How Theory Can Inform Experiments (and vice-versa)

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Economic Science Association
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Experiment

Play

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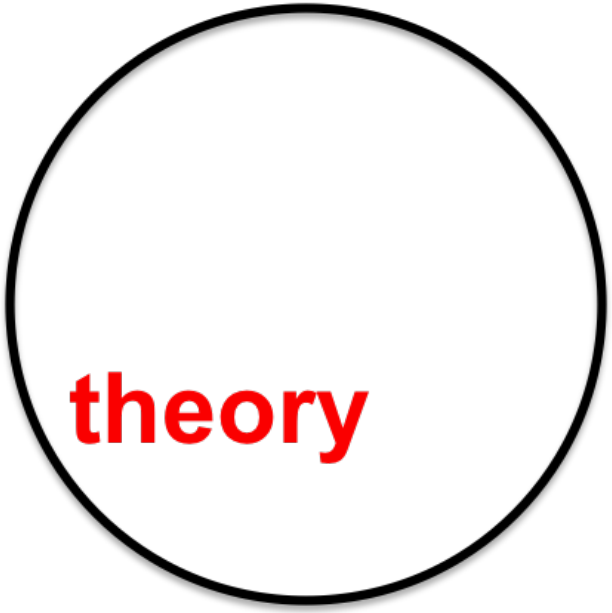
- I'll conduct a helicopter tour, touching down just once or twice on each of the main continents.

Theory



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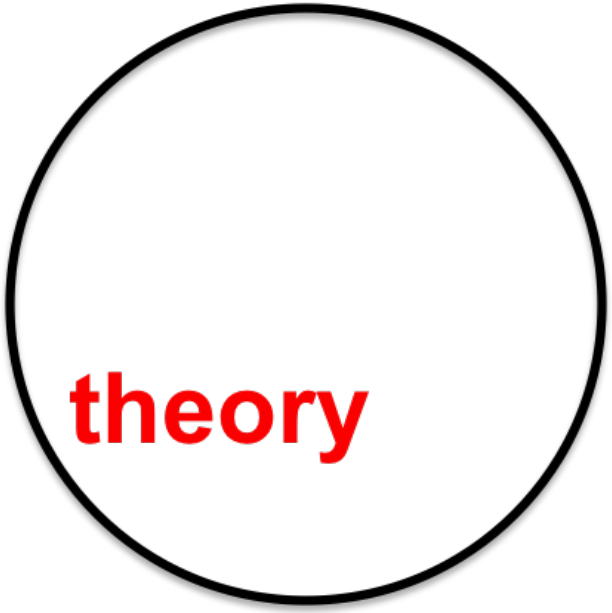

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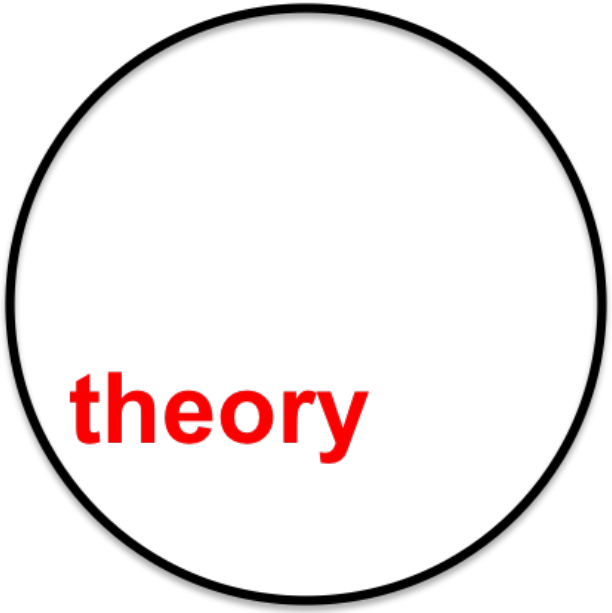

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- Left to itself, theory tends to build gossamer bridges to nowhere.

