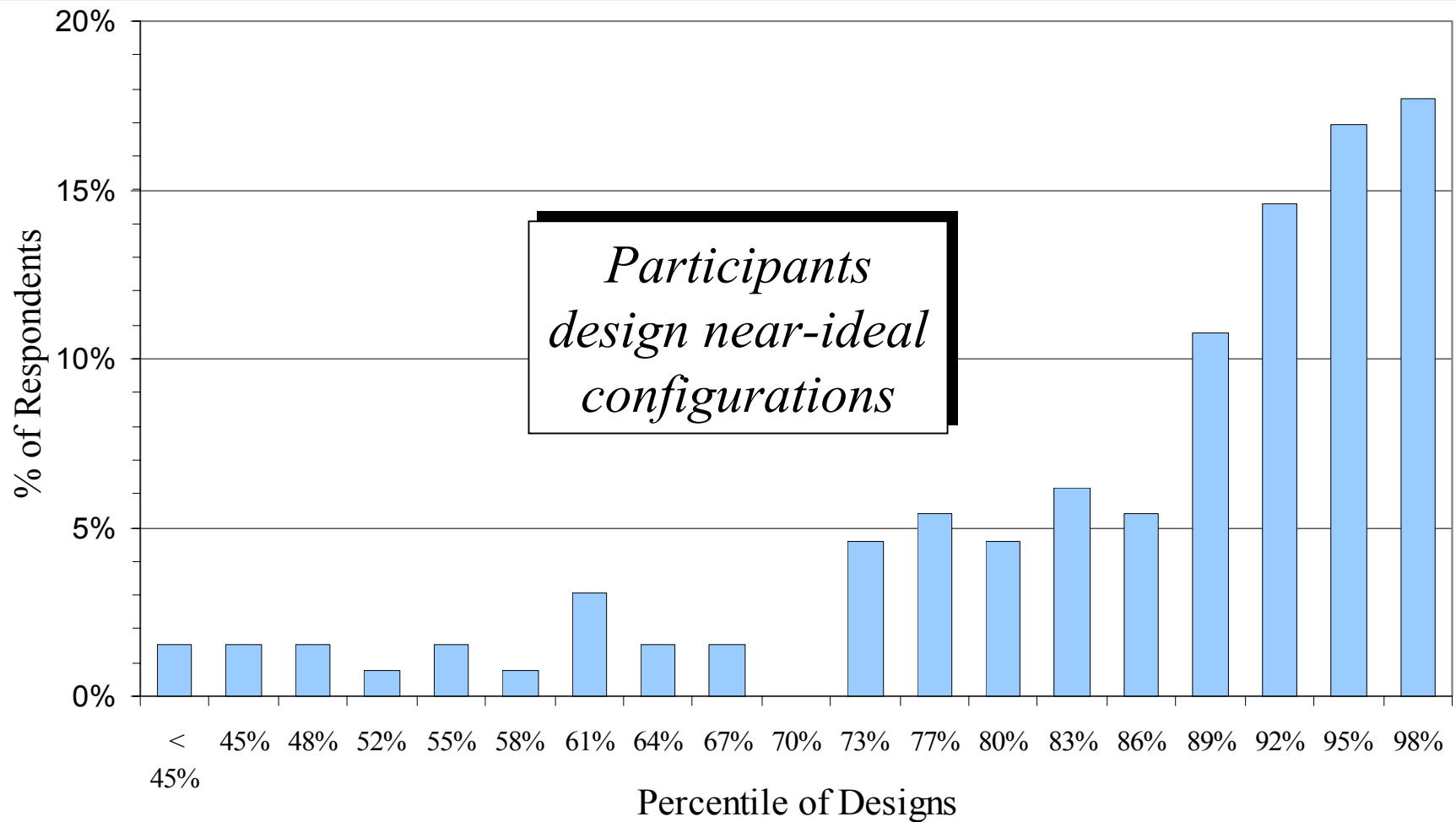
Price:	\$968
Weight:	8.5 oz
Battery Life:	7.2 hours

Submit My Design

Internet

e.g. Slots, weight, battery, size, pricing

Users Design High Utility Attribute Bundles



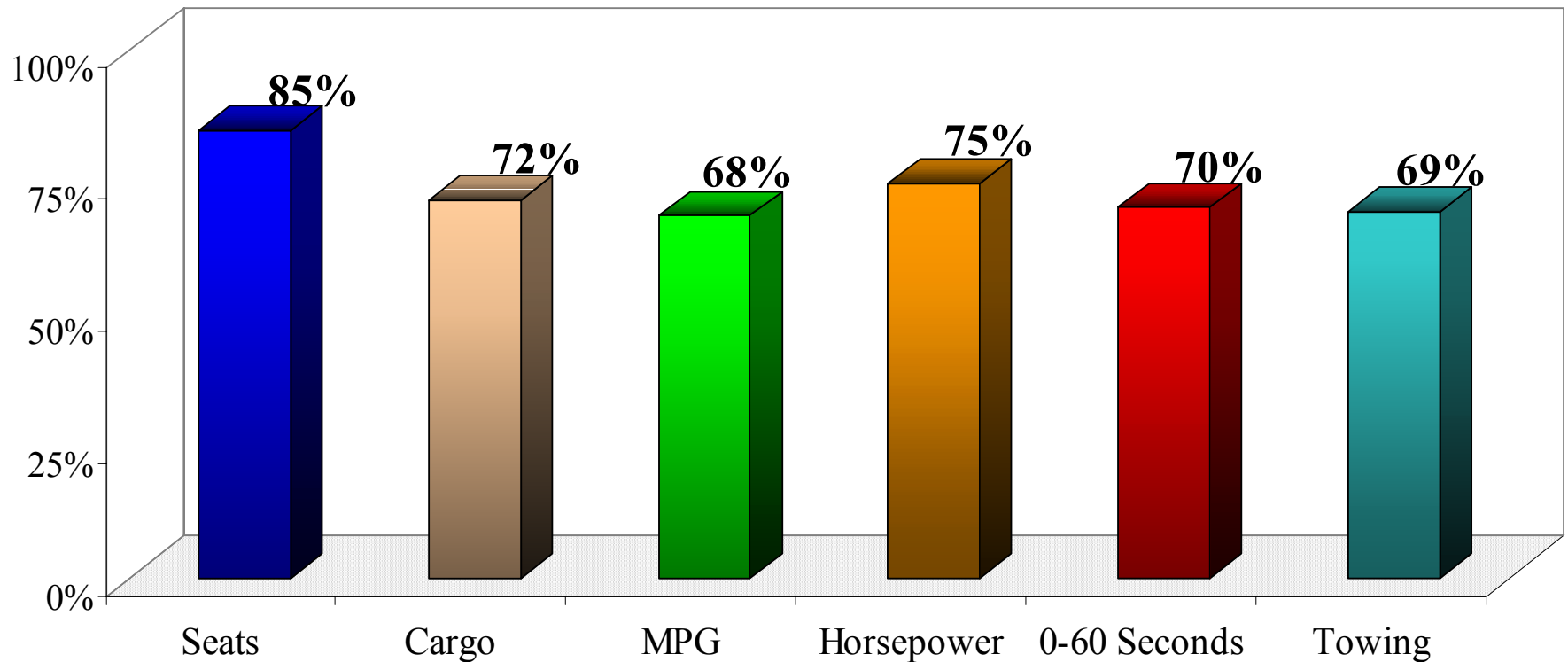
CEB 1/16/01 and MBA's 3/20/01 (n=129)

User Design as Conjoint Validation

Attribute-by-Attribute “Hit Rates”

Hit Rates for Each Feature (WCA vs. UD)

(By Individual by Feature, n=130)



CEB 1/16/01 and MBA's 3/20/01 (n=130)

User Interface for Securities trading of Concepts (STOC)

Market News

22:32:38: Market is Open

Symbol: AirStik Time: 22:38:52 Time Remaining: N/A



Symbol:

AirStik

Size:

Price:

Market Buy

Market Sell

Limit Buy

Limit Sell

Open Orders

Cancel Order

Buy 75 shares of AirStik at \$27 1/8.
Buy 30 shares of AirStik at \$27 1/2.
Buy 10 shares of AirStik at \$27 3/4.

Transactions

You bought 35 shares of AirStik for \$27 1/2 per share.
You bought 5 shares of AirStik for \$27 3/4 per share.
You bought 20 shares of AirStik for \$26 per share.
You bought 50 shares of AirStik for \$26 1/2 per share.
You bought 50 shares of AirStik for \$26 7/8 per share.
You bought 10 shares of AirStik for \$26 1/2 per share.

Quote / Portfolio

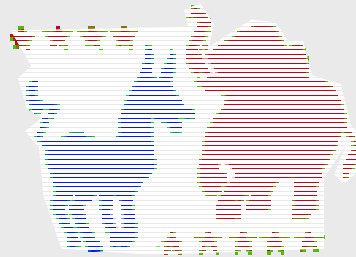
	Last	Low	High	Bid (size)	Ask (size)	Volume	Quantity	Market Value
AirStik	27 3/4	26	28	27 3/4 (10)	28 (915)	475	455	12626.25
Solibloc	-	-	-	5 1/2 (50)	6 1/4 (60)	0	100	0.00
Gearhead	16 1/8	14 1/2	16 1/8	14 1/2 (450)	16 1/8 (50)	100	100	1612.50
SilverBullet	15 1/2	10	15 1/2	10 (400)	15 1/2 (1200)	300	100	1550.00
TRS	-	-	-	1/8 (70)	- (0)	0	100	0.00
Gecko	-	-	-	1 1/8 (1000)	5 (400)	0	100	0.00
Epic	-	-	-	11 1/8 (200)	12 (1000)	0	100	0.00
Skitzo	-	-	-	- (0)	- (0)	0	100	0.00
RimGripper	-	-	-	17 1/2 (800)	17 5/8 (1200)	0	100	0.00
2wister	10 3/4	10 3/4	11	10 3/4 (100)	11 (300)	1000	100	1075.00
Cash								344.37
Total								17208.11

