

Behavioral economics

Colin Camerer, Caltech

- ▶ Using facts and ideas from psychology to establish limits on calculation, willpower and greed
- ▶ Goal is generalization of economic theory
 - Often add one parameter or process
- ▶ Two levels of analysis:
 - How does a *person* behave (given economic constraint)?
 - How does an economy operate (given people)?

History: The Paretian turn (c. 1900): Inferring preference from choice is good enough

It is an empirical fact that the natural sciences have progressed only when they have taken secondary principles as their point of departure, instead of trying to discover the essence of things. ... Pure political economy has therefore a great interest in relying as little as possible on the domain of psychology.

[W]e are concerned only with certain relations between objective facts and subjective facts, principally the tastes of men. *Moreover, we will simplify the problem still more by assuming that the subjective fact conforms perfectly to the objective fact.*

Building blocks of microeconomics

- ▶ Preferences over
 - Bundles of goods
 - Risk
 - Time
- ▶ Social preferences
- ▶ Information processing (Bayes' rule)
- ▶ Equilibrium

Where utility theories come from

▶ Axiomatic

- ▶ Decompose representations into logical “bones”
- ▶ Find sets of axioms that are mathematically equivalent to numerical representations

▶ Empirical

- ▶ What mathematical functional forms fit choice data?

▶ Evolutionary

- ▶ What preference structures would have adapted? (e.g., Robson JEcLit 01, JEcPers 02)

▶ Neural

- ▶ Do brain structures obey axioms?

▶ Ideal: All four criteria could cohere

Rational (or simplifying) assumption	Behavioral alternative model	Representative citation
Complete preferences		
description-invariance	Framing, reference-dependence	Kahneman-Tversky 1979 Koszegi-Rabin 2005
procedure-invariance	Contingent weighting	Slovic-Lichtenstein, 1971, Grether-Plott 1979
context-independence	Comparative utility	Tversky-Simonson ?
separable $u(x)$	Regret, disappointment	Loomes-Sugden ?, Gul 1991
Choice over		
Risk	Prospect theory	Kahneman-Tversky 1979
Ambiguity	Nonadditive decision weight	Schmeidler 1989
Time	Hyperbolic β - δ discounting	Laibson 1997
Self-interest	Inequality-aversion, fairness	Rabin, 1993, Fehr-Schmidt 1999
Bayesian judgment	Overconfidence	Odean 1998
	Encoding bias	Rabin-Schrag 1999
Equilibrium	Learning	Erev-Roth 1998 Camerer-Ho 1999
	Quantal response, cognitive hierarchy Neuroeconomics Camp July 06	McKelvey-Palfrey, 1995, Camerer-Ho-Chong 2004

Preferences over goods

- ▶ Completeness and transitivity
 - $A > B, B > C \rightarrow A > C$
 - Can be “represented” by numbers
- ▶ Implicit assumptions in practice:
 - Descriptions don’t matter (framing)
 - Procedure doesn’t matter (pref reversals)
 - Choice set doesn’t matter

Reference-dependence



- ▶ Sensations depend on reference points r
 - E.g. put two hands in separate hot and cold water, then in one large warm bath
 - ▶ Hot hand feels colder and the cold hand feels hotter
- ▶ Requires theory of “mental accounting”
 - What gains/losses are grouped together?
 - When are mental accounts closed/opened?
 - Conjecture: time, space, cognitive boundaries matter
 - ▶ Example: Last-race-of-the-day effect (bets switch to longshots to “break even”, McGlothlin 1956)

Prospect theory value function:
Note kink at zero and diminishing marginal sensitivity
(concave for $x > 0$, convex for $x < 0$)

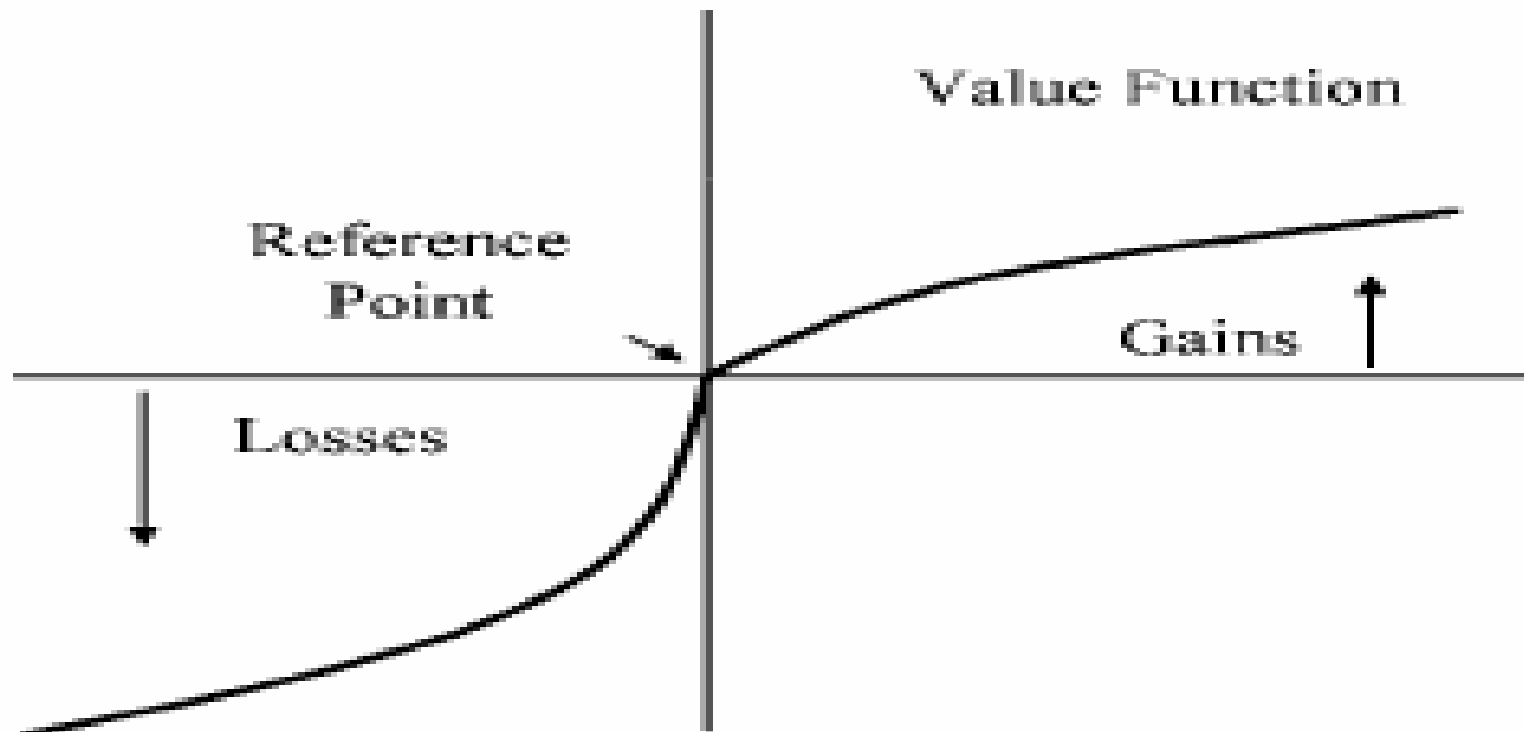
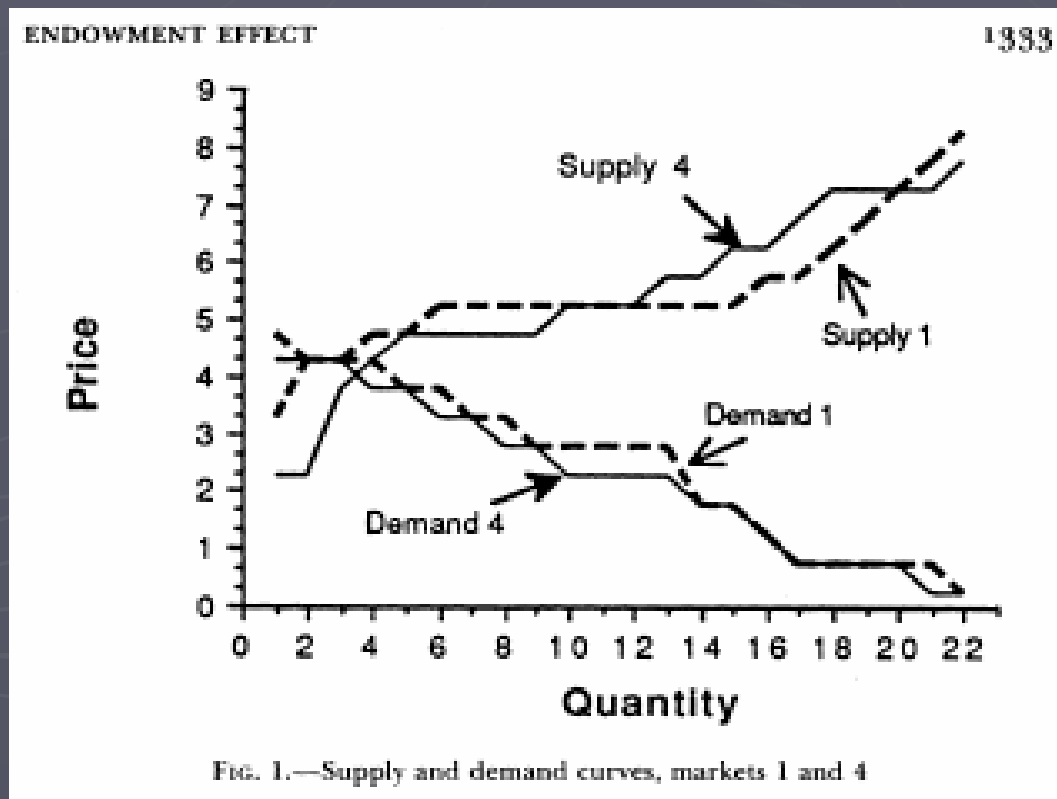