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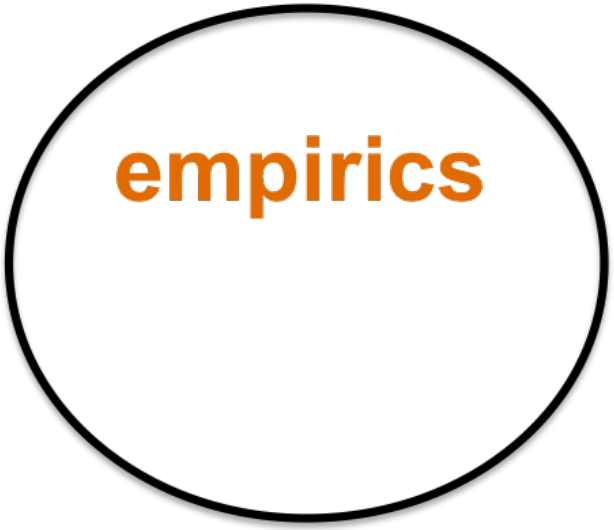
- Left to itself, empirics wanders aimlessly in the swamp.



The Engine

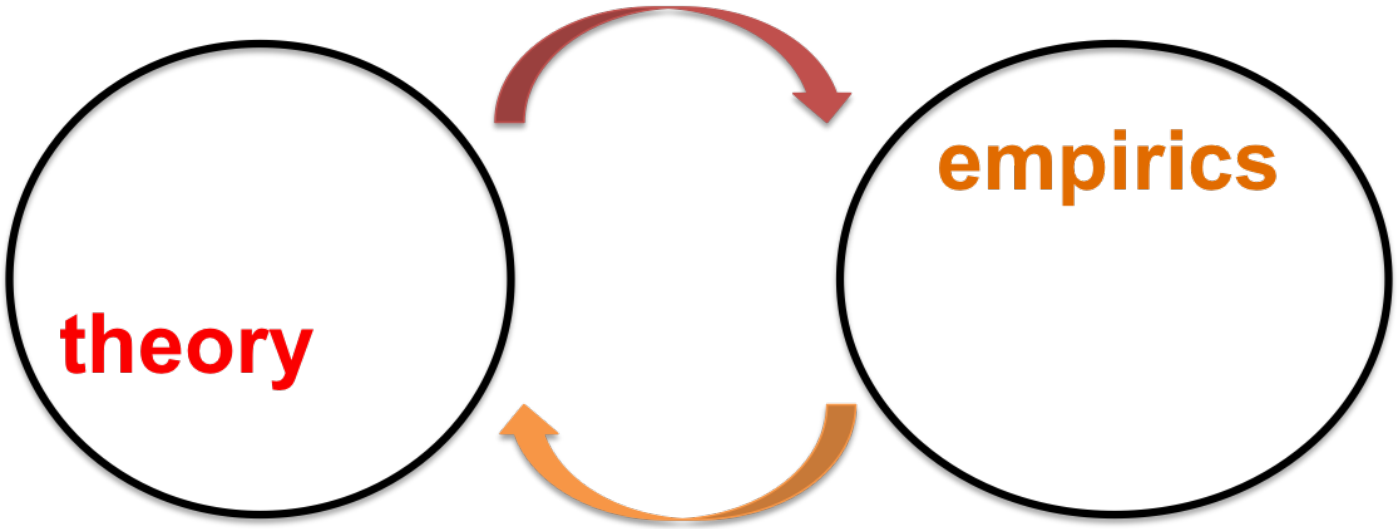


Figure: aka Cycle of Creative Destruction (Al Roth), aka scientific hermeneutics, ...

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- The interplay of theory and empirics propels science forward.

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- My own first encounter was with Vernon Smith's work on markets.
- CE was the core theory of economics for over a century, but did not seem conducive to experiments.
  - Key primitives of the theory, preferences and beliefs, seemed unobservable;
  - even observing production functions seemed problematic.

Lab Markets

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- Now one could check convergence over time and as number of B, S increased.