Warning: Applet Window

Gore vs. Bush

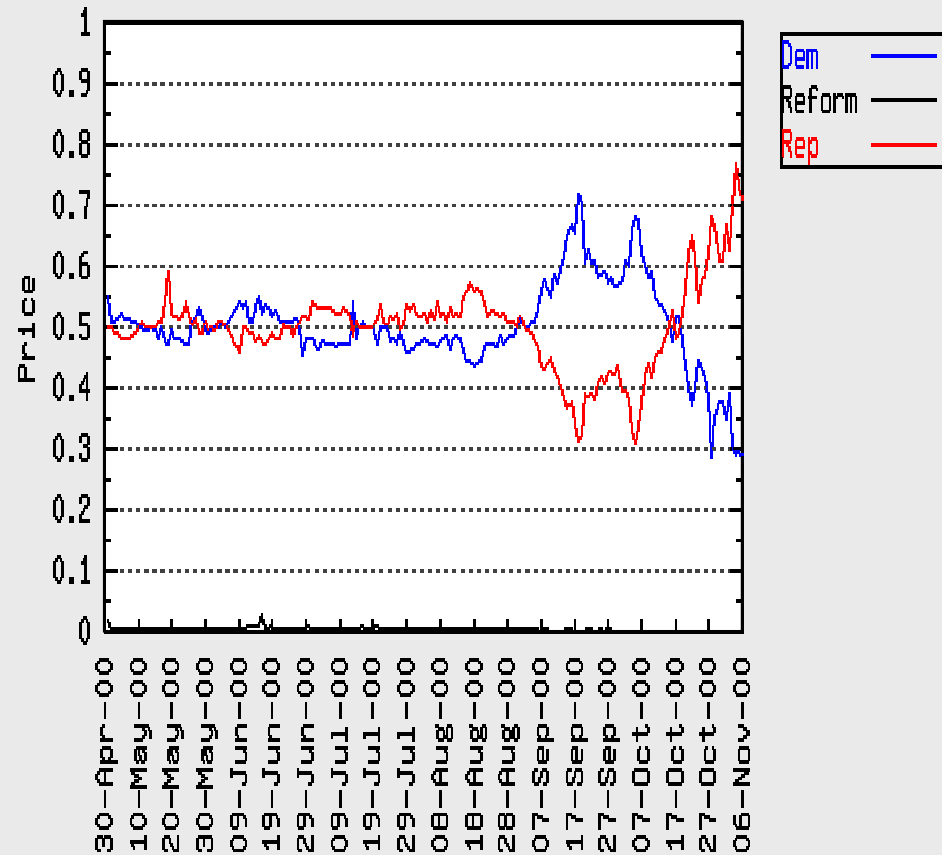
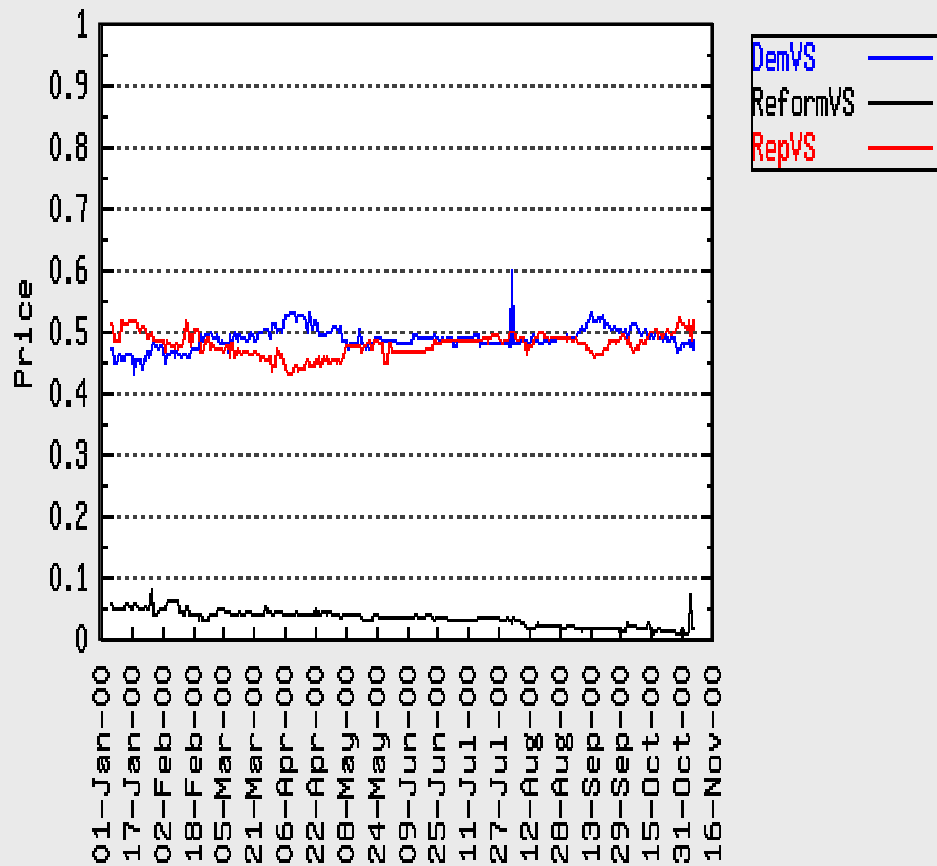
Share of Vote

PRES00_VS
2000 U.S. Presidential Vote Share



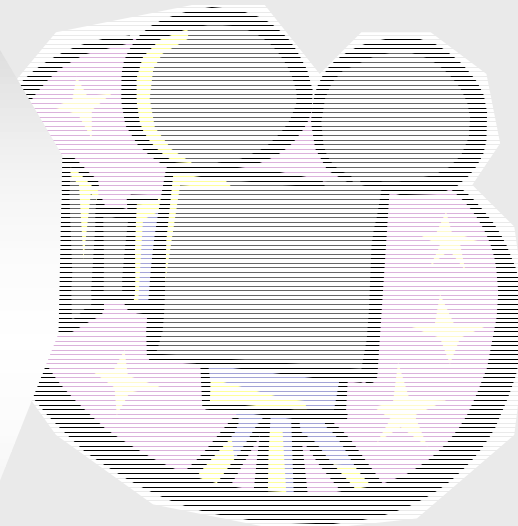
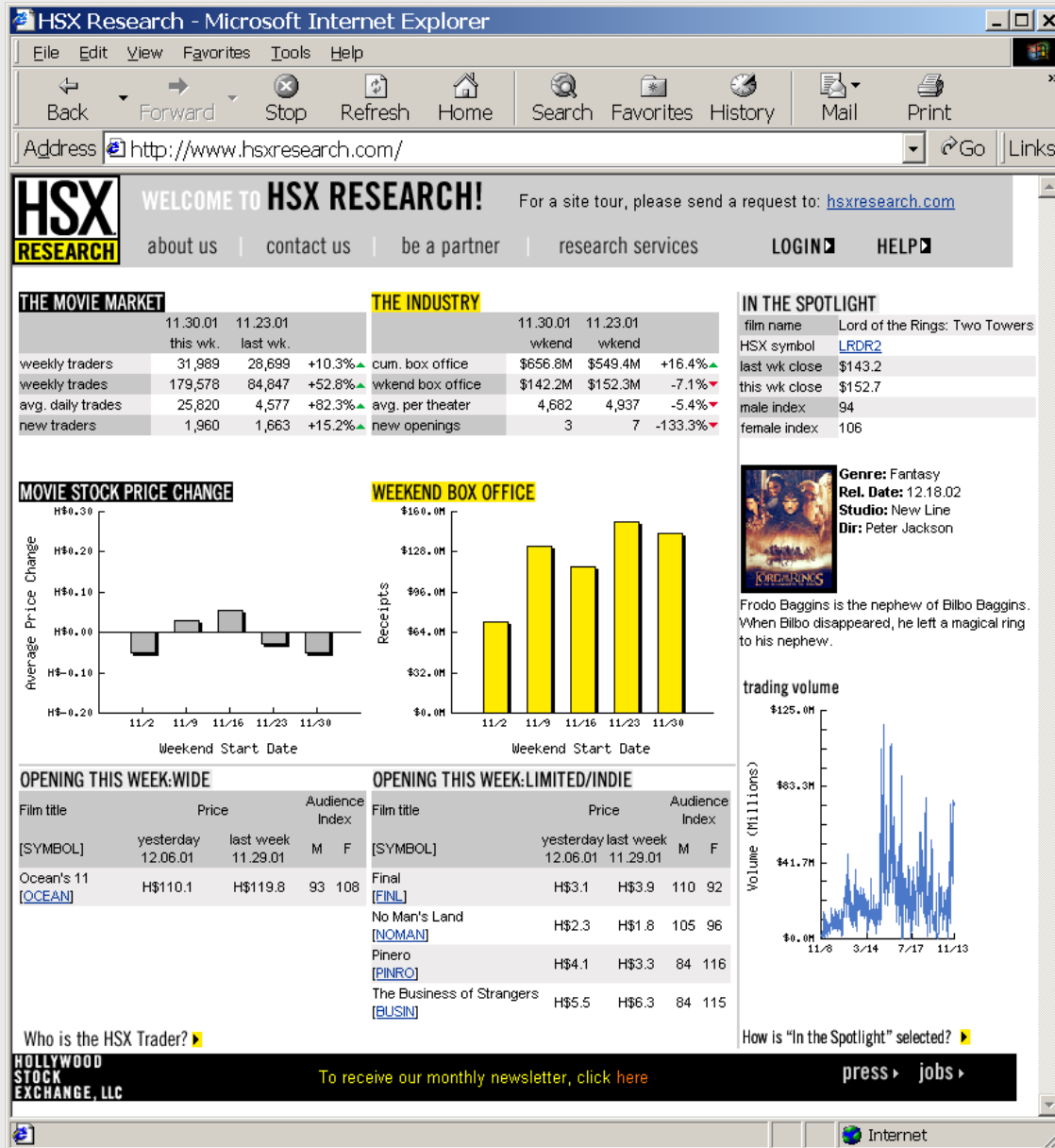
Probability of Winning

PRES00_WTA
2000 U.S. Presidential Election Winner-Takes-All Market



Source: Iowa Electronics Market (IEM), 11/7/00 at 2pm

Hooray for Hollywood



Source: HSX.com, December 7, 2001

Bragging rights to predicting the future ...