FIGURE II
Prospect Theory

Endowment effects: KKT “mugs” experiment (JPE '90)



Framing professional economists: AEA charges for 3 vs 2 journals.
 Chose "one *less journal credit*" rather than "one *more journal surcharge*"
 Why? AEA Predicted a bigger dropoff if a surcharge was imposed

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Loss-aversion empirics

- ▶ Kahneman et al 90 endowment effects: $\lambda \approx 2.29$
- ▶ Hardie et al 93 price elasticities $\lambda \approx 1.63$
- ▶ Chen et al 05:
 - Monkeys buying 1+.5(1) or 2-.5(1) $\lambda \approx 2.70$
- ▶ Ho-Zhang retailer channels exp (05) $\lambda \approx 1.57$
- ▶ Chua-Camerer 04 savings: $\lambda \approx 2.63$
- ▶ Bateman et al 04 experiments: $\lambda \approx 1.30$
- ▶ Patricia Tovar '04 trade policy $\lambda \approx 1.95$

- ▶ Endogenizing reference points (Koszegi-Rabin)
$$U(c|r) = m(c) + \mu[m(c) - m(r)]$$

r is optimal choice ("personal equilibrium")
→ results are sensitive to expectations
(e.g., novice/expert trading cards)

Economic domain	citation(s)	Type of data	Estimate d λ
Instant endowment effects for goods	Kahneman-Knetsch-Thaler (1990)	Field data (survey), goods experiments	2.29
Choices over money gambles	Kahneman and Tversky (1992)	Choice experiments	2.25
Asymmetric price elasticities for consumer product increases & decreases	Putler (1992), Hardie-Johnson-Fader (1993)	Consumer purchases (supermarket scanner data)	2.40, 1.63
Loss-aversion for goods relative to money	Bateman et al (2005)	Choice experiments	1.30
Loss-aversion relative to initial seller "offer"	Chen, Lakshminarayanan, Santos (2005)	Capuchin monkeys trading tokens for stochastic food rewards	2.70
Reference-dependence in two-part distribution channel pricing	Ho and Zhang (2004)	Bargaining experiments	2.71
Aversion to losses from international trade	Tovar (2004)	Non-tariff trade barriers, US 1983	1.95-2.39
Surprisingly few announcements of negative EPS and negative year-to-year EPS changes	DeGeorge-Patel-Zeckhauser (1999)	Earnings per share (EPS) changes from year to year for US firms	
Disposition effects in housing	Genesove and Mayer (2001)	Boston condo prices 1990-97	
Disposition effects in stocks	Odean (1998)	Individual investor stock trades	
Disposition effects in stocks	Weber and Camerer (1998)	Stock trading experiments	
Daily income targeting by NYC cab drivers	Camerer-Babcock-Loewenstein-Thaler (1997)	Daily hours-wages observations (three data sets)	
Equity premium puzzle	Benartzi-Thaler (1995)	US stock returns	
Consumption: Aversion to period utility loss	Neuroeconomics Camp July 06 Chua and Camerer (2004)	Savings-consumption experiments	

Reference-dependence and endowment effects

- ▶ Koszegi-Rabin applied to pens (x_p), \$ (x_d) and transitions (y_p, y_d)
- ▶ Utility is direct plus “transition utility” $t(\cdot)$

$$u(x_p, x_d; y_p, y_d) = bx_p + x_d + t(y_p) + t(y_d)$$

$$t(y_p) = \begin{cases} \omega \cdot v(y_p) = \omega \cdot b \cdot y_p & \text{if } y_p \geq 0, \\ -\lambda \cdot \omega \cdot v(|y_p|) = -\lambda \cdot \omega \cdot b \cdot y_p & \text{if } y_p < 0, \end{cases}$$

- ▶ ω is weight on ref-dependent utility, λ is strength of loss-aversion

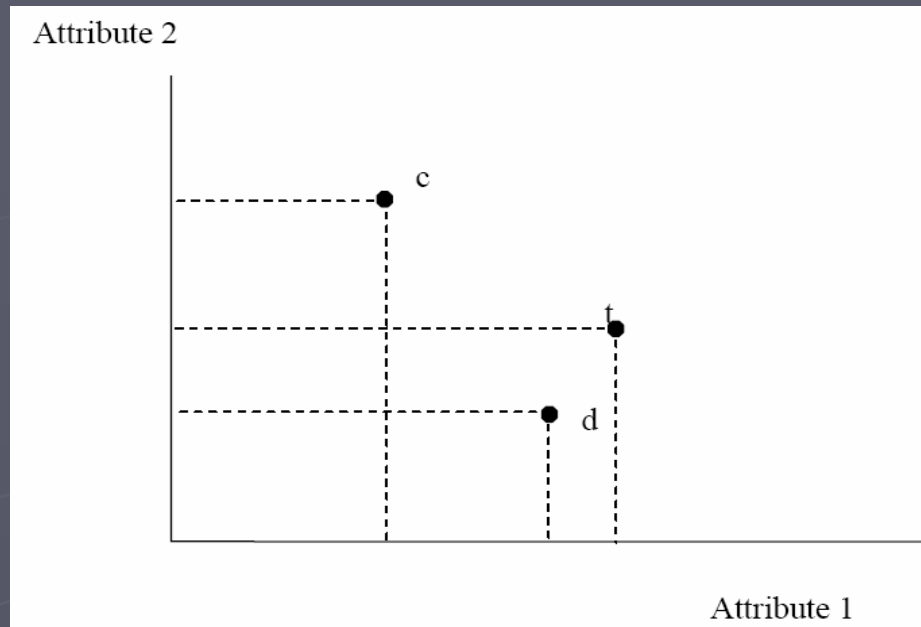
Endowment effects analysis

- ▶ Choosing (choice-equivalent P_c)
 - Reference points $r(p)=r(d)=0$
 - $U(\text{gain pen})=b+\omega b$ $U(\text{gain } P_c)=P_c+\omega P_c$
 - Equating gives $P_c=b$
- ▶ Selling (selling price P_s)
 - Reference points $r(p)=b, r(d)=0$
 - $U(\text{"lose" pen, gain } \$) = P_s + -\lambda \cdot \omega \cdot b \cdot 1 + \omega \cdot P_s$
 - $U(\text{keep pen, gain } 0)=b$
 - Equating gives $P_s = \frac{b(1+\lambda\omega)}{1+\omega}$
- ▶ Buying price $P_b = \frac{b(1+\omega)}{1+\lambda\omega}$
- ▶ Prices ordered by $P_s > P_c > P_b$ iff $\lambda, \omega > 0$

Reference point can be an “anchor”: Valuations for listening to poetry framed as labor (top) or leisure (bottom) (Ariely, Loewenstein, Prelec QJE 03 and working paper <http://sds.hss.cmu.edu/faculty/Loewenstein/downloads/Sawyersubmitted.pdf>)

<u>Odd Social Security Number Digit (Willingness to Accept Group) (N=46)</u>	
% Willing to attend for \$ - <u>Soc.Sec.No.</u>	63%
Mean valuation (st. error)	— \$4.46 (.51)
Would attend for free	9%
<u>Even Social Security Number Digit (Willingness to Pay Group) (N=35)</u>	
% Willing to pay \$ - <u>Soc.Sec.No.</u> to attend	20%
Mean valuation (st. error)	— \$1.13 (.59)
Would attend for free	49%

Asymmetric dominance (choice-set effects)



- ▶ Introducing d enhances preference for t
- ▶ Shown in birds and bees (Shafir et al Beh Ecol Sociobiol 02)
- ▶ Shown in store sales with baked beans 19% → 33% (Doyle et al Psy & Mktg 99)

Preferences over risk

- ▶ How do people weigh and combine likelihoods and outcomes?
 - Gambling
 - Risky investment (stocks, college, mates)
 - Insurance
 - Social risks (terrorism, global warming)
- ▶ Notation: $f(x)$ is a risk with probability $f(x)$ of outcome x

Possible decision rules

▶ Maximin

- Choose risk with the best worst outcome
- $f^* = \operatorname{argmax}_g [\min_x x]$

▶ Safety-first/VAR

- Choose best EV with $p(\text{loss})$ below a threshold
- $f^* = \operatorname{argmax}_g \sum_x xg(x)$ subject to $\sum_{x<0} g(x) \leq p^*$

▶ Mean-variance

- Prefer high EV, low variance
- $f^* = \operatorname{argmax}_g E(g) - b\sigma^2(g)$

▶ Expected utility

- Choose risk with highest probability-averaged outcome utility
- $f^* = \operatorname{argmax}_g \sum_x g(x)u(x)$

Prospect theory (Kahneman-Tversky 79)

- ▶ 2nd most highly cited paper in Econometrica history
- ▶ Reference-dependence $v(x-r)$
Diminishing marginal sensitivity
 $v''(x-r) < 0 \quad x > r$ and $v''(x-r) > 0 \quad x < r$
Loss-aversion
- ▶ Nonlinear weighting of probability