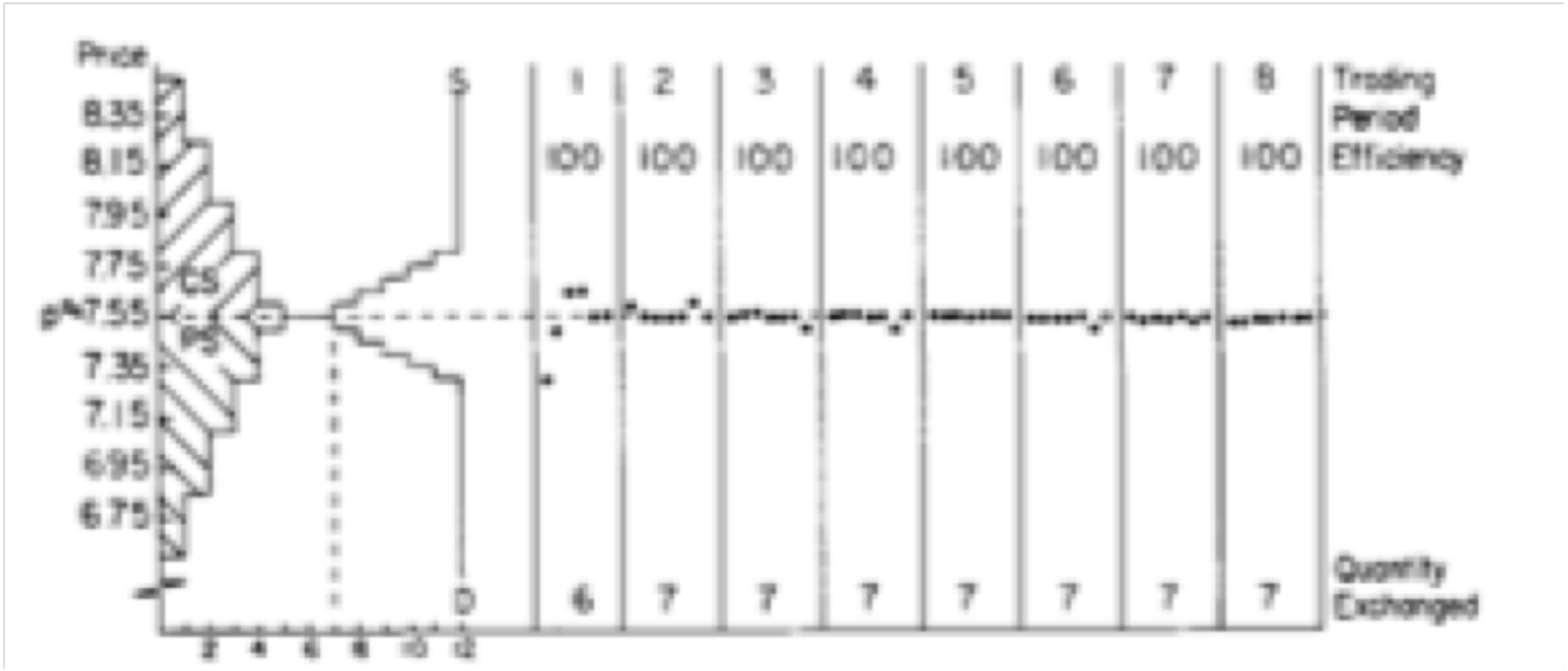

Figure: From Smith, *Economic Inquiry* 1982: A scientific mystery in the making.

Lab Markets Results

- Shocking results: reliably got quick convergence even with as few as 3B+3S.
- Smith and later investigators found that this extends rather broadly, to odd S/D configs, to some asset markets, to other market trading formats e.g., Call and PO , ...

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- vice-versa: Why not $\sqrt{n}$?? A scientific mystery.

The engine turns

- Smith proposed excess rent dynamic, but it doesn't solve the mystery.
- New theories of CDA convergence proposed in 1980s by Easley & Ledyard, by me, by Wilson, by Gjerstad & Dickhaut; and on CMs by Sattertwaite & Williams, ...

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- We still await a full solution of the mystery, but see my 1995 EJ paper with Ostroy for 2 turns of the engine, drilling into Bertrand competition within period.
- Now market design is the hot spot here; cross-fertilized by different tradition (Gale-Shapley; Al Roth).

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- Tests go back to late 1940s, e.g. Estes' 2 lightbulb guesses and "probability matching."
- K-T Prospect Theory (like a raft of other non-EUTs) summarizes many (ir)regularities; with 5 or more free parameters it fits lots more data than Ew or EUT;
- A problem with both EUT and PT is that fitted parameters don't seem stable across tasks (or even frames). An underexplored frontier for experimenters.

Social Preferences: Distributional

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- One way to rationalize: expand the object-of-choice set to entire allocations, e.g., income distributions.
- In late 1990s, Bolton & Ockenfels, and Fehr & Schmidt developed testable models of distributional preferences. (Charness & Rabin straddle).
- But maybe such preferences are misspecified? After all, Ss don't treat random strangers the same way outside the lab, and numerous studies show that Ss are far more generous with generous first movers than with greedy first movers.

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- X = Gjerstad (GEB, 2007) fits reciprocity sensitivity (a), convexity (α) parameters, plus 2 or 3 others to capture individual idiosyncrasies, etc.
- Get fairly consistent fits across existing experiments.