Foresight Exchange - Microsoft Internet Explorer

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Address <http://www.ideosphere.com/fx/> Go

foresight exchange
HOME

- Claims
- All Accounts
- Ticker Page
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The Foresight Exchange Prediction Market

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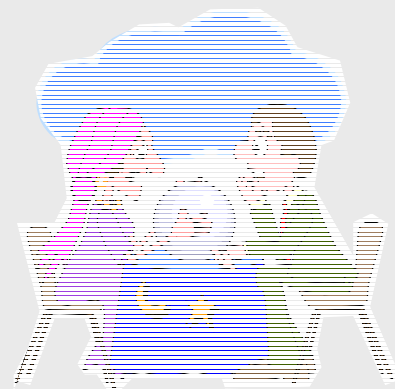
Top 10 Players by Score, as of 2001/12/10 06:16:04 GMT

Rank	Uid	Score	Networth	Nym	Email
1	157	5.131	10262.79	fh	fredh@ix.netcom.com
2	163	4.984	11811.12	jim	jim@acm.org
3	73	4.794	10273.65	Karl Hallo	khallow@hotmail.com
4	79	3.113	5909.31	jbs	jbs@Quiotix.COM
5	2631	2.844	5687.70	Veazie	rush70@worldnet.att.net
6	617	2.667	5334.34	aof	andrzej@daimi.au.dk
7	2118	2.589	5193.68	Messiah	kneisl@email.unc.edu
8	303	2.549	5098.02	tucker	
9	1877	2.332	4663.53	BigFatSlug	
10	1722	2.309	4617.17	veaseym	usenet@veasey.org

Top 10 Claims by Transaction Volume in the Last 7 Days

Rank	Volume	%	Symbol	Short Description
1	969	26.2%	ACrash	Amazon crashes by 2002
2	678	18.3%	LOTR	Lord of the Rings sets record
3	377	10.2%	01stck	Big changes in 01 Stock Market
4	290	7.8%	le7Pri	10 Million Dig. Prime ere 2002
5	218	5.9%	Tran	Machine Translation by 2015
6	115	3.1%	pmin04	Prez w/o majority on 2/1/05
7	101	2.7%	Earth2	Habitable Earth-class planet
8	100	2.7%	Terror10	Another US Terrorist < 2010
9	100	2.7%	XPRIZE	X PRIZE: low-cost space flight
10	94	2.5%	TIBET	Smalltalk-like <100K JS lib
Total	3702	100%		

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Source: <http://www.ideosphere.com/fx/>, December 10, 2001

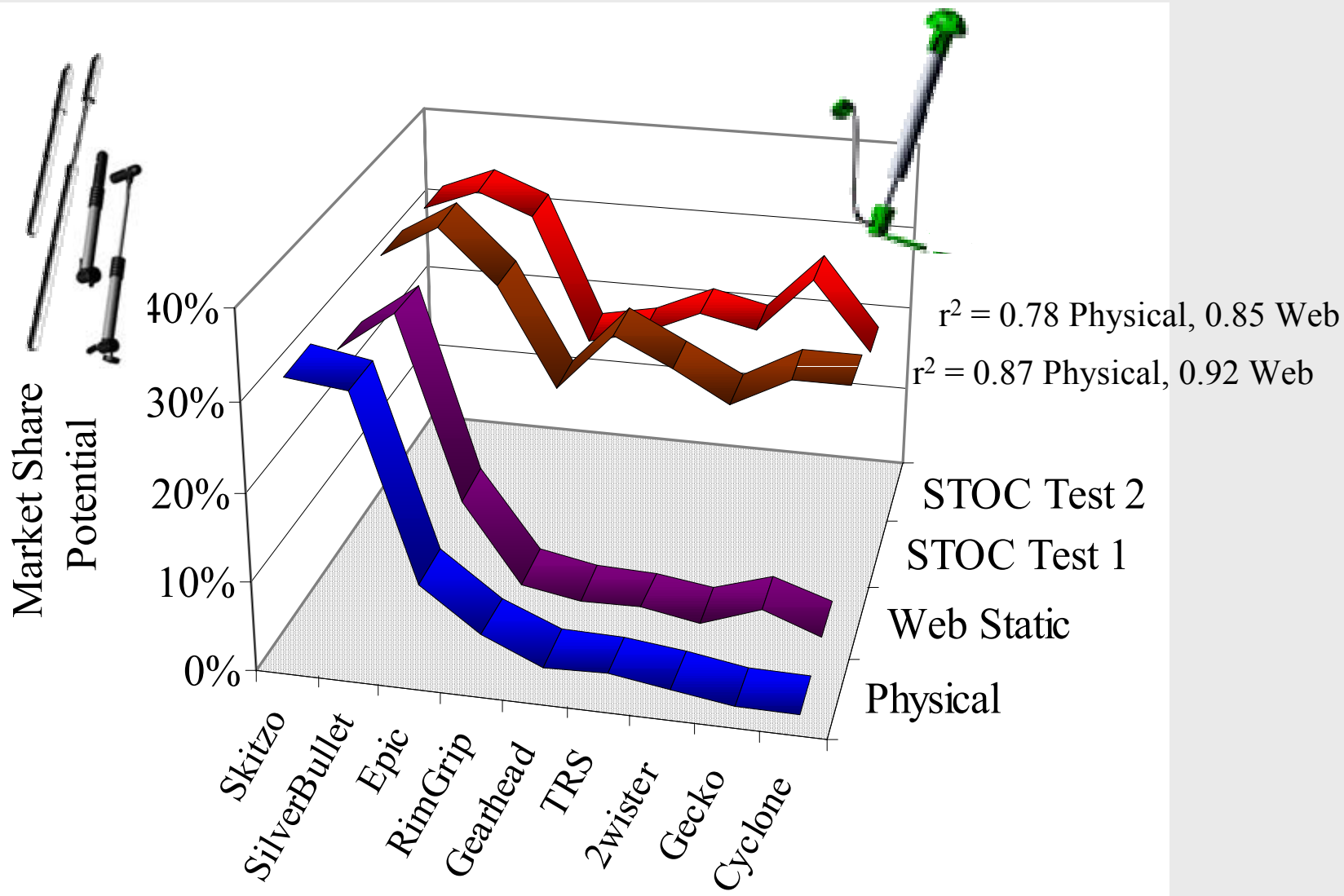
Current game markets share some traits



- All three predict actual future outcomes
- Underlying reasons are not made explicit

STOC Outcomes vs. Virtual Concept Testing: *Bicycle Pumps*

Median Stock Prices




Choice Out of a Set of Eight (Rank order): *Crossover Vehicles*

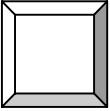
PONTIAC

Pontiac Aztek **\$24,000**

The Aztek features a unique body design, 10 storage bins, a sliding rear cargo tray, and sporty handling.




Seats: 5
 Seat Flexibility: ☒
 Cargo Volume: ☒
 Fuel Economy: ☒
 Horsepower: ☒
 0-60 Seconds: ☒
 Towing Capacity: ☐




Mercedes-Benz

Mercedes-Benz ML320 **\$39,000**

Rugged, but luxurious, the ML-320 features solid on/off road performance, plus 5000 lbs. of towing capacity.




Seats: 5 (7 opt.)
 Seat Flexibility: ☒
 Cargo Volume: ☐
 Fuel Economy: ☐
 Horsepower: ☐
 0-60 Seconds: ☐
 Towing Capacity: ☒




The Ultimate Driving Machine


BMW X-5 **\$49,000**

The X-5 "Sports Activity Vehicle" performs and handles like a sports sedan. Its interior is very luxurious, but cargo storage is limited.






Seats: 5
 Seat Flexibility: ☐
 Cargo Volume: ☐
 Fuel Economy: ☐
 Horsepower: ☒
 0-60 Seconds: ☒
 Towing Capacity: ☒



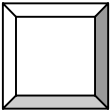

ACURA


Acura MD-X **\$37,000**

The MD-X's middle and rear seats fold flat into the floor. It boasts a high-tech, two-tone interior.



Seats: 7
 Seat Flexibility: ☒
 Cargo Volume: ☒
 Fuel Economy: ☒
 Horsepower: ☒
 0-60 Seconds: ☒
 Towing Capacity: ☐



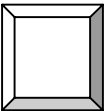

Audi


Audi Allroad **\$42,000**

The Allroad takes Audi's A6 Avant Wagon to new heights, up to 8" ground clearance with 2" of adjustable air-suspension height.



Seats: 5 (7 opt.)
 Seat Flexibility: ☒
 Cargo Volume: ☐
 Fuel Economy: ☐
 Horsepower: ☒
 0-60 Seconds: ☐
 Towing Capacity: ☒



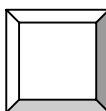

TOYOTA

Toyota Highlander **\$29,000**

The Highlander, based on the Lexus RX-300, is a practical, smooth riding, seven seater.

Seats: 5
 Seat Flexibility: ☒
 Cargo Volume: ☒
 Fuel Economy: ☒
 Horsepower: ☐
 0-60 Seconds: ☐
 Towing Capacity: ☐




LEXUS


Lexus RX-300 **\$36,000**

The RX-300 defined the crossover category and is the top-selling Lexus. Its rear bench seat slides forward and back.






Seats: 5
 Seat Flexibility: ☐
 Cargo Volume: ☐
 Fuel Economy: ☒
 Horsepower: ☐
 0-60 Seconds: ☐
 Towing Capacity: ☐



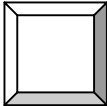

BUICK

Buick Rendezvous **\$30,000**

The Rendezvous' middle seat is movable and the rear seat folds into the floor. The ride is smooth and the interior large, seating up to seven.

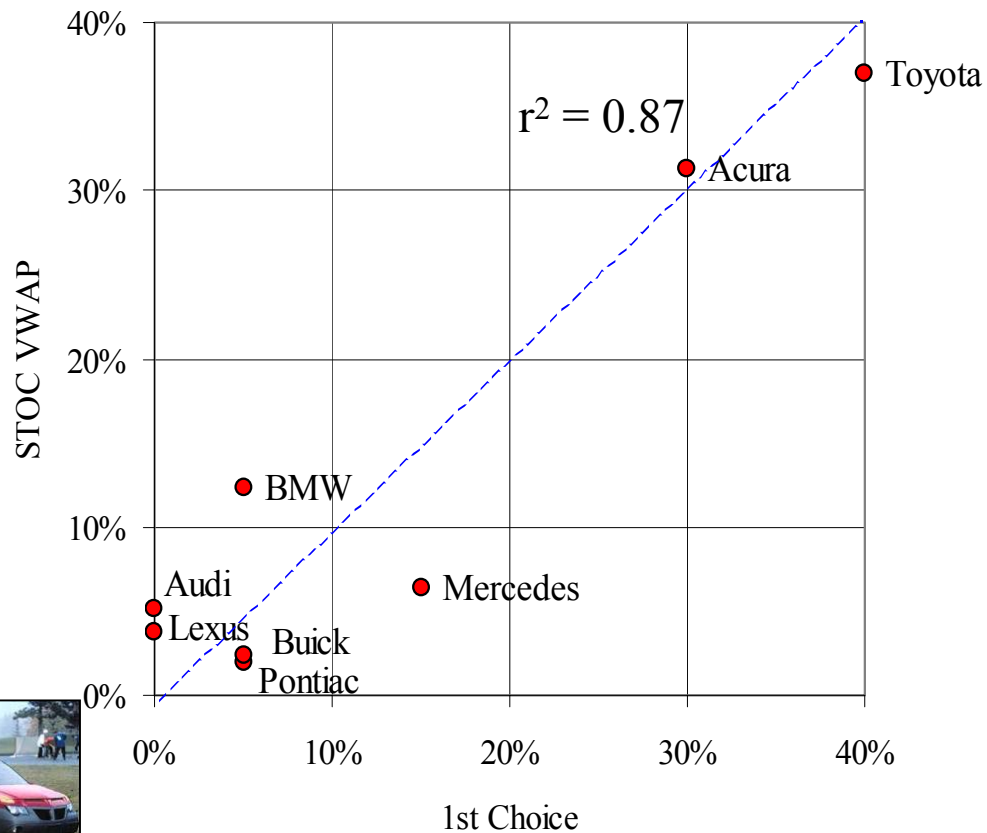



Seats: 7
 Seat Flexibility: ☒
 Cargo Volume: ☒
 Fuel Economy: ☒
 Horsepower: ☐
 0-60 Seconds: ☐
 Towing Capacity: ☐