Empirical weighting functions

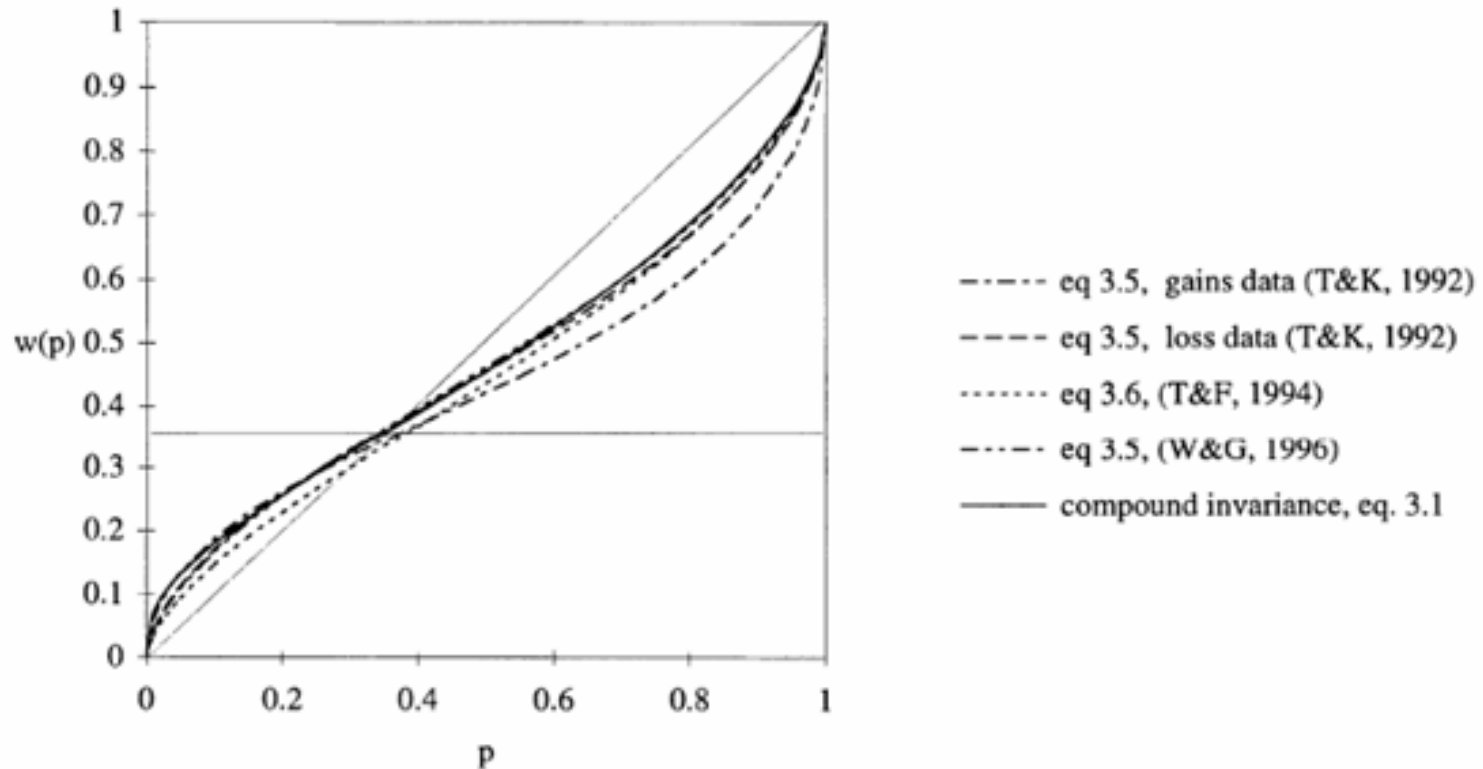


FIGURE 1.—The compound invariant form (solid line) and several empirical probability weighting functions. Estimates of the one-parameter equation (3.5) are taken from Tversky and Kahneman (1992) and Wu and Gonzalez (1996a); estimates of the two-parameter equation (3.6) are taken from Tversky and Fox (1994).

Many variants of expected utility

Table 1. Predictions of competing theories about properties of indifference curves

Theory (figure no.)	Functional form for $U^*(F) = U(qX + (1 - q)Y) (X < Y)$	Properties of curves			
		Straight lines?	Fanning out?	Fanning in?	Miscellaneous
Expected utility (1)	$qU(X) + (1 - q)U(Y)$	Yes	No	No	Curves parallel
Weighted utility (2)	$\frac{qW(X)U(X) + (1 - q)W(Y)U(Y)}{qW(X) + (1 - q)W(Y)}$ $W(X) < 1$ $W(X) > 1$	Yes	Yes	No	Curves meet in a point
		Yes	No	Yes	
Implicit expected utility (3)	$qU(X, U^*) + (1 - q)U(Y, U^*)$	Yes	Maybe	Maybe	Only testable property is between
The fanning-out hypothesis (4)	$\frac{-U''(x; F)}{U'(x; F)} > \frac{-U''(x; G)}{U'(x; G)}$ if $F(x) < G(x)$ for all x	Maybe	Yes	No	Movements to north cause steeper slopes
Lottery-dependent utility (5)	$qU(X, C_F) + (1 - q)U(Y, C_F)$ $h(x)$ concave $C_F = \int h(X)dF(X)$ $h(x)$ convex	No	Yes	No	Curves concave
		No	Yes	No	Curves convex
Prospect theory (6)	$u(X) + \pi(q)U(Y - X)$ $\pi(q)U(X) + \pi(r)U(Y), q + r < 1$	No	Lower edge	Left edge, hypotenuse	Parallel along $P_H = (1 - P_L)/2$
Rank-dependent utility (7)	$g(q)U(X) + (1 - g(q))U(Y)$ g concave g convex	No	Lower edge	Left edge	Parallel along hypotenuse
		No	Left edge	Lower edge	

► Source: Camerer JRiskUnc 88, Edwards (Ed) Utility Theories, 92

Neuroeconomics Camp July 06

Preferences over temporal streams

$$U^t(u_t, u_{t+1}, \dots, u_T) \equiv u_t + \sum_{\tau=t+1}^T \delta^{\tau-t} u_\tau$$

- Discount factor compresses many forces
 - mortality, uncertainty, time compression...
- Accepted as normative and descriptive
...but initially arbitrary (Samuelson 1937)
- Note: Separability (no habit formation)
- Exponential \rightarrow time consistency

Magnitude and hyperbolic effects

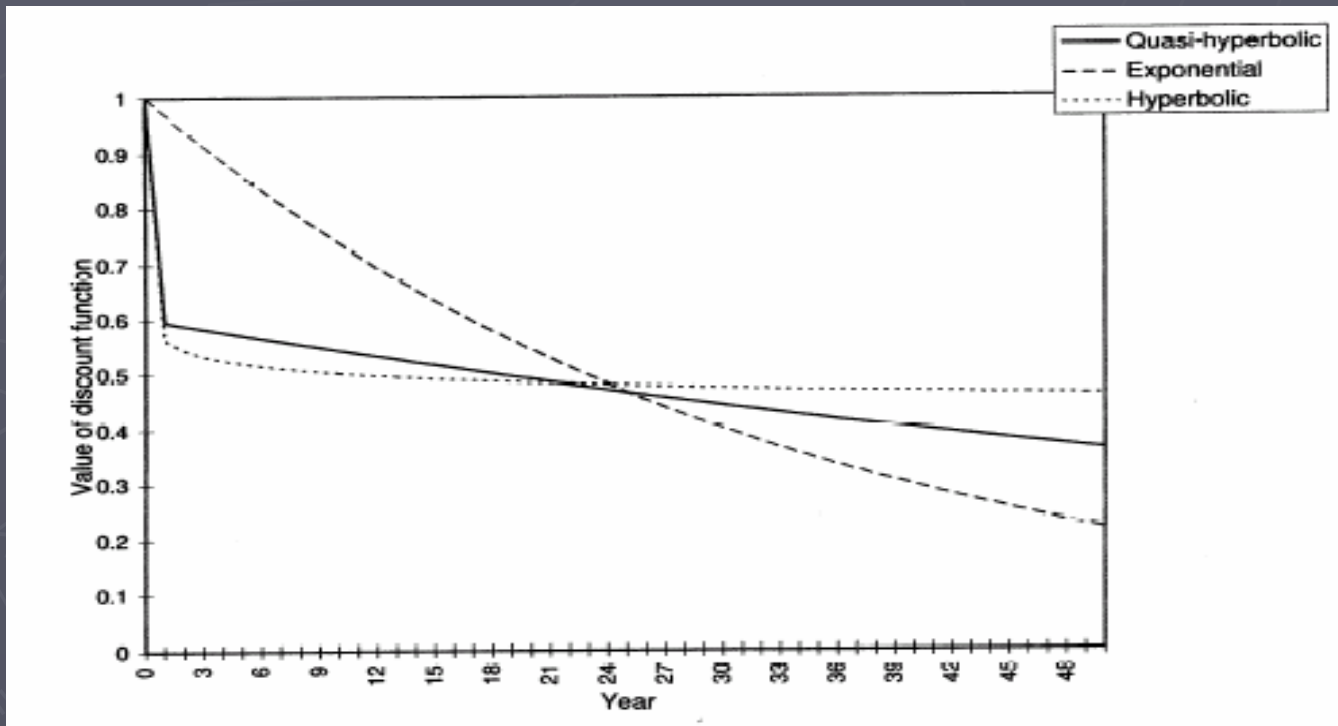
- ▶ \$15 now is same as ____ in a month. ____ in a year. ____ in 10 years.
 - Thaler (1981)
 - ▶ \$20 in a month (demand 345% interest)
 - ▶ \$50 in a year (120%)
 - ▶ \$100 in 10 years (19% interest)
 - Show discount rates decrease over time...
- ▶ Students asked:
 - \$150 vs. \$x in 1 month, 1 year, 10 years
 - \$5000 vs \$x

Results of class survey



Quasi-hyperbolic (present-biased) discounting

$$U^t(u_t, u_{t+1}, \dots, u_T) \equiv u_t + \beta \sum_{\tau=t+1}^T \delta^{\tau-t} u_\tau$$



Frontier questions about time preference

▶ Field data

- Army cash-outs (Warner-Pleeter AER 01), $r > \approx 20\%/yr$
- Credit cards (Ausubel 05)
- Gym membership (della Vigna, Malmendier 05 AER)
 - ▶ Fixed fee/days ($=\$19/day$) versus $\$10/day$

▶ Big question:

- Naïve vs sophisticated: How much *voluntary* external commitment is purchased?
 - E.g. IRS refunds
 - Commitment to deadlines
 - Ashraf PI study (QJE in press), most choose a “lockbox”

▶ Institutions

- Sell commitment (e.g. financial+estate planning)
- Exploit procrastination (e.g. gyms, Netflix)

Sophisticates seek self-control (from periodic food stamp checks, Ohls 92; Shapiro, 03 JPubEc)

“Break it [benefit check] down with a check on the 1st and a check on the 15th like they used to do [for AFDC]. If you’re spending most of your money in the first few days of the month with one check, if you spend most of it on the 1st, you know [with two checks] you got that other money coming through so you’re stringing it out.”