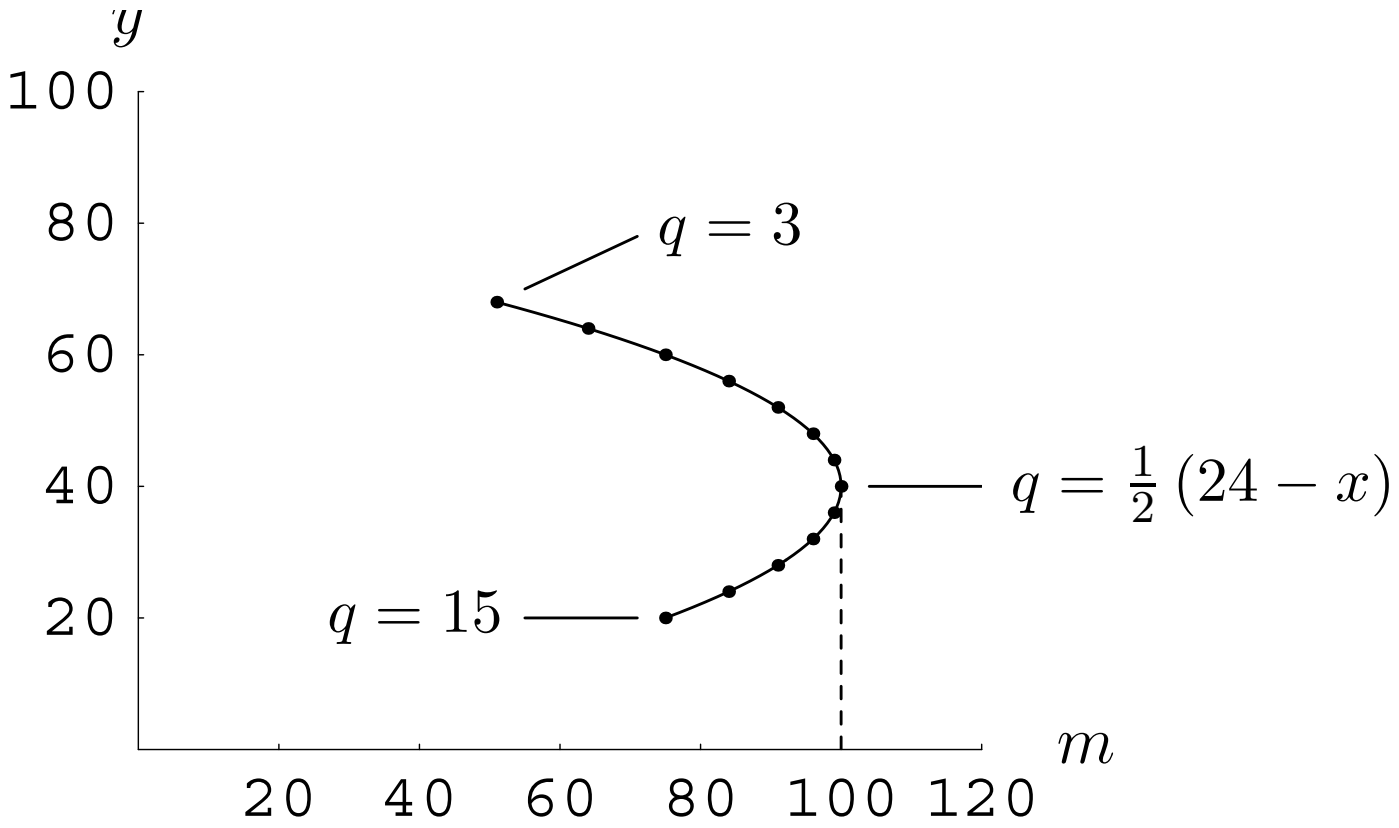

Figure: Feasible Stackelberg joint profits when first mover output is x=4.