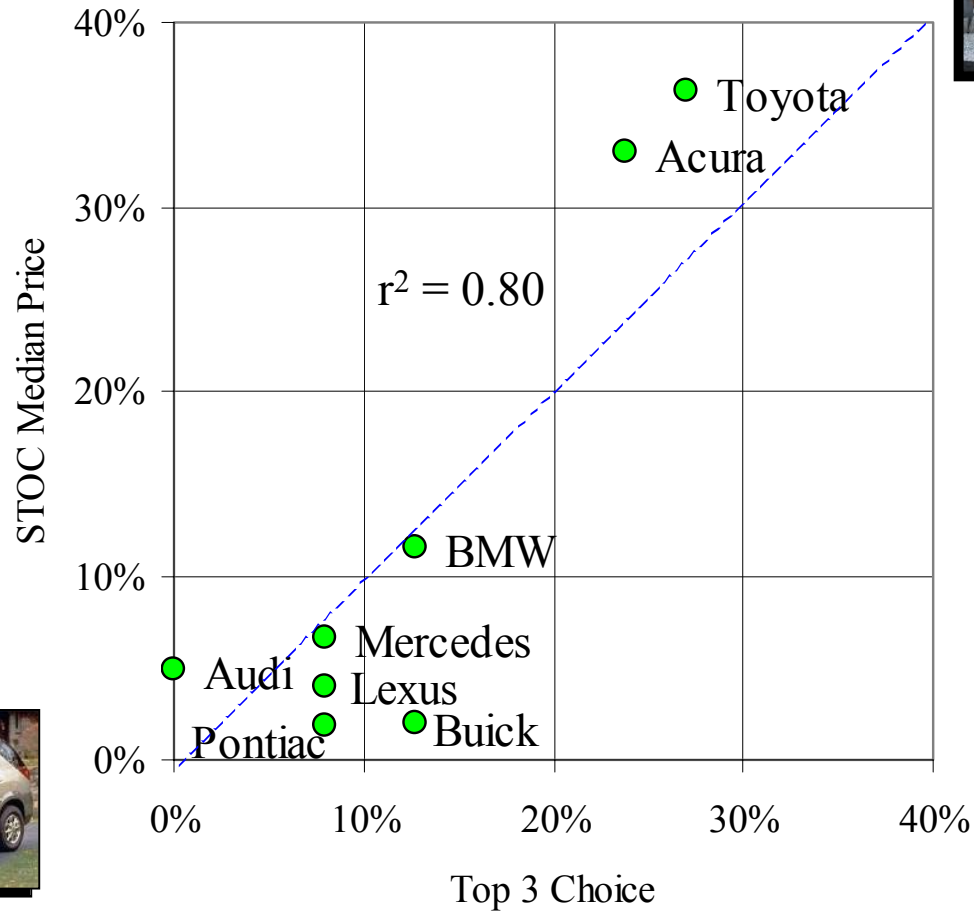
Securities Trading of Concepts (STOC): *Crossover Vehicles*

STOC Vol.-Weighted Avg. Price vs. 1st Choice
(8) Crossover Vehicles - SDM's Oct. 20, 2000

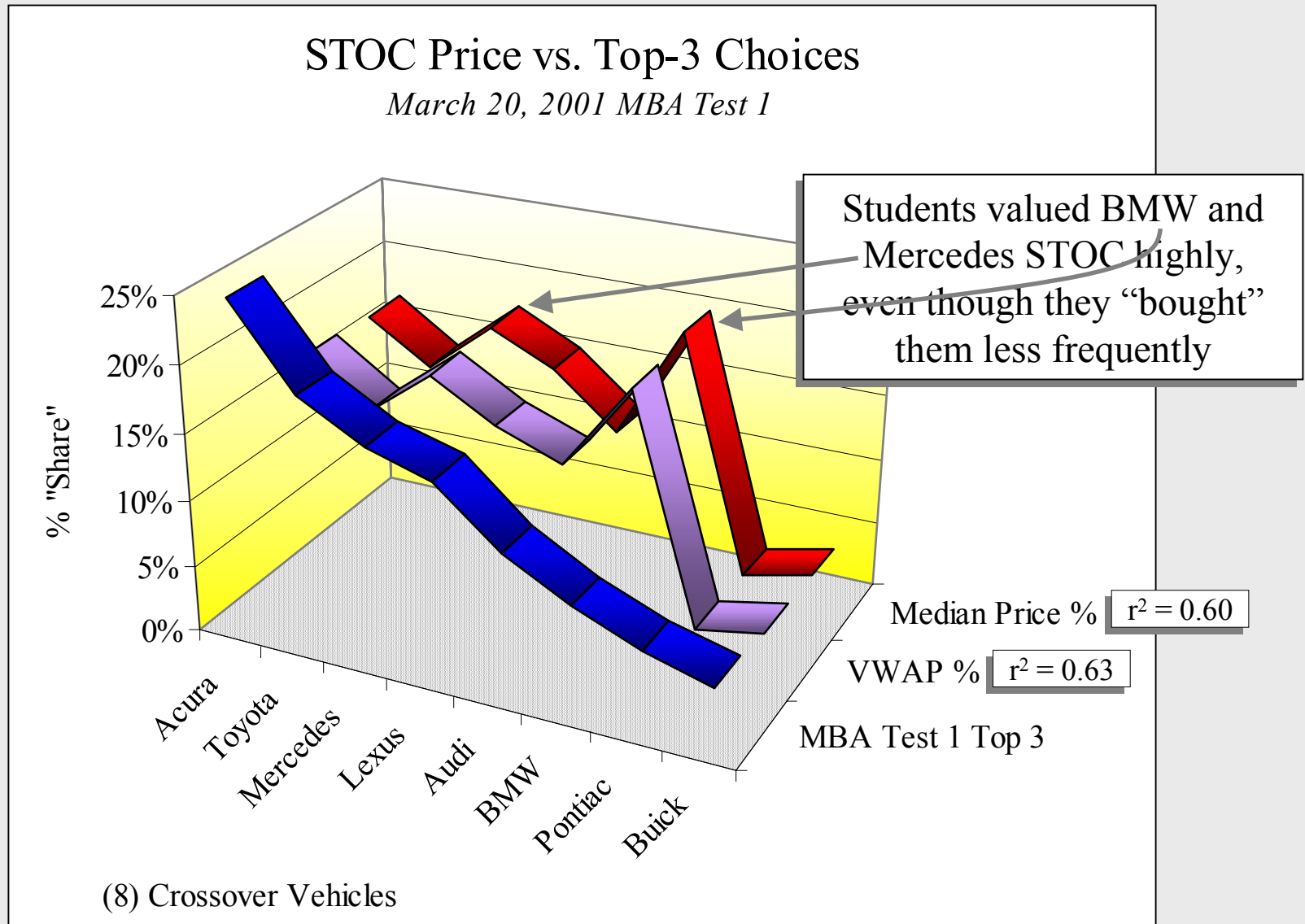


Securities Trading of Concepts (STOC): *Crossover Vehicles*

STOC Median Price vs. Top 3 Choices
(8) Crossover Vehicles - SDM October 20, 2000)



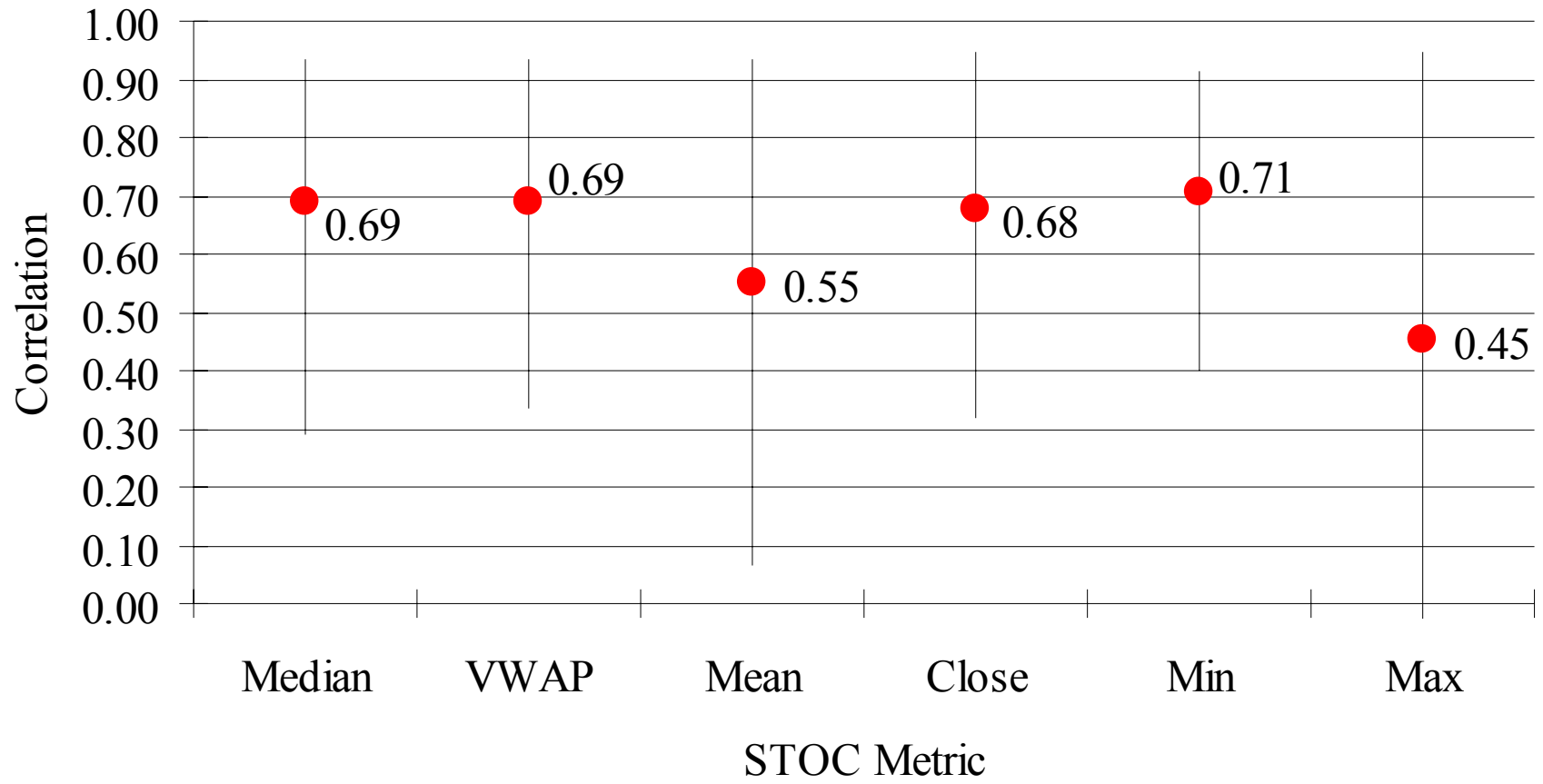
Securities Trading of Concepts (STOC): *Crossover Vehicles*



Which STOC metric is best?