“Give it to us in two installments. At the end of the month I’m dying [for money]. If you got it on the 1st and 15th, or whatever, it would be so much better. Checks or coupons, it doesn’t matter, either way, but it does not last a month. The second part of the month is always a struggle.”

Information processing

- ▶ Hypothetical AIDS base rate: .1%
- ▶ Test has 90% accuracy
- ▶ You test HIV-positive
- ▶ What is $p(\text{AIDS})$?

Information processing

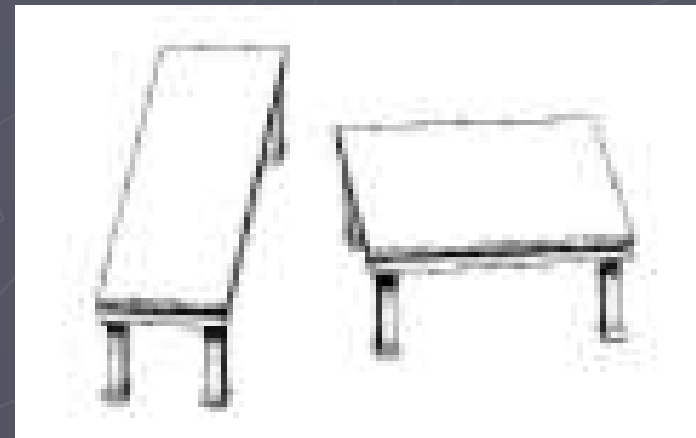
- ▶ Hypothetical AIDS base rate: .1%
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- ▶ What is $p(\text{AIDS})$?

- Bayes' rule:

- $$P(A|+) = \frac{P(+|A)P(A)}{P(+|A)P(A) + P(+|\text{noA})P(\text{noA})}$$
$$= (.9)(.001) / (.9 * .001 + .1 * .99) = .083$$

“Heuristics and biases” program (KT et al)

- ▶ Economic assumption:
 - People weigh information objectively, integrate using Bayes’ rule
- ▶ Idea: Heuristics used can be illuminated by the biases that result
 - Like optical illusions



Heuristics and models

- ▶ Representativeness, availability, anchoring
- ▶ Formalism: “Mis-Bayesian” models
 - Add one mistake then use Bayes’ rule
 - E.g. Rabin-Schrag (QJE 00) confirmation bias
 - ▶ If $P(A) > P(\text{not-}A)$ then data inconsistent with A are sometimes misperceived as consistent
 - Hindsight bias: After an event, revise prior belief *and* update using data (“double count”; Biais and M Weber 05)

Social preferences

- ▶ Self-interest is a useful, common assumption...*but!*
- ▶ → econ's skeptical social preferences are fragile:
"when self-interest and ethical values with wide verbal allegiance are in conflict, much of the time, most of the time in fact, self-interest theory...will win." (George Stigler)
- ▶ Challenge is to create a general, precise, accurate, psychologically plausible model of social preferences
 - Distributional (inequity-aversion-- Fehr-Schmidt, Bolton-Ockenfels; Rawlsitarian (me+min+us)-- Charness-Rabin)
 - Reciprocal (Rabin et al)
 - "Signaling" or self-image (Levine, Bernheim, Rotemberg)

Ultimatum game

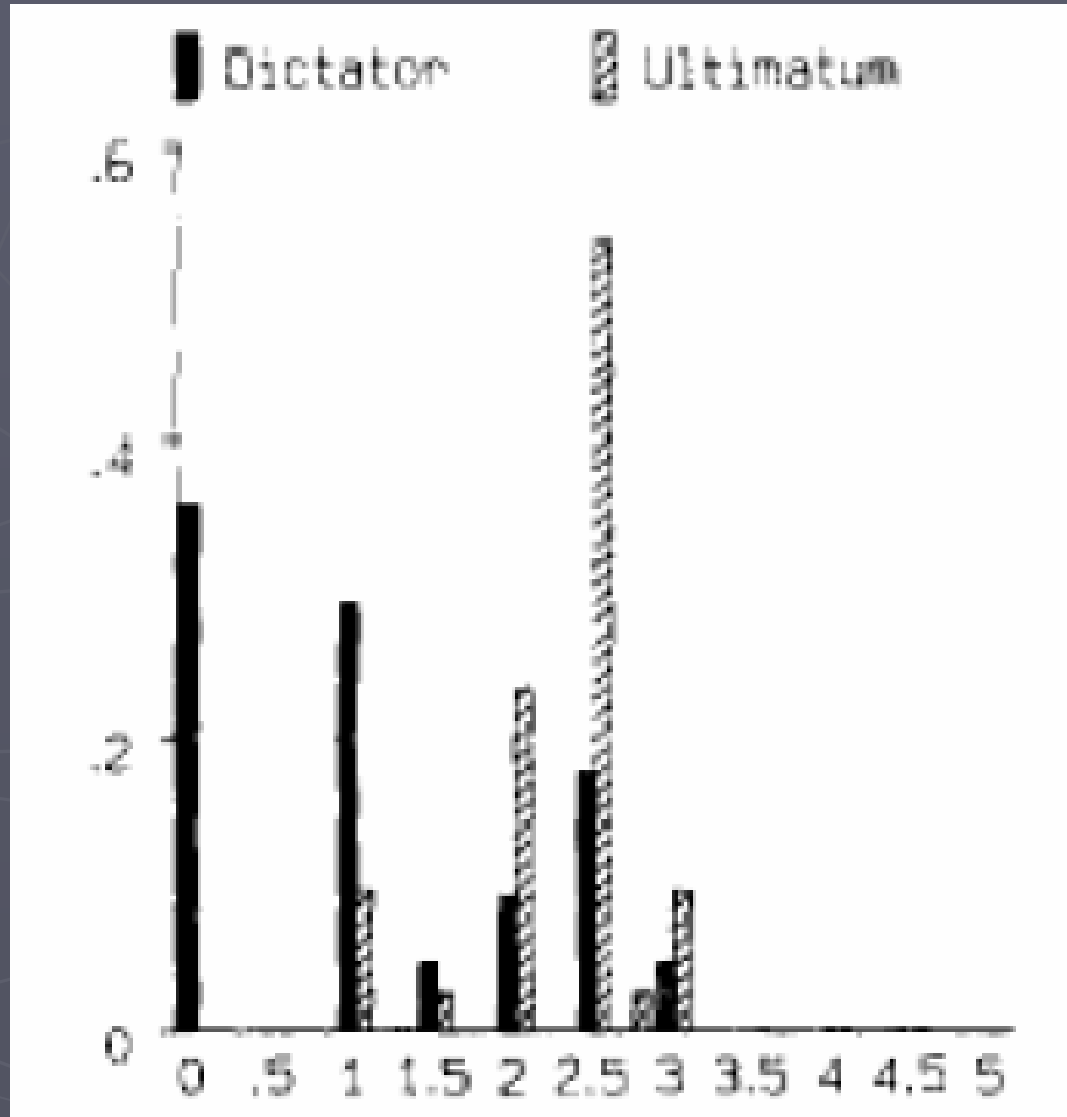
- ▶ Proposer offers division of \$10; responder accepts or rejects
- ▶ Theories:
 - Rejections express social preferences (care about \$, envy, guilt)
 - “Unnatural habitat” (adapted to repeated games, one-shot is Stroop)
- ▶ Some variants:
 - Dictator games (no rejection)
 - Repetition etc.– weak Demographics (generally weak)
 - Stakes– As \$ rises, rejected \$ goes up, rejected % goes down
 - Low information about “pie” size → lower offers (and “pleading poverty”)