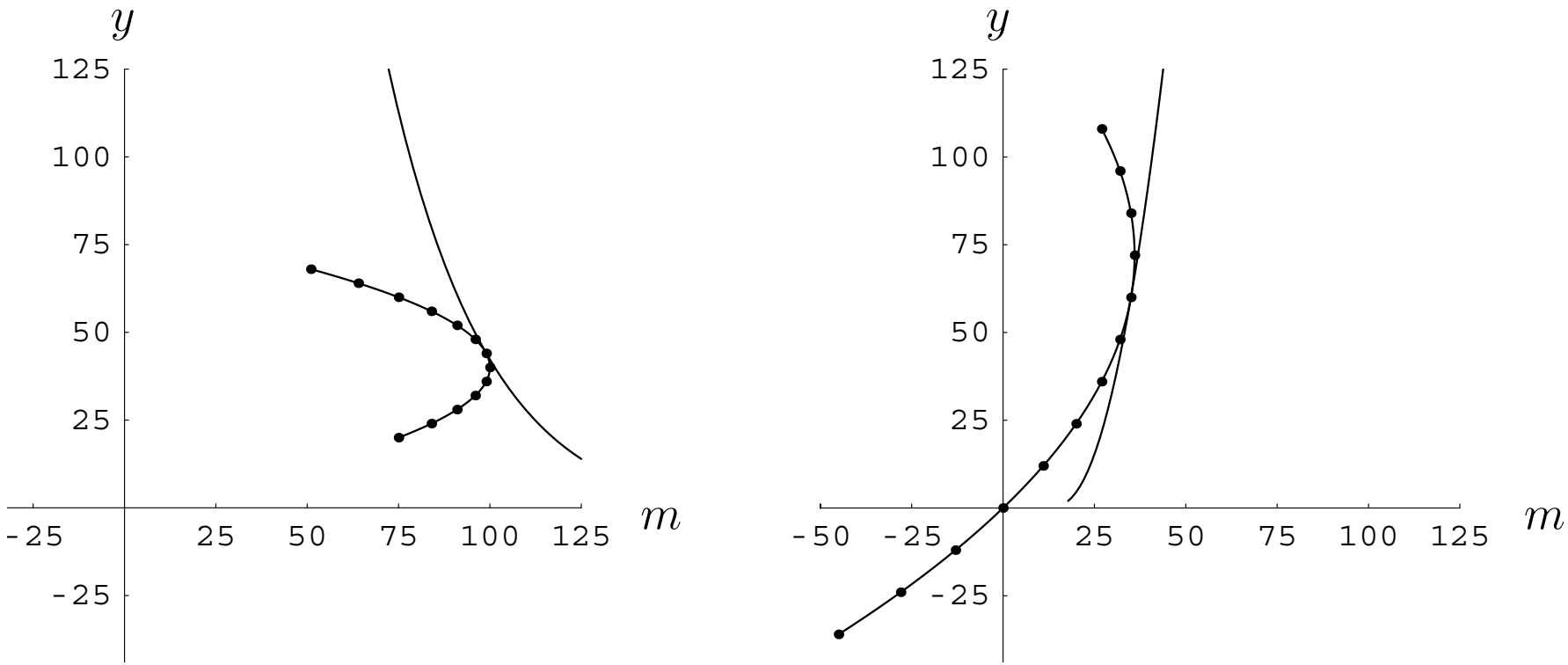

Figure: Feasible Stackelberg joint profits and contingent preferences when x=4, 12. Note endogenous heteroskedasticity.

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  - Emotional states in equilibrium?

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- I'll talk about 2 remaining puzzles today, and recent progress from my lab.

Puzzle 1: Finite Horizon Prisoner's Dilemma

- Selten & Stoecker (1986) show that unravelling occurs but doesn't go very far. Why?
- Gang4 motivated by lab results, but doesn't actually predict observed behavior (Cooper et al., 1996).

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- Gang4 motivated by lab results, but doesn't actually predict observed behavior (Cooper et al., 1996).
- Two hints from theory:
  - Nash defined Grim strategies in 1952, noted that they are an equilibrium in the infinitely repeated game and "very nearly" an equilibrium in finitely repeated game.
  - Radner (1986) noted that Grim is epsilon dominant among cutoff strategies.