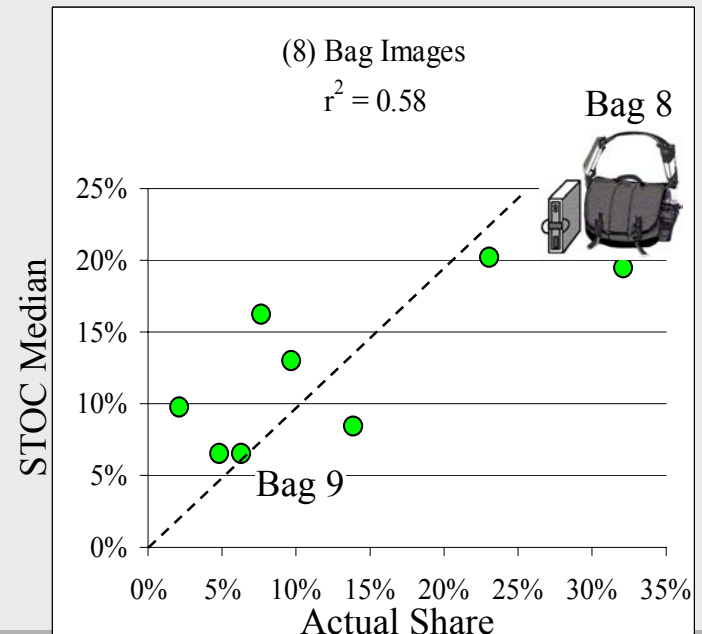
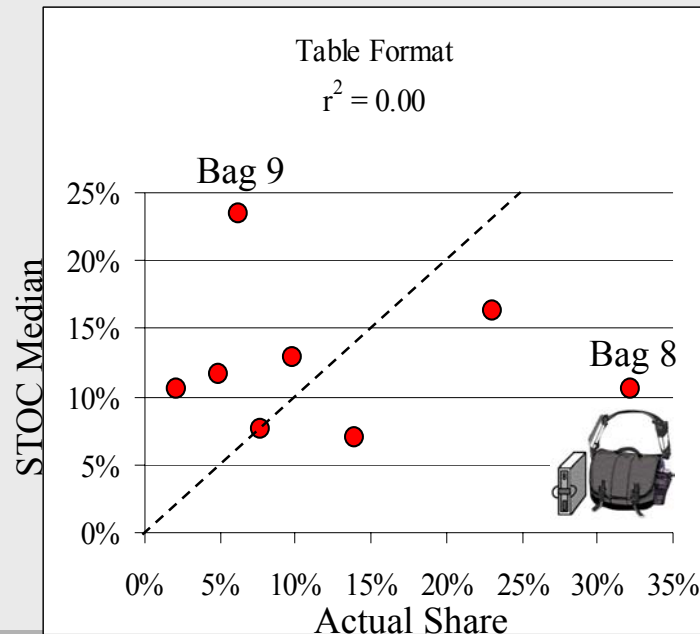
Correlations Between STOC and 1st Choice

(Max - Average - Min for four independent trials)



STOC Games for *Laptop Bags*: Tabular vs. Image Stimuli

	Bag 3	Bag 4	Bag 8	Bag 9	Bag 10	Bag 13	Bag 15	Bag 16
Price	\$89	\$88	\$99	\$80	\$95	\$79	\$78	\$87
Size	Medium	Large	Large	Medium	Large	Medium	Medium	Large
Appearance	Black	Red & Black	Black	Black	Red & Black	Red & Black	Red & Black	Black
Logo	No	Yes	No	Yes	No	No	No	Yes
Handle	Yes	Yes	Yes	No	No	No	Yes	Yes
PDA Holder	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Cell Phone Holder	No	No	Yes	Yes	Yes	No	No	No
Mesh Pocket	No	Yes	Yes	Yes	No	Yes	Yes	No
Closure for Sleeve	Full Flap	Velcro Tab	Velcro Tab	Velcro Tab	Full Flap	Velcro Tab	Full Flap	Velcro Tab
Boot	Yes	No	Yes	No	Yes	Yes	No	Yes



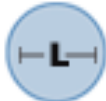








Prediction was very bad with the table - better with the larger images

Securities Trading Of Attributes (STOA): *Laptop Bag*












Will prediction improve if traders consider each attribute independently?

Nine *Laptop Bag* Attribute Stocks

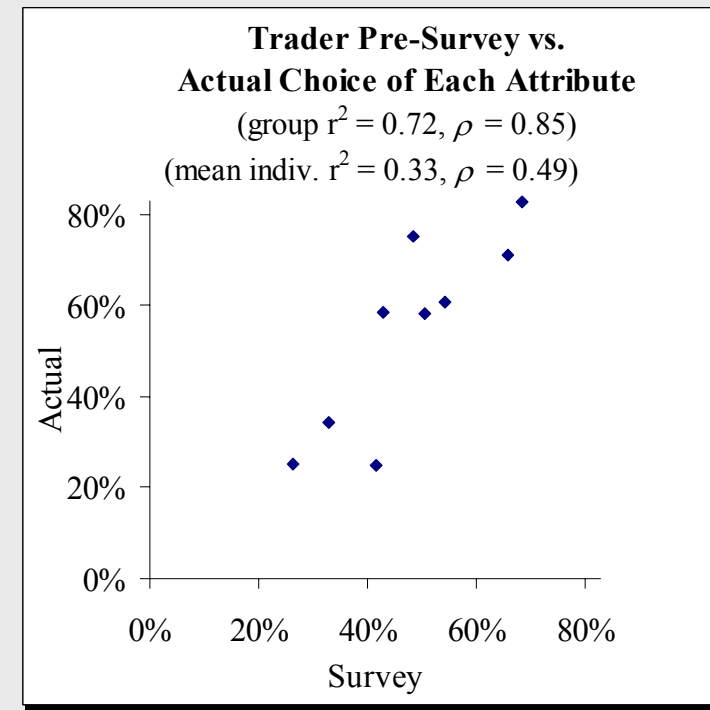
Larger_size  Adds \$9 <input type="text"/>	Red_color  No price change <input type="text"/>	Logo  Adds \$4 <input type="text"/>	Handle  Adds \$6 <input type="text"/>	PDA_holder  Adds \$6 <input type="text"/>
Cell_holder  Adds \$7 <input type="text"/>	Mesh_pocket  Adds \$4 <input type="text"/>	Flap_closure  Adds \$7 <input type="text"/>	Bottom_boot  Adds \$7 <input type="text"/>	



Prior Individual Estimates of Attributes: *Laptop Bags*

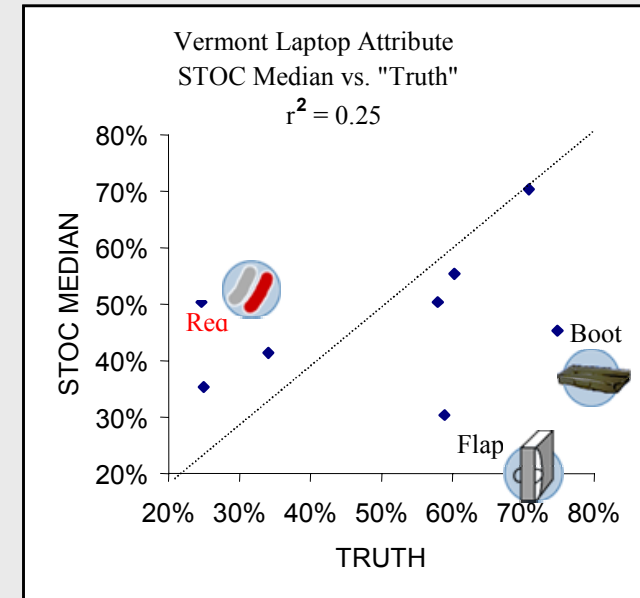
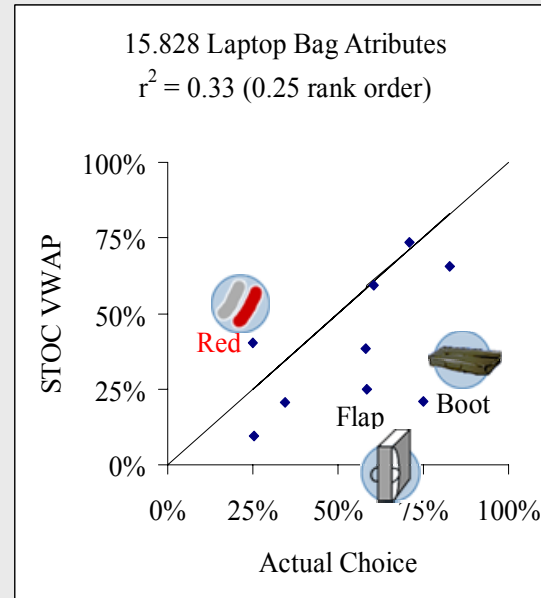
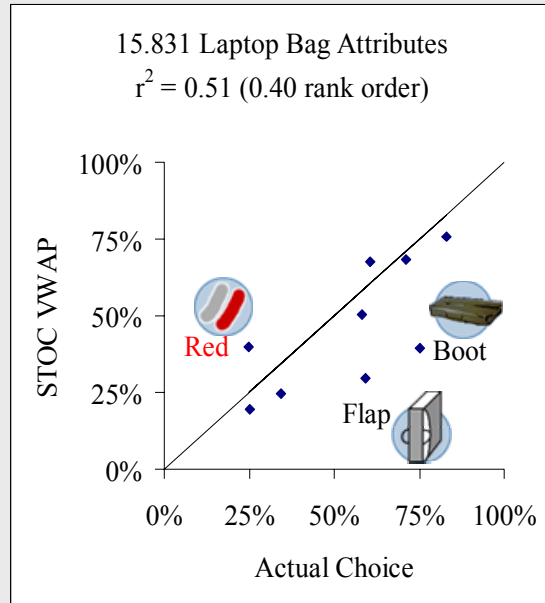
			109 Survey Responses	330 Actual Choices
1. Larger size	 Adds \$9	54% ($\pm 19\%$)		61%
2. Red color	 No price change	22% ($\pm 20\%$)		25%
3. Logo	 Adds \$4	66% ($\pm 22\%$)		71%
4. Handle	 Adds \$6	68% ($\pm 19\%$)		83%
5. PDA holder	 Adds \$6	26% ($\pm 16\%$)		25%
6. Cell holder	 Adds \$7	33% ($\pm 18\%$)		34%
7. Mesh pocket	 Adds \$4	51% ($\pm 22\%$)		58%
8. Flap closure	 Adds \$7	43% ($\pm 22\%$)		59%
9. Bottom boot	 Adds \$7	49% ($\pm 22\%$)		75%

Aggregate Opinions
Improve prediction



What % of 330 first year Sloanies (in 2000) bought each of the nine upgrades?