Why Fehr-Schmidt players reject

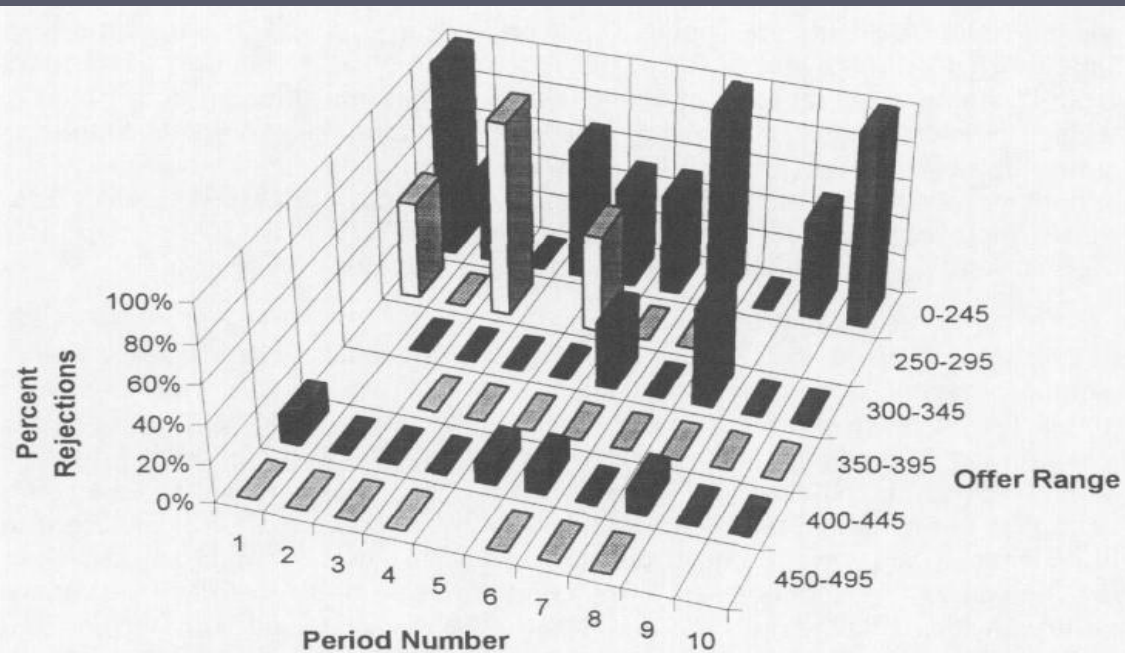
- ▶ $U_i(x_i, x_j) = x_i - \alpha \cdot \max(x_j - x_i, 0) - \beta \cdot \max(x_i - x_j, 0)$
- ▶ Offer x out of \$10
- ▶ Suppose $x < \$5$.
 - Accept if $u(x, 10-x) = x - \alpha(10-x-x) > 0 = u(0, 0)$
 - \rightarrow Accept if $x^* > 10\alpha / (1+2\alpha)$
 - \rightarrow Reject if $x^* < 10\alpha / (1+2\alpha)$

Ultimatum vs dictator "games" (Forsythe et al 1994)

NB: Dictator games are "weak situations", more variance



Do players learn to accept low offers at high stakes? No. Would learn *a lot* more from the strategy method (acc/rej for all offers)



1500 Sk: Rejections / Offers

Period	Offer Ranges						
	450 -495	400 -445	350 -395	300 -345	250 -295	200 -245	ALL
1	0/4	1/7	0/0	0/0	1/2	2/2	4/15
2	0/4	0/6	0/0	0/1	0/1	1/2	1/14
3	0/2	0/8	0/2	0/1	1/1	0/1	1/15
4	0/1	0/7	0/2	0/1	0/0	2/3	2/14
5	0/0	1/10	0/1	0/1	1/2	1/2	3/16
6	0/1	1/9	0/1	1/3	0/1	1/2	3/17
7	0/2	0/8	0/2	0/1	0/1	3/3	3/17
8	0/1	1/9	0/1	1/2	0/0	0/2	2/15
9	0/0	0/8	0/3	0/4	0/0	1/2	1/17
10	0/0	0/9	0/1	0/4	0/0	1/1	1/15
ALL	0/15	4/81	0/13	2/18	3/8	12/20	21/155

FIGURE 1c.— High stakes (1500 Sk).

Sobel JEL arguments & counterarguments:

“Restricting theory to use only a subset of available tools is not discipline. It is a handicap.”

- ▶ If it ain't broke don't fix it.
 - It is broke
- ▶ Social prefs too hard for agents or theorists
 - Traditional models impose no limits; why start now?
 - There are tractable models. No harder than other theory.
- ▶ Evolutionary models show only selfishness persists
 - False.
- ▶ “No other approach of comparable generality...”
 - Social prefs even more general
- ▶ Econ needs discipline from self-interest and “well understood general principles”
 - Discipline comes from good scientific practice (and facts)
- ▶ Standard models make precise predictions. Social won't.
 - False: E.g. intrinsic reciprocity tightens up folk theorem results
- ▶ Too many free variables.
 - Single model applied to many domains.

Equilibrium

- ▶ Local markets
 - Supply=demand
- ▶ Game theory
 - Beliefs by A about B match B's choices (no surprises)
- ▶ Non-equilibrium theories
 - Satisficing, ϵ -equilibrium, quantal response equilibrium
 - Learning, imitation
 - Cognitive hierarchy

The cognitive hierarchy (CH) model (I)

► Discrete steps of thinking:

Step 0's choose randomly (nonstrategically)

K-step thinkers know proportions $f(0), \dots, f(K-1)$

Calculate what 0, ...K-1 step players will do

Normalize beliefs $g(n) = f(n) / \sum_{h=0}^{K-1} f(h)$.

Calculate expected payoffs and best-respond

► Exhibits "increasingly rational expectations":

- Normalized $g(n)$ approximates $f(n)$ more closely as $n \rightarrow \infty$

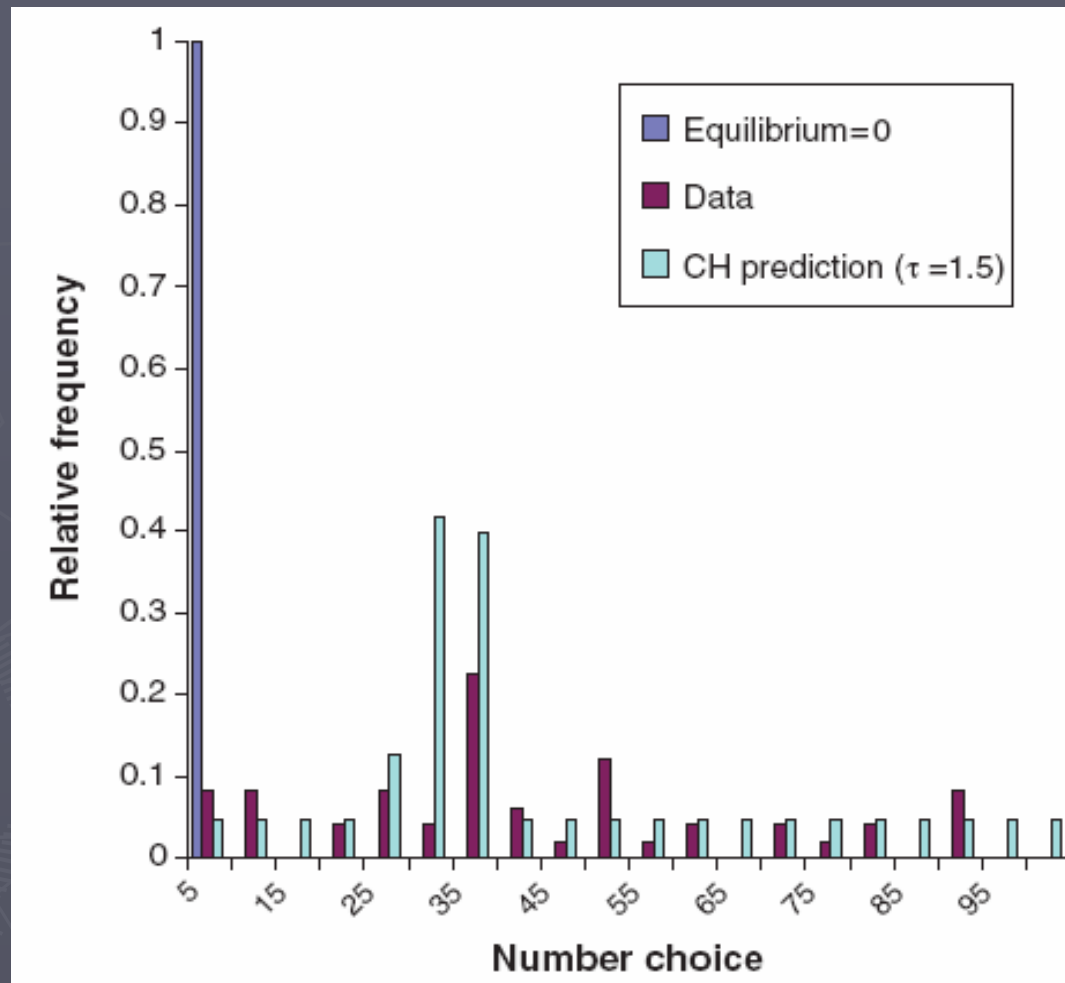
- i.e., highest level types are "sophisticated"/"worldly and earn the most

- Also: highest level type actions converge as $K \rightarrow \infty$

- (\rightarrow marginal benefit of thinking harder $\rightarrow 0$)

1. Limited equilibration Beauty contest game

- ▶ N players choose numbers x_i in $[0,100]$
- ▶ Compute target $(2/3)*(\sum x_i / N)$
- ▶ Closest to target wins \$20



Estimates of τ in pBC games

Table 1: Data and estimates of τ in pbc games (equilibrium = 0)			
subjects/game	Mean		Steps of Thinking
	Data	CH Model	
game theorists	19.1	19.1	3.7
Caltech	23.0	23.0	3.0
newspaper	23.0	23.0	3.0
portfolio mgrs	24.3	24.4	2.8
econ PhD class	27.4	27.5	2.3
Caltech g=3	21.5	21.5	1.8
high school	32.5	32.7	1.6
1/2 mean	26.7	26.5	1.5
70 yr olds	37.0	36.9	1.1
Germany	37.2	36.9	1.1
CEOs	37.9	37.7	1.0
game p=0.7	38.9	38.8	1.0
Caltech g=2	21.7	22.2	0.8
PCC g=3	47.5	47.5	0.1
game p=0.9	49.4	49.5	0.1
PCC g=2	54.2	49.5	0.0
		mean	1.56
		median	1.30

Aggregation: What happens in an economy with some limited-rationality agents?