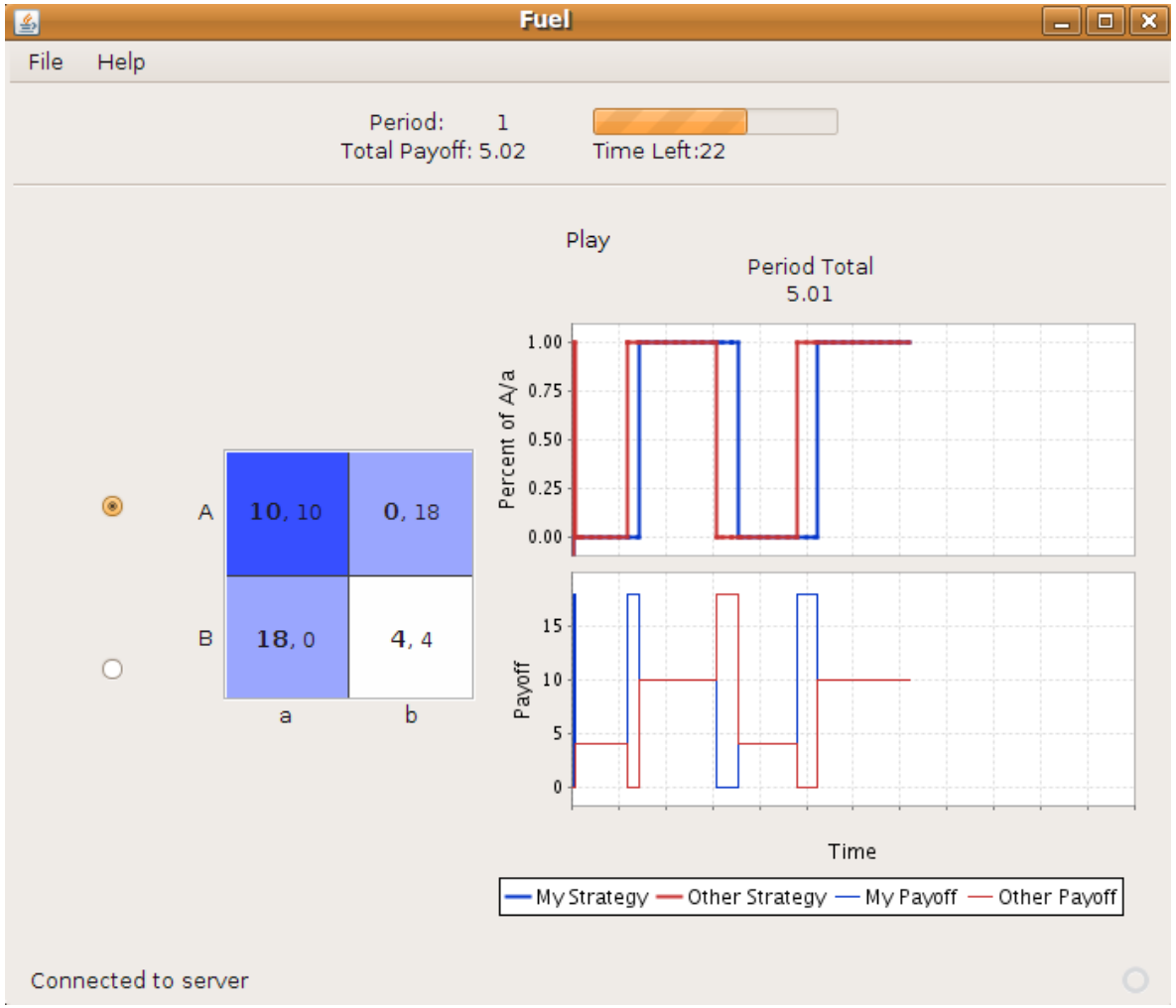

Figure: Continuous time PD. 60 second pairings, Med-a parameters.

Continuous time PD: results

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- Often see "a little flurry of aggressiveness at the end and perhaps a few sallies, to test the opponent's mettle..."
- overall, 90%+ mutual cooperation.

Puzzle 2: Nonconvergence to interior unique NE

- Stylized fact for > 50 years; decent ex post fits by QRE, IBE, TASP, ...
- but why?? The counterintuitive logic of mixing? Biased learning? something else?