Securities Trading Of Attributes (STOA): *Laptop Bags*



Large



Red



Logo



Handle



PDA



Cell



Mesh



Flap

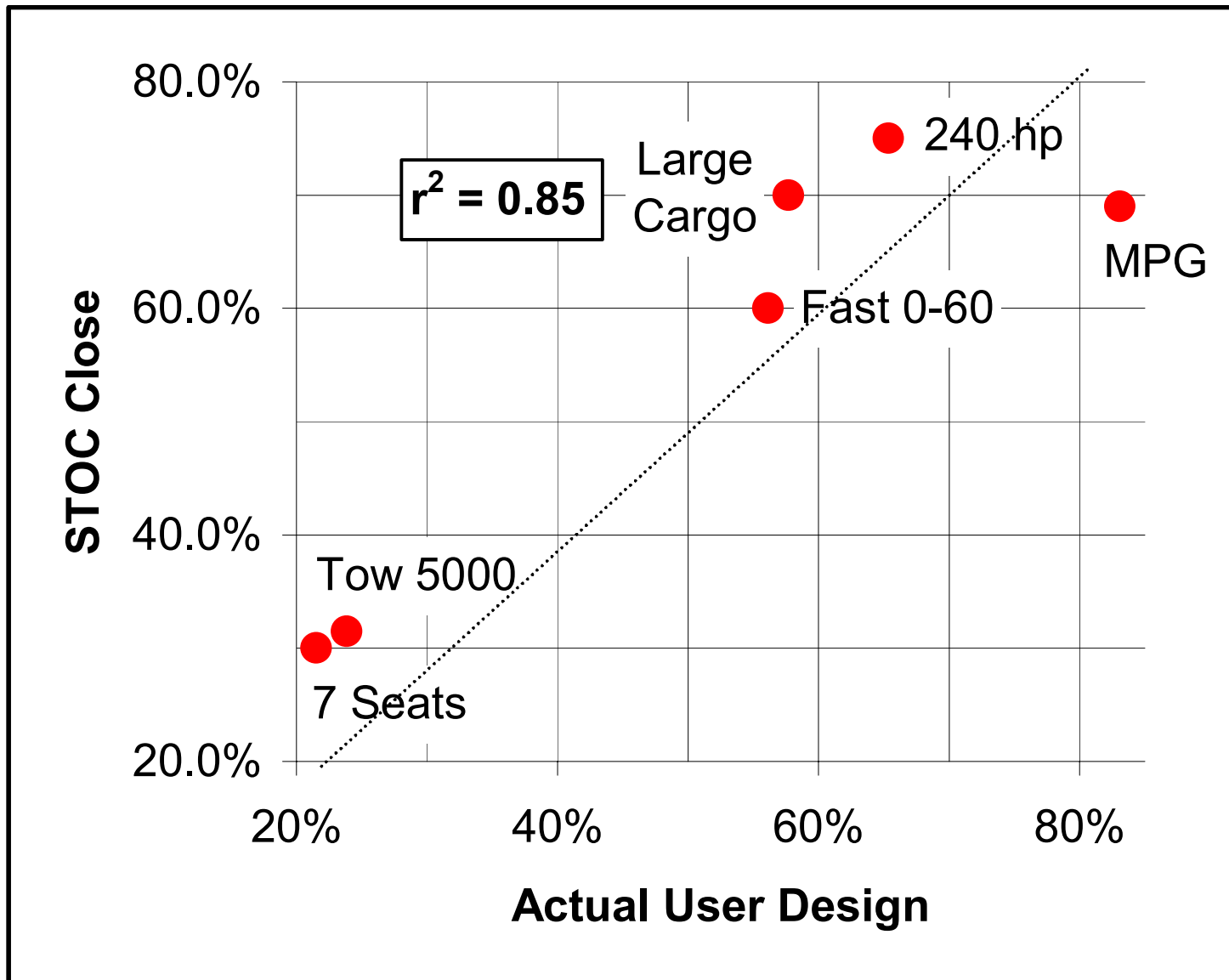


Boot

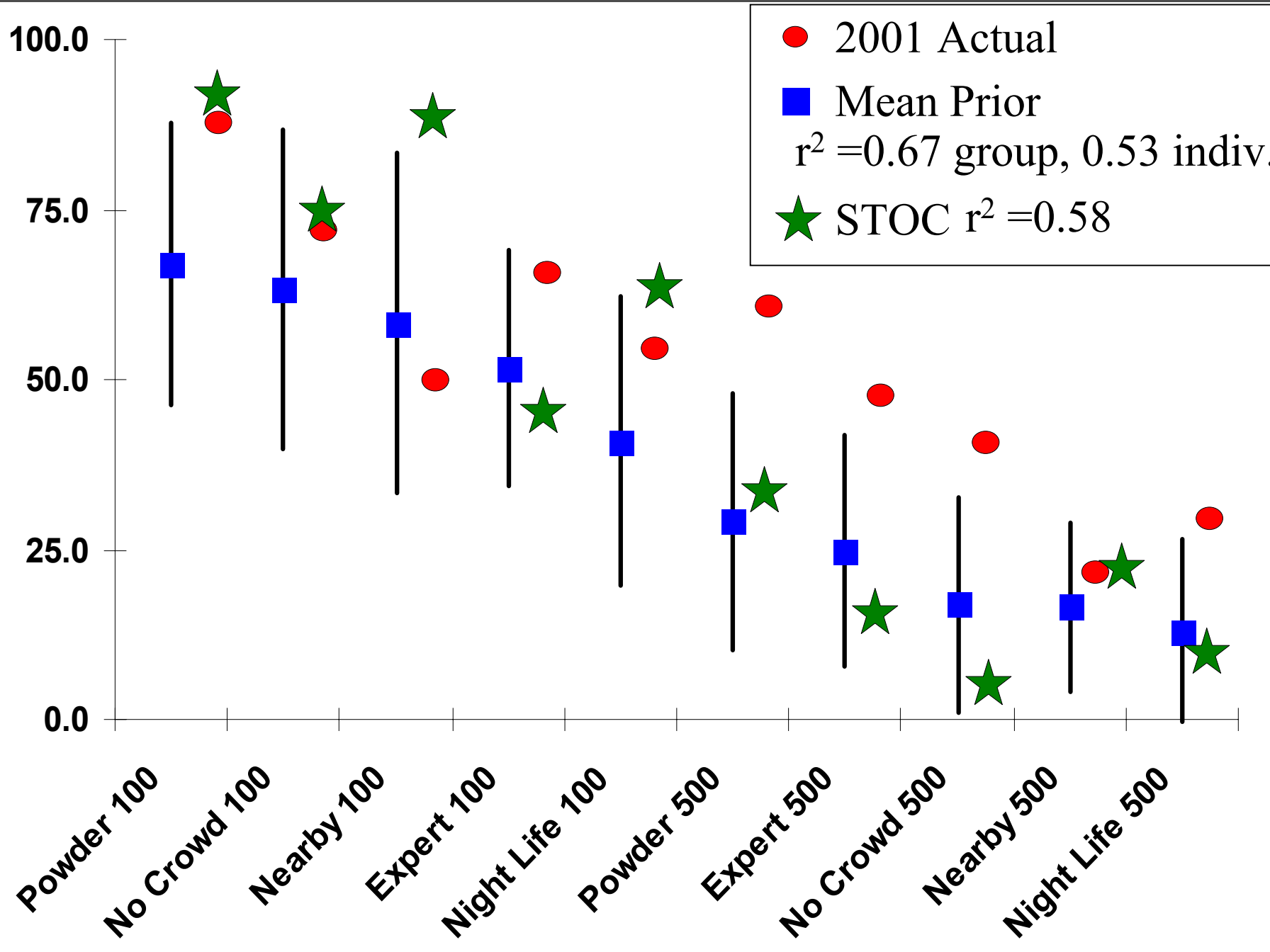


Can traders predict each attribute independently? *YES!*

STOC for Vehicle Attributes: *Crossover Vehicles*



STOC for *Ski Resort* attributes



We let 241 people design their ideal *PDA/Cell phone* device

MIT WOW - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Links »

Please select ONE in each row

Size ▶ ☐ compact ☒ Full-size

Screen color ▶ ☐ monochrome display ☒ color display

Memory ▶ ☐ 16 MB ☐ 32 MB ☒ 64 MB

Palm vs. Pocket PC ▶ ☐ Palm OS ☒ Pocket PC

Please select as many as you want

<input checked="" type="checkbox"/> cell phone	<input checked="" type="checkbox"/> hands free	<input checked="" type="checkbox"/> extended battery
<input checked="" type="checkbox"/> wireless	<input checked="" type="checkbox"/> blue tooth	<input checked="" type="checkbox"/> Thumb keyboard
<input checked="" type="checkbox"/> CF slot	<input checked="" type="checkbox"/> SD slot	<input checked="" type="checkbox"/> GPS

Click on an icon for a description of that feature.