► Early theory:

- Russell-Thaler 87 AER: Depends on market completeness
- Haltiwanger-Waldman 85 AER: Depends on substitution/complementarity
- Political science: Depends on median voter
- Finance: DeLong et al 90 JPE: Noise traders can create horizon risk for short-horizon rational traders

Aggregation 2

- ▶ Experiments with markets show mixed results
 - Representativeness, curse of knowledge (Camerer 87 AER, 90 JPE, Kagel et al JRU)
 - Wason 4-card task, bids help (Maciejovsky-Budescu 05)
 - ▶ Bids for diagnostic cards in Wason 4-card task are rational
- ▶ Sorting and “division of labor...’strongly attenuates if not eliminates’ any effects” caused by bounded rationality” (Becker)
- ▶ “Organizational repairs” (Heath et al 00)
 - Microsoft one-way mirror for consumer complaint
 - Trading firms swap trader positions to limit loss-aversion

Aggregation 3

- ▶ Which is more profitable?
 - Firms *limit* rationality mistakes from workers...but then can better *exploit* consumer mistakes
 - Example: Pathological gambling

[GAMBLING PROBLEMS - TOP RATED ONLINE CASINO SITES. FREE KENO MASSAGE SANDALS BONUS](#)

... is licensed and gambling problems regulated ! Here you will find gambling problems more information about all ...

www.casino-startup.com/gambling-problems.html - 17k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)

Conclusions

- ▶ Behavioral economics is now well-established
 - Should cease to be a distinct subfield around 2010
- ▶ Roots economics in psychology and biology
- ▶ Formalisms can be used to make predictions
- ▶ Imperfect rationality is as natural as
 - Imperfect competition
 - Imperfect information
- ▶ Interesting questions about market equilibrium
- ▶ Controversies are healthy (normal science)
 - E.g. reference points are fragile
- ▶ Frontiers:
 - Field data, careful theory, new psychology, neuro

Logic vs biologic:

► Which do you prefer?

A:	90%	6%	1%	3%
	\$0	45	30	-15

B:	90%	7%	1%	2%
	\$0	45	-10	-15

Logic vs biologic: B stochastically dominates B

► Which do you prefer?

90	6	1	1	2
\$0	45	30	-15	-15

90	6	1	1	2
\$0	45	45	-10	-15

The franchising of behavioral economics

- ▶ Finance (Shiller-Thaler)
 - Rationality limits influence pricing, corporate
- ▶ Game theory (Camerer)
 - Formal models of cognitive hierarchy, learning
- ▶ Labor (Fehr)
 - Reciprocity/crowding out overturns many conclusions
- ▶ Law (Sunstein)
 - Influence of framing, norms, tackle paternalism
- ▶ Public finance (Slemrod, Rangel)
 - What is welfare?

Formal theory and field data

▶ Formal theory:

- Careful models of psychology...good for psychology!
- Example: Benabou-Tirole “crowding out”
 - ▶ High incentive sends a signal that work is hard or worker lacks skill → lowers effort

▶ Field studies

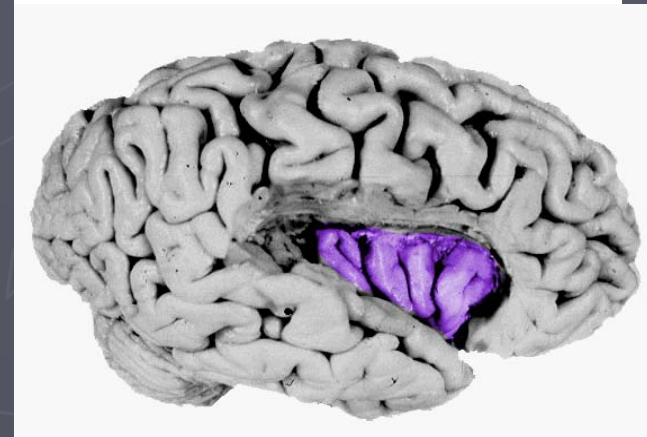
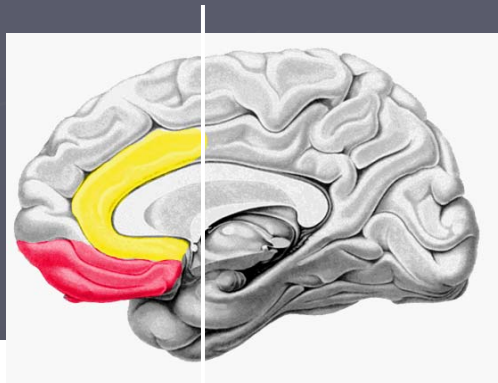
- Finance (many)
- Labor supply (Camerer et al, Henry Farber, Lorenz Goettee...)
- Health club contracts (Della Vigna-Malmendier)
- Credit cards (Ausubel)

Neuroeconomics

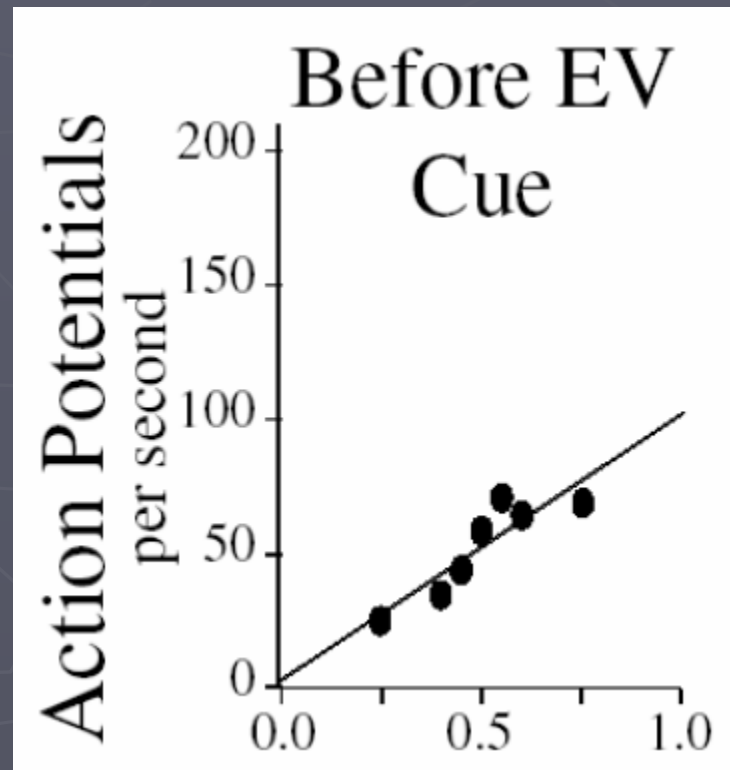


- ▶ I. Support for rational-choice models
 - Expected-value neurons (Glimcher)
 - “Monkey shopping” satisfies GARP (Chen et al)
- ▶ II: Support for behavioral alternatives
 - Loss-aversion in monkey shopping
 - Ambiguity vs. risk (Knight, Ellsberg)
- ▶ III: New concepts
 - Equilibrium as a “state of mind”
- ▶ IV: *Causing* behavior
 - Oxytocin and trust
 - Dual process models: Tempt the doer, overload the planner

Cingulate (yellow), orbitofrontal (pink),
amygdala (orange), somatosensory (green),
insula (purple)



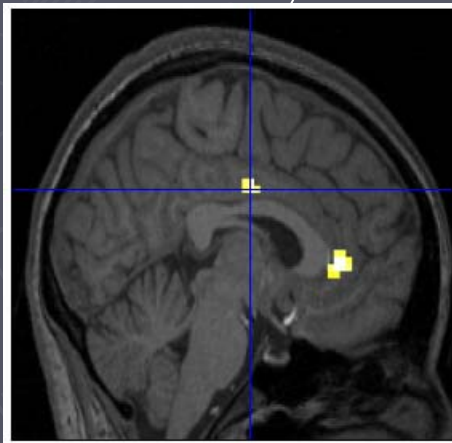
Neuron firing rates (y axis) encode expected value (x-axis) (Glimcher)



Design goal: Link *stimuli* with *unobserved* parametric processes/variables with *circuitry*

Experiment

		Your Payoffs				Player Z's Payoffs			
		AA	BB	CC	DD	AA	BB	CC	DD
A	76	25	x	x	93	12	x	x	
B	43	74	x	x	40	62	x	x	
C	94	59	x	x	16	37	x	x	
D	x	x	x	x	x	x	x	x	



0-step thinking
1-step thinking
Equilibrium $C = br(B)$
 $w(\text{red}) - P(\text{red})$

Real World Questions

The high temperature in New York City, NY on November 7, 2003, is above 50 Fahrenheit.

\$ 10

Or

\$ 3

The high temperature in Dushanbe, Tajikstan on November 7, 2003, is above 50 Fahrenheit.