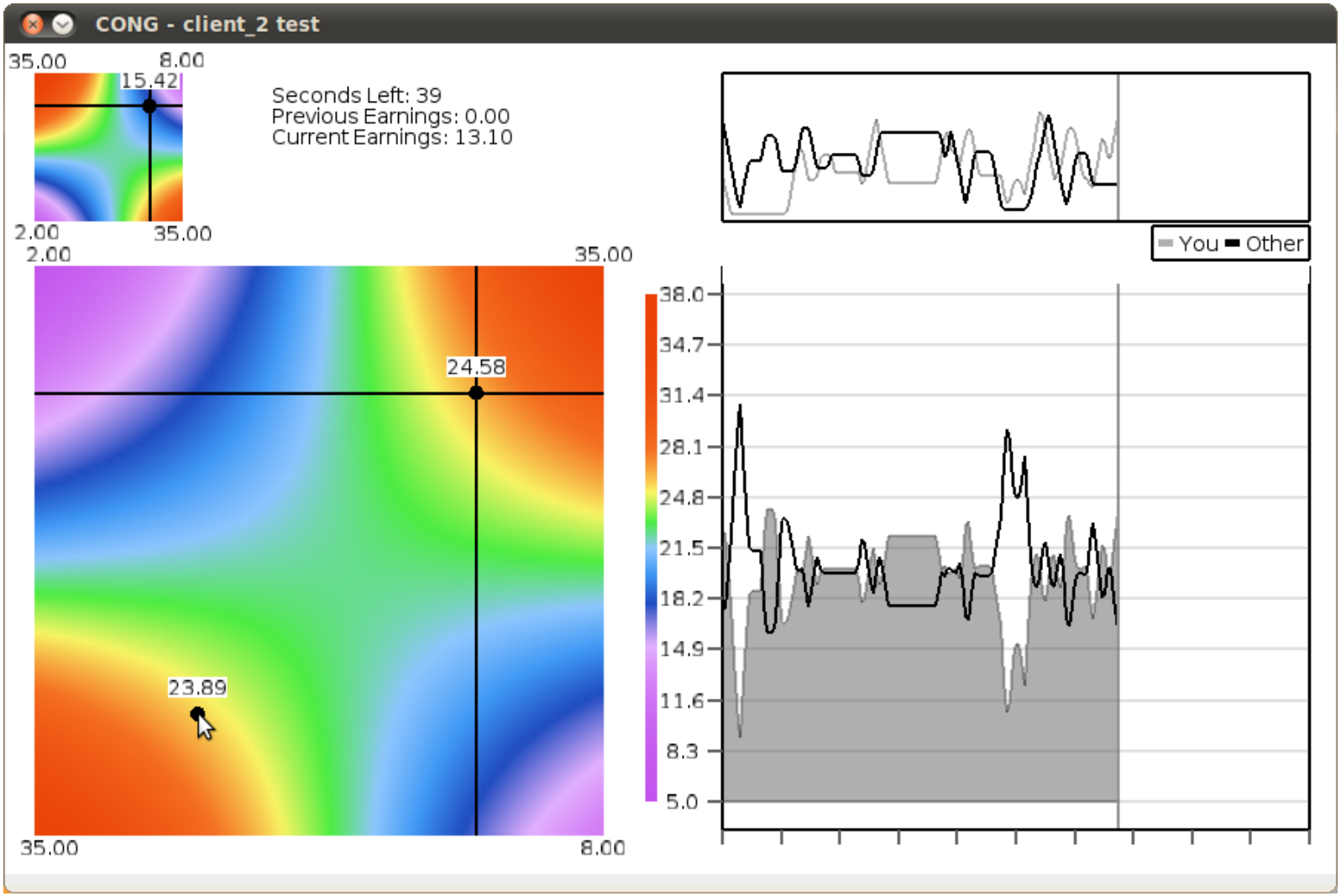


Figure: Heatmaps represent a payoff bimatrix with unique NE. Pairings are for 120 seconds.

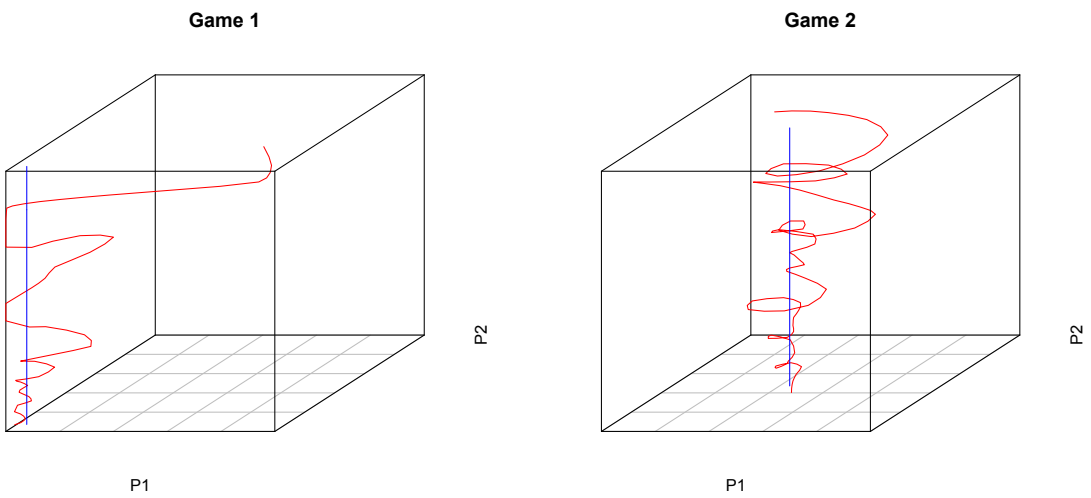


Figure: Typical pilot results hint that the problem may have been merely difficulty in mixing and inadequate learning opportunities.