GPS

Pocket PC

12:52

Full-size color display 64 MB Pocket PC

cell phone hands free extended battery wireless

blue tooth Thumb keyboard CF slot SD slot

Bluetooth

My Device:




















Price:	\$968
Weight:	8.5 oz
Battery Life:	7.2 hours

Submit My Design

Internet

Each feature was traded off against price, weight, & battery

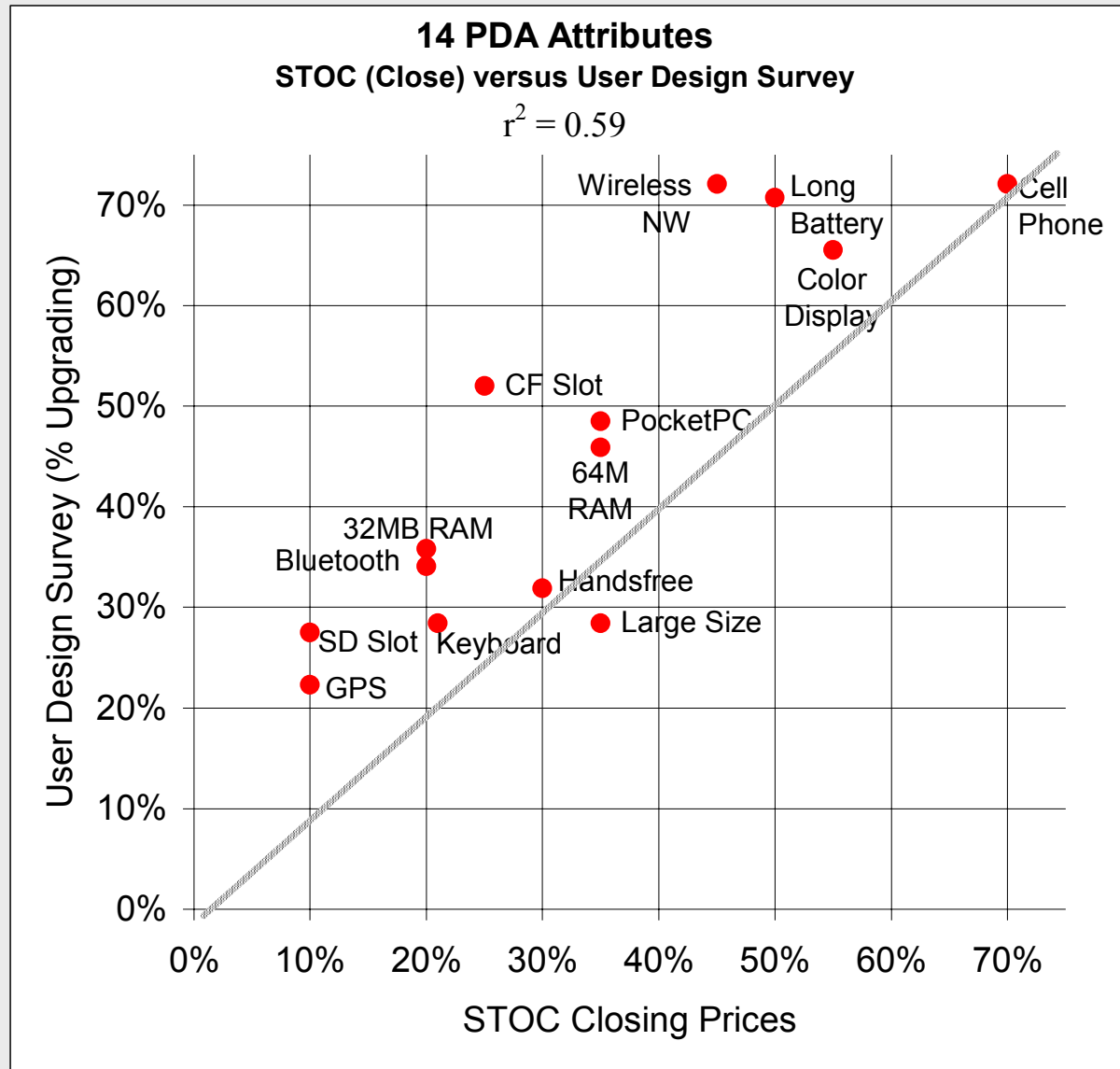
The (14) Features were then traded as (14) “Stocks” in a game

			% Upgrade	Price	Weight	Battery
SIZE	 compact	 full-size	<input type="text"/>	\$10	3.0 oz	-
COLOR	 monochrome	 color	<input type="text"/>	\$99/149	-	-20%
MEMORY	 16 MB	 32 MB	<input type="text"/>	\$25	-	-
MEMORY	 16 MB	 64 MB	<input type="text"/>	\$50	-	-
OS	 Palm	 Pocket	<input type="text"/>	\$40	-	-5%
CELL	 cell		<input type="text"/>	\$99	1.0 oz	-
HANDSFREE	 hands free		<input type="text"/>	\$50	-	-5%
BATTERY	 extended battery		<input type="text"/>	\$99	0.5 oz	+300%
WIRELESS	 wireless		<input type="text"/>	\$99/149	0.5 oz	-10%
BLUETOOTH	 blue tooth		<input type="text"/>	\$49	\$	-5%
KEYBOARD	 Thumb keyboard		<input type="text"/>	\$25	\$	-10%
CF SLOT	 CF slot		<input type="text"/>	\$15	0.5 oz	-5%
SD SLOT	 SD slot		<input type="text"/>	\$15	\$	-
GPS	 GPS		<input type="text"/>	\$129	1.0 oz	-10%



Stock price = % of respondents who bought each feature

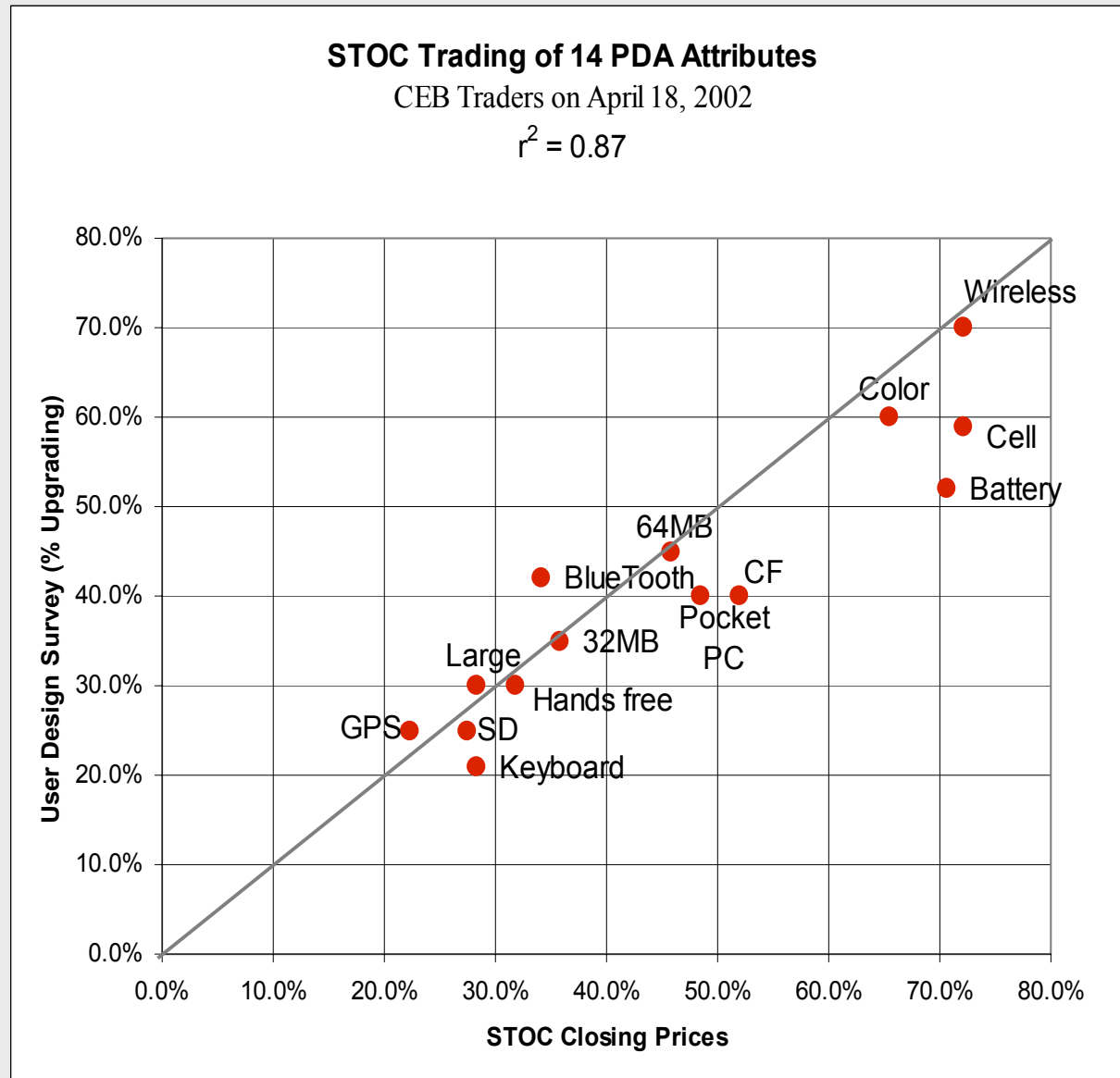
241 PDA/Cell Designs vs. STOC trading by MIT Students



Source: Ely Dahan, MIT, January 9, 2002

Student STOC trading agreed quite well with the original survey

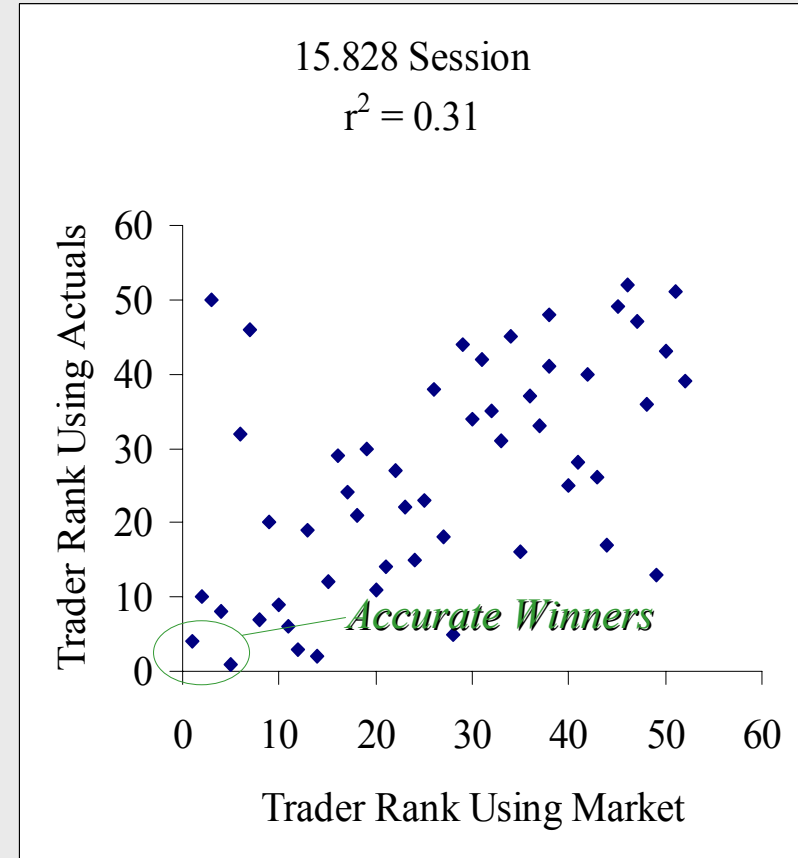
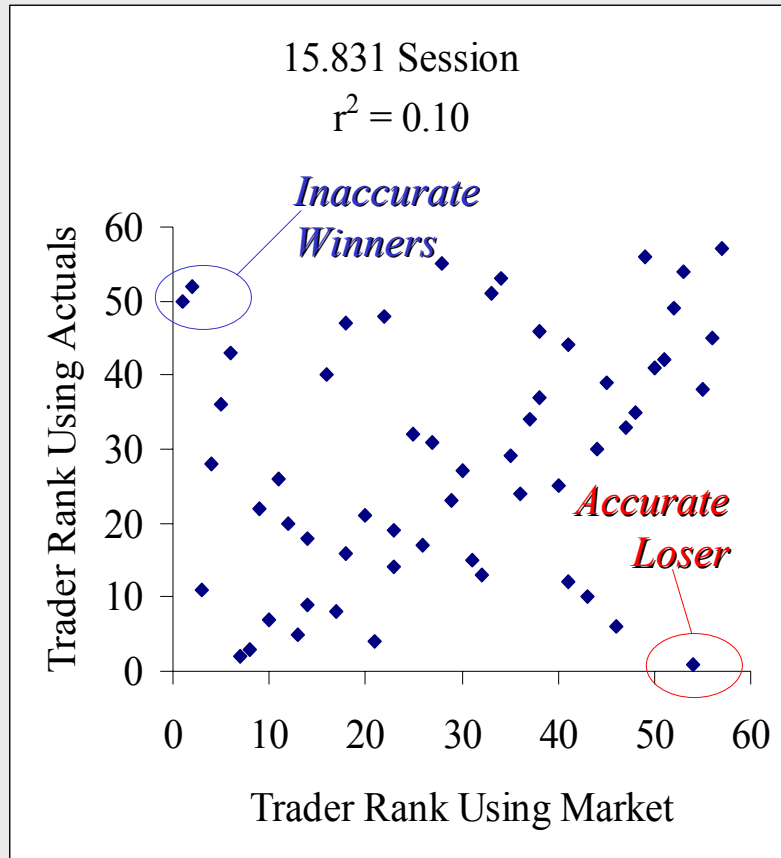
How did Executives do with *PDA/Cell* attributes?