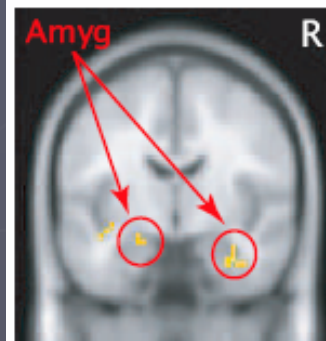
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Or

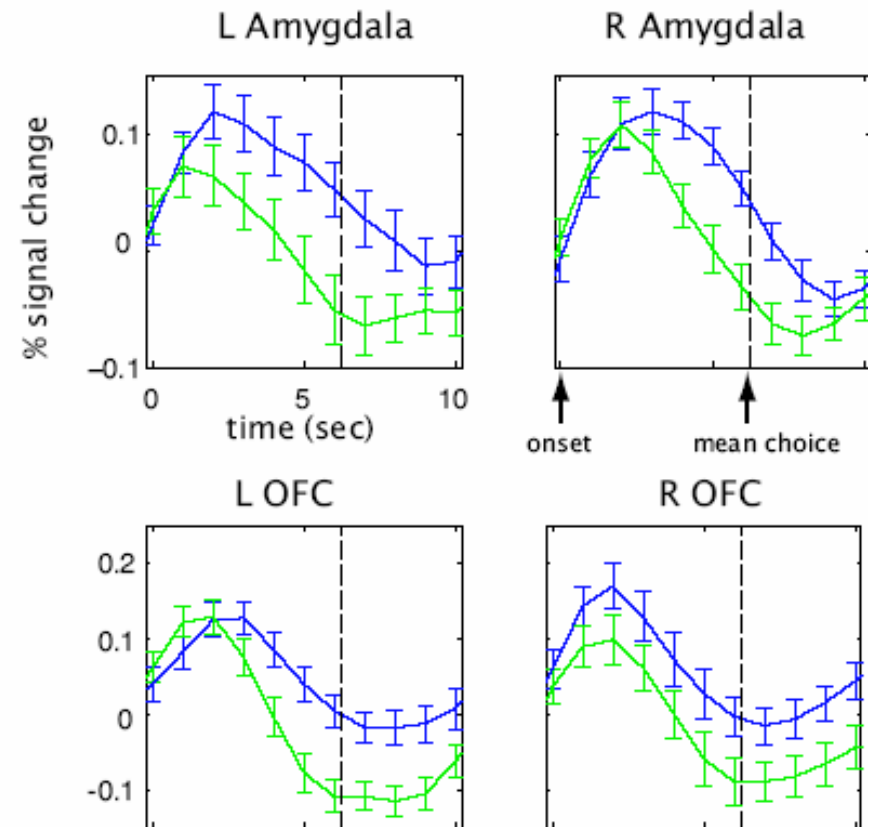
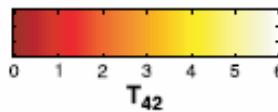
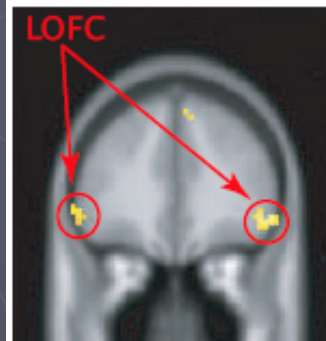
\$ 3

Differential activation ambiguity > risk

▶ Activity in amygdala →



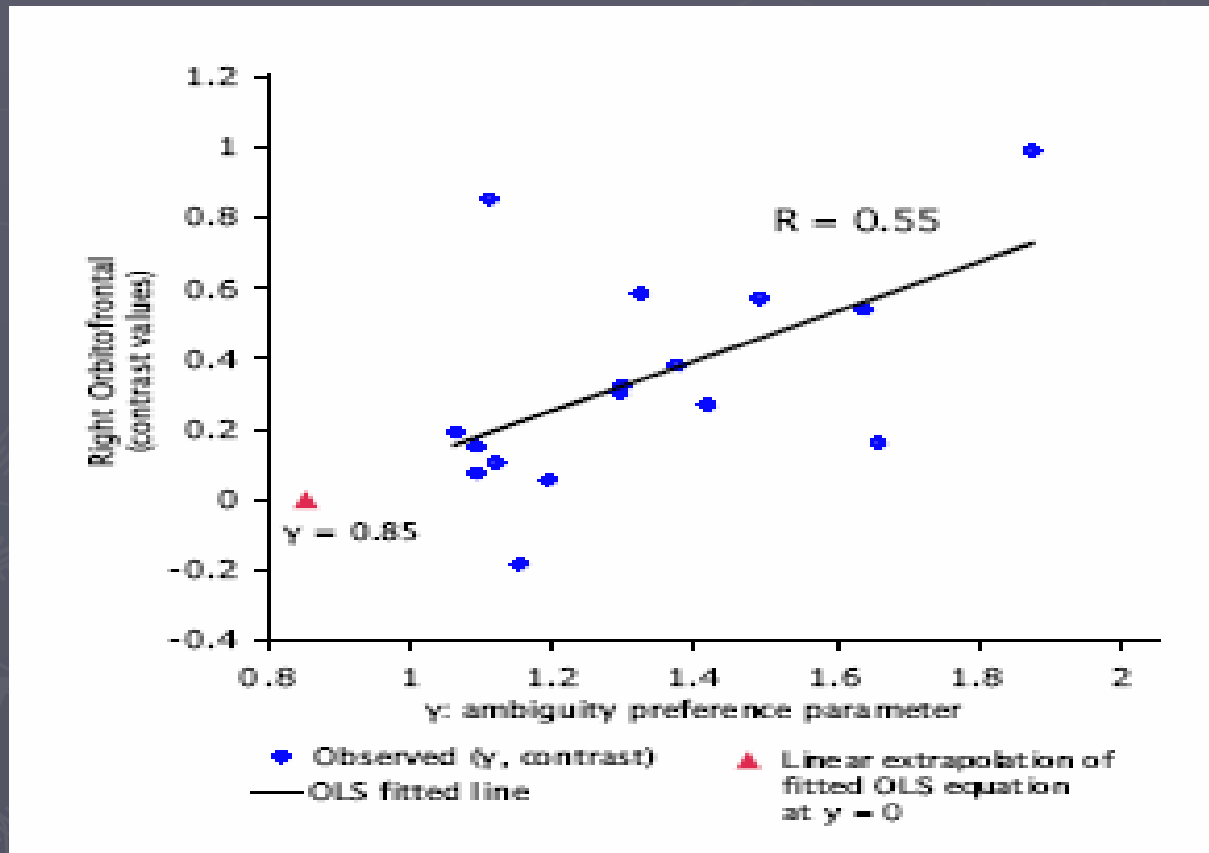
▶ Activity in bilateral OFC →



Parametric measurement of risk- and ambiguity-aversion

- ▶ Measure ambiguity aversion by $w(\text{red})=P(\text{red})^\gamma$
 - $\gamma > 1$ ambiguity-aversion, $\gamma = 1$ neutrality
- ▶ Measure risk-aversion by $u(x)=x^\rho$
 - $\rho < 1$ risk-aversion, $\rho = 1$ neutrality
- ▶ Estimate with logit “softmax” model
 - $P(\text{bet } \$10 \text{ red} > x) = 1 / (1 + \exp[\lambda * [x^\rho - \$10^\rho P(\text{red})^\gamma]])$

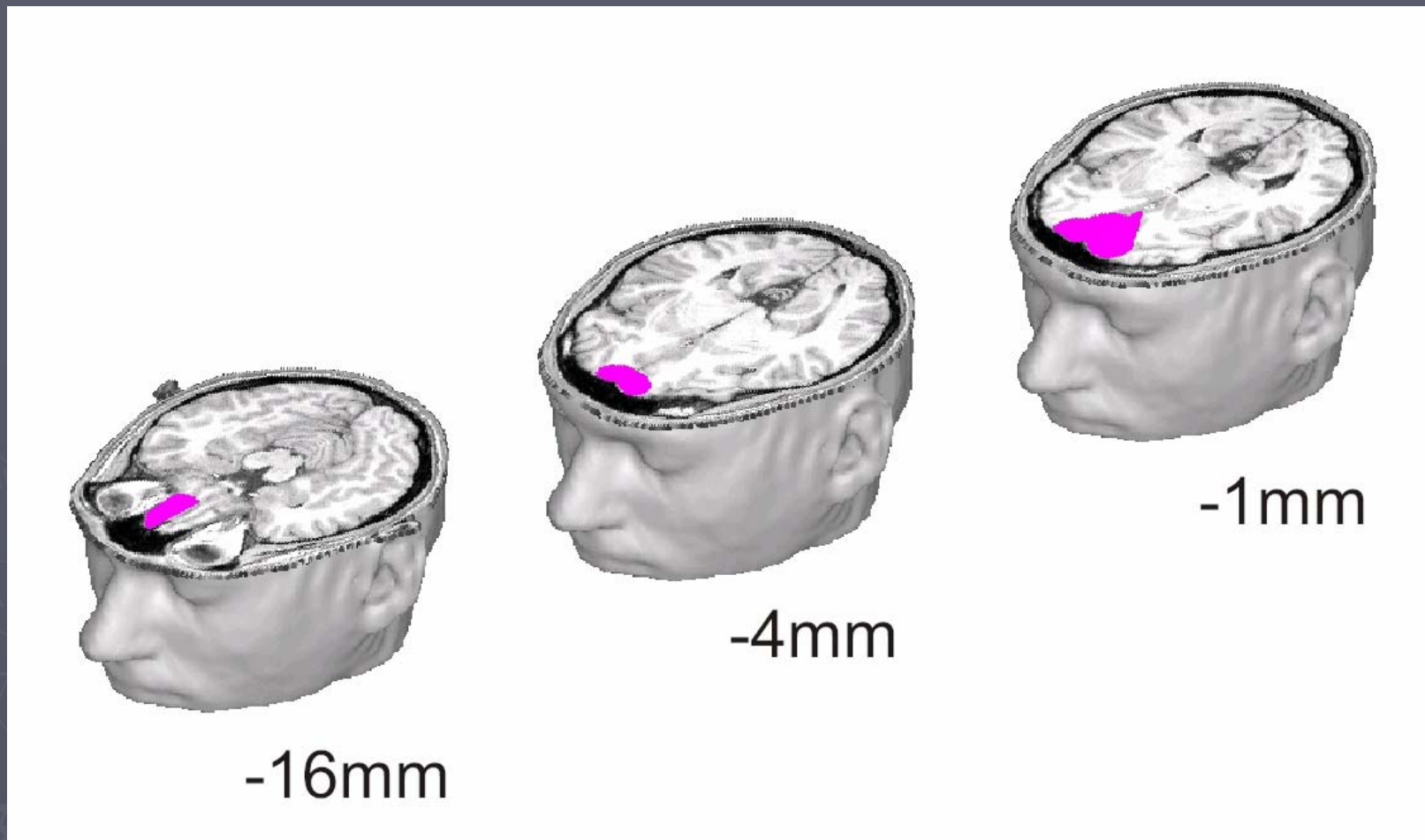
Correlation of estimated ambiguity-aversion across subjects (γ , x-axis) with ROFC activation