Source: Ely Dahan, MIT, April 18, 2002

CEB Executives did even *better than students!*.

How do individual traders rank? (*laptop bag attributes*)



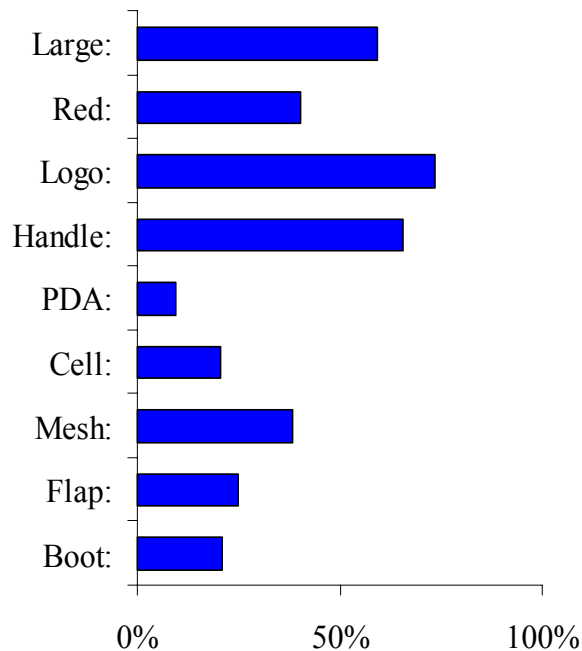
High market-priced portfolios don't always identify "accurate" traders

Order Effect: Bottom stocks get traded less, at lower prices

Vol.-Weighted Avg. Price

Position v. Price $r^2 = 0.41$

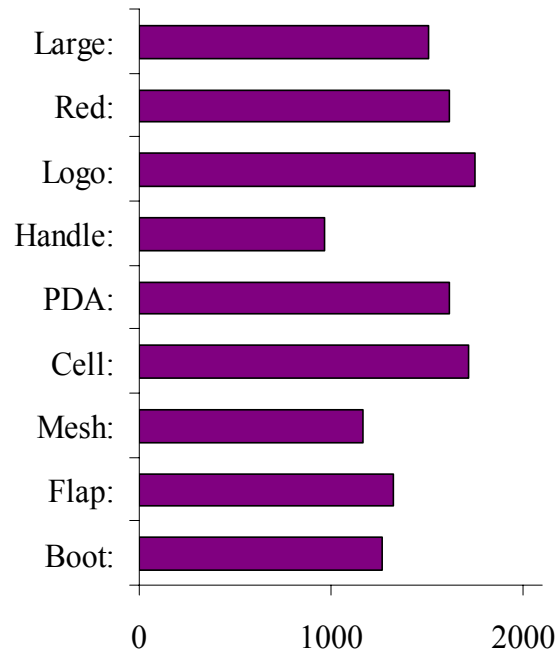
$\rho = -0.64$



VOLUME

Position v. Volume $r^2 = 0.14$

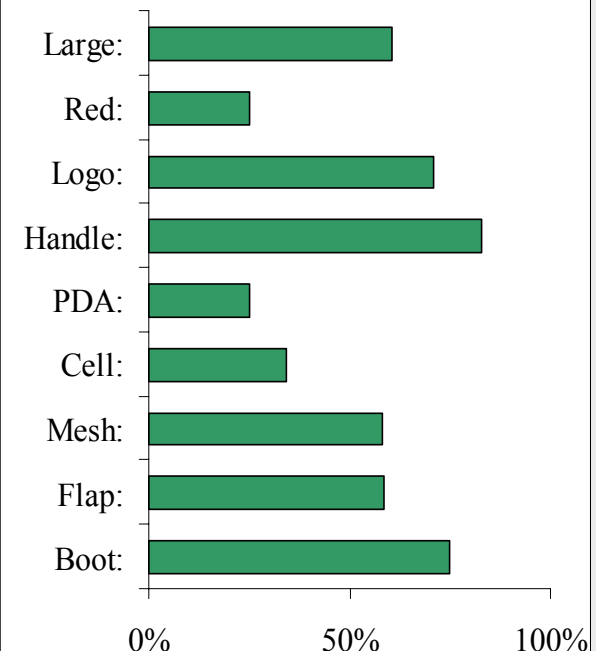
$\rho = -0.38$



ACTUAL

Position v. Actual $r^2 = 0.03$

$\rho = +0.18$

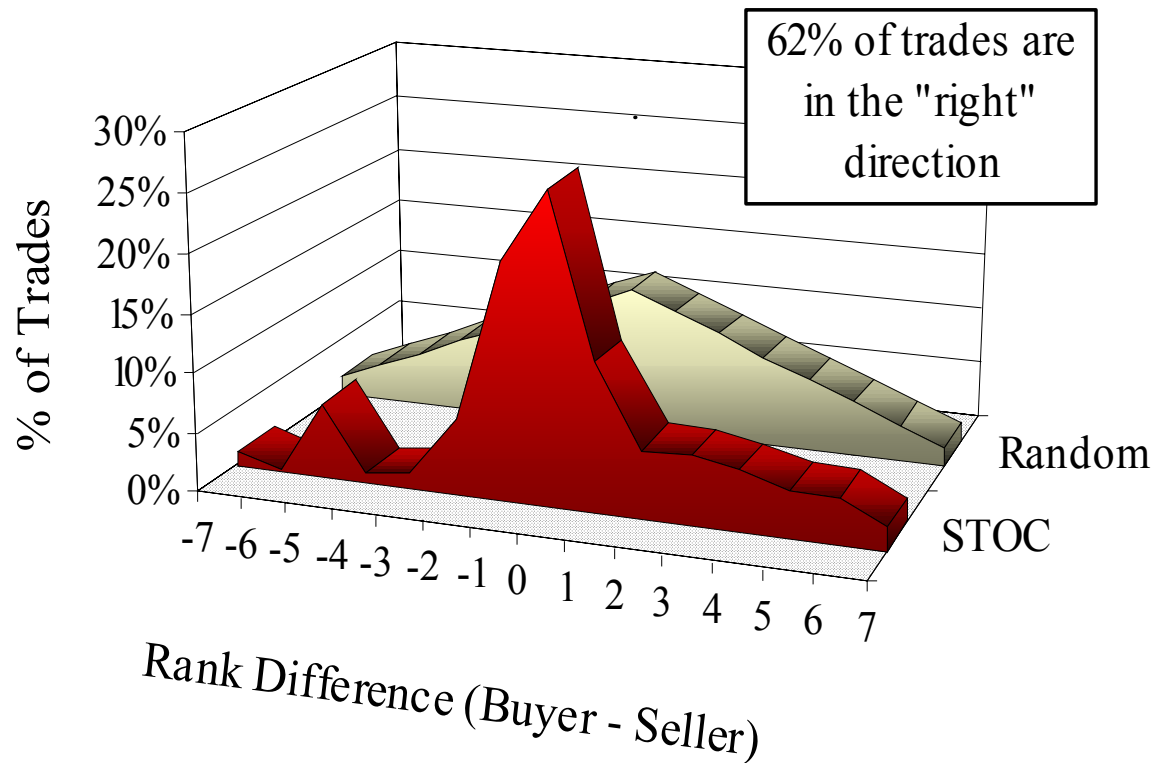


October 15, 2001, 1pm (n=52)

This suggests a need to have stocks randomly ordered by trader

Do STOC sellers rank concepts lower than buyers?

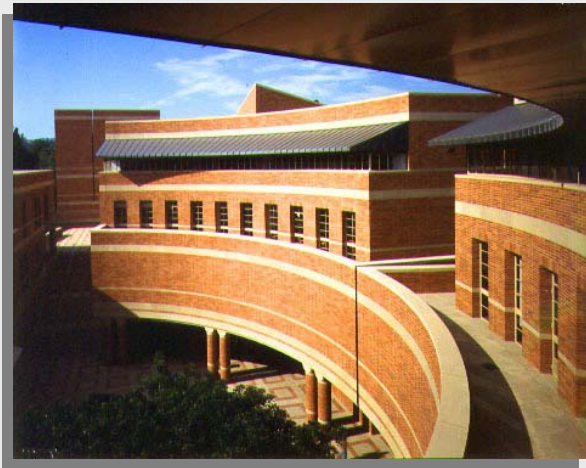
STOC Traded Vehicles Are Close in Rank
($n = 165$ transaction pairings)



Conclusions about STOC

- Functions well with informed traders
- Is accurate at identifying winners
- Measures preferences in the aggregate
- Traders behave heterogeneously, learn
- Predicts well for many product categories
- Can be effective with concepts AND attributes
- Real outcomes are not absolutely necessary

Thank you.



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