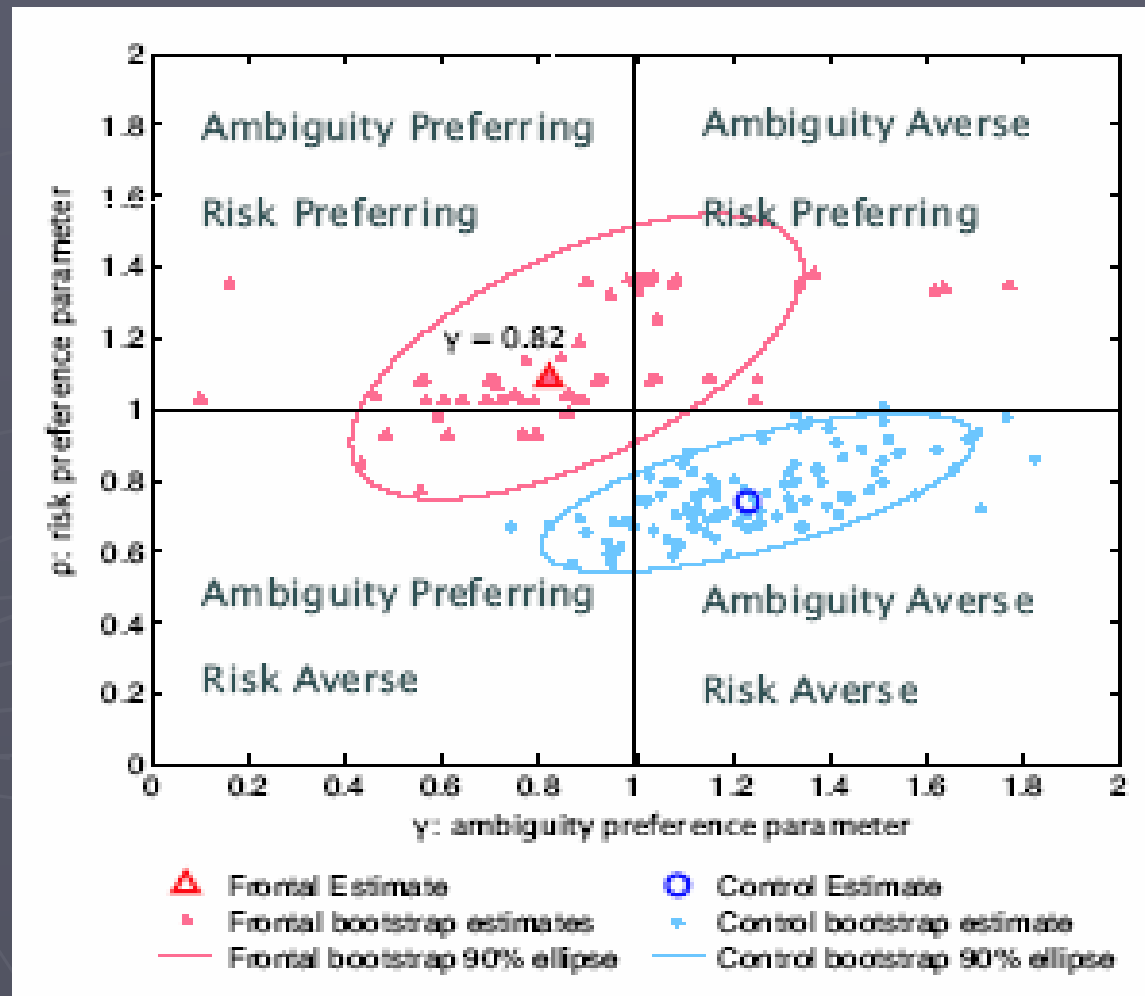
OFC lesions (picture from Coricelli, Sirigu et al, Science 04)

Patients are ambiguity-neutral (n=4 only)

Guess: They are not receiving emotional discomfort from insula



Risk- and ambiguity-aversion in Iowa lesion patients: Frontal damage linked to risk- and ambiguity-neutrality



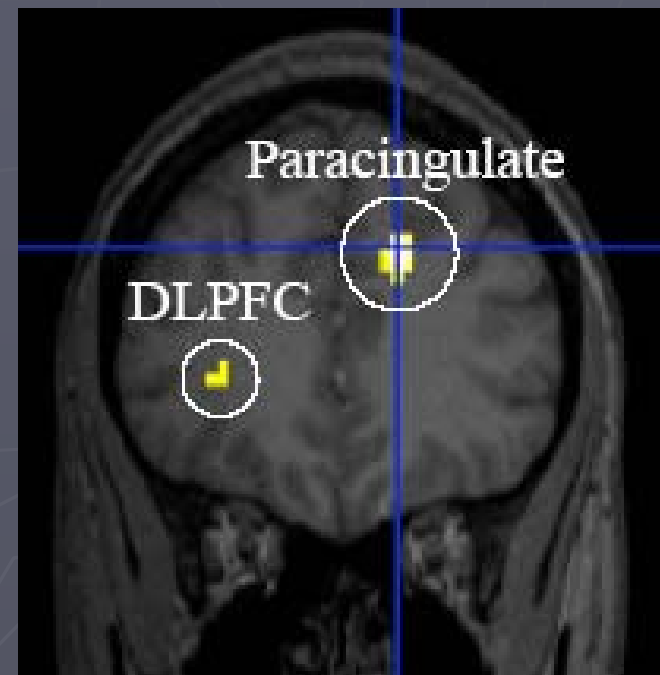
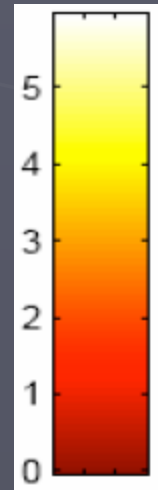
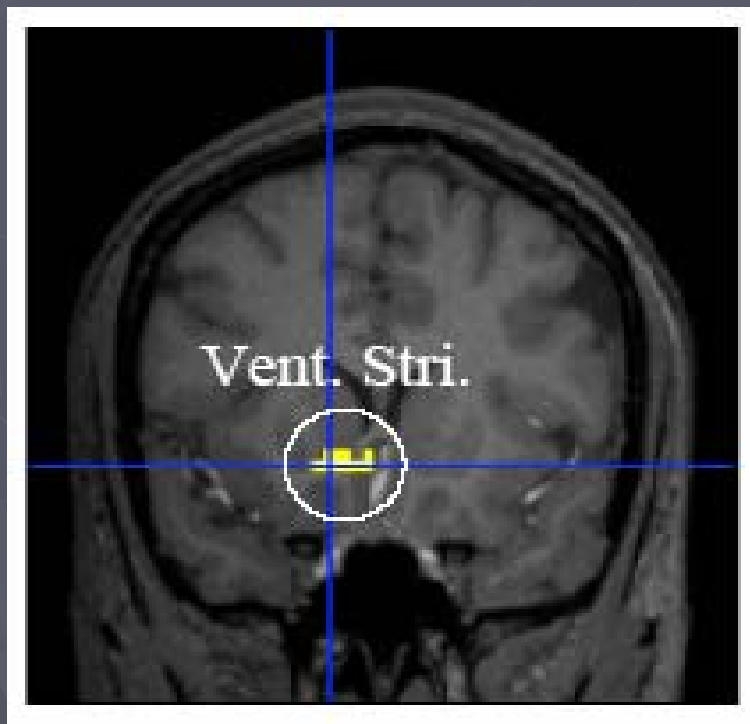
Example: 1-step (easy) game; B dominates A. L-R payoff separation allows "eye tracking"

	Player 1's Payoffs				Player 2's Payoffs			
	AA	BB	CC	DD	AA	BB	CC	DD
A	21	62	x	x	41	88	x	x
B	45	74	x	x	74	47	x	x
C	x	x	x	x	x	x	x	x
D	x	x	x	x	x	x	x	x

Equilibrium is a state of mind:

Expected reward
(in equilibrium ↓)

theory of mind +
(↓ out-of-equilibrium)



Causing behavior

- ▶ Why do we care about understanding neural mechanisms?
 - Neural mechanisms imply different comparative statics
 - Rational choice: Prices, budget constraints
 - Neuro: Emotions, state variables matter
 - Example: social bonding → oxytocin...
Does oxytocin → trust? Yes (Kostfeld et al 05)
 - Example: Does shock fear increase ambiguity-aversion? Don't know yet...

Dual process models and behavior change

► One system is like an internal constraint

Shefrin-Thaler 81	planner	doer
Bernheim-Rangel 05	cold state	hot state
Benhabib-Bisin 05	controlled	automatic
Loewenstein-O'D 05	deliberative	affective
Fudenberg-Levine 04	long-run	short-run
Brocas-Castillo 05	principal	agent

► Can change behavior by tying up resources of the planner, tempting the doer

Tying up the planner: Shiv and Fedorikhin (1999, J Consumer Res)

- ▶ Planner processing resources manipulated by having people keep a 2-digit or 7-digit number in mind as they walk from one room to another
- ▶ On the way, subjects face choice between piece of cake or fruit salad

Processing burden	% cake
Low (remember 2 digits)	37%
High (remember 7 digits)	59%

Reference-dependence and loss-aversion

- ▶ A kink at point of reference $\frac{\mu'_-(0)}{\mu'_+(0)} \equiv \lambda > 1$
- ▶ Psychophysics: more sensitive to downward change
- ▶ Empirics I: First-order risk-aversion for small gambles
- ▶ Evolutionary: Creates defense of territory
- ▶ Neural: Separate gain-loss areas
- ▶ Empirics II: $\lambda \approx 2$ in many different studies

Loss-aversion requires “decision isolation”:

Utility from consumption in 210 periods (Chua-Camerer 04)