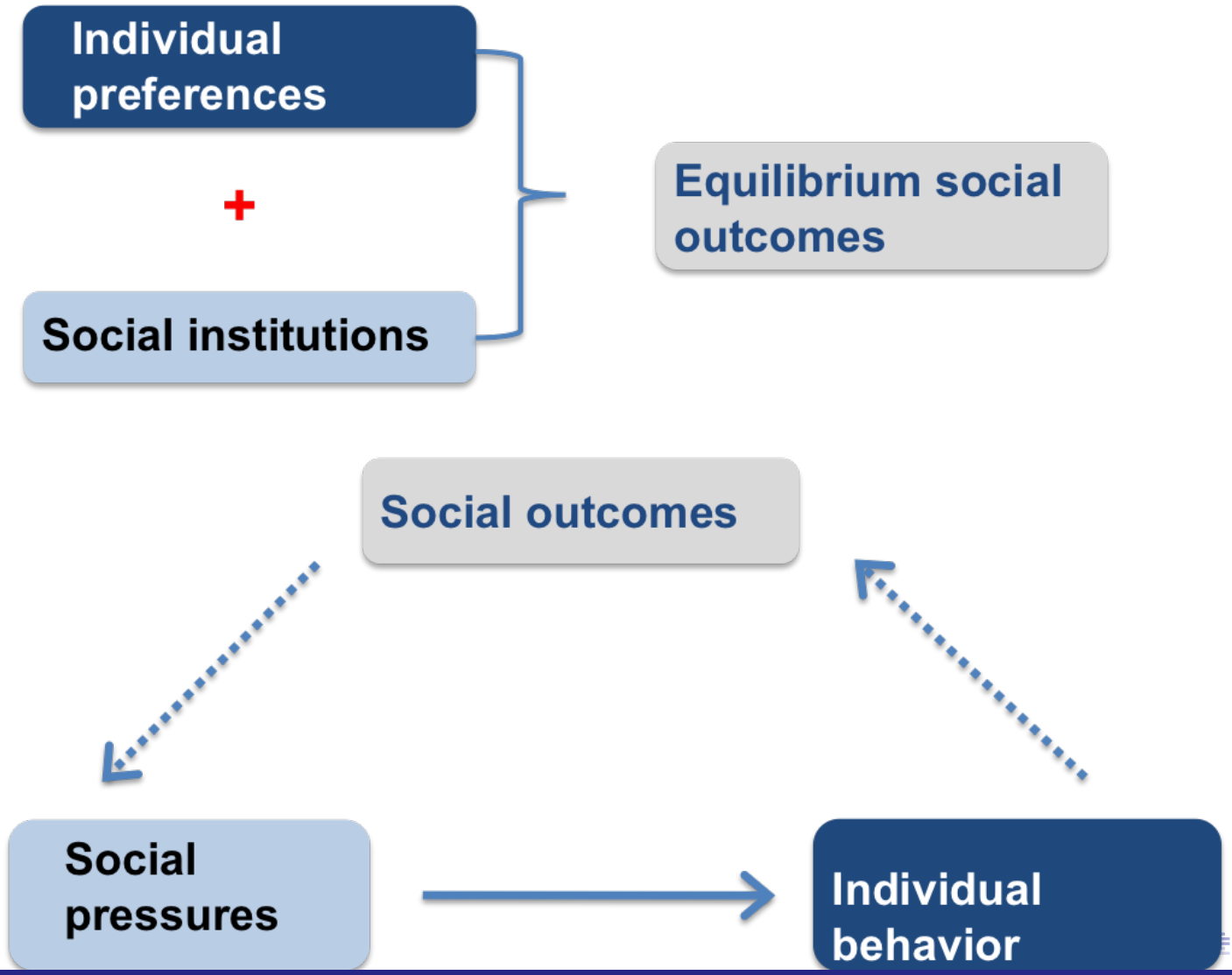
Advertisement for ConG

- Evgame theory predicts behavior for population games in continuous time; tests await.
- RPS: convergence to NE or cycles? Theories differ.
- Qwerty controversy: is there lock-in?
- Does traditional theory predict oligopoly pricing dynamics? Cournot quantity adjustment?

The Role of Theory

- Traditional hardnosed economic theory takes as given the individual primitives and the social institution (or game or market, if you will), and predicts the equilibrium outcomes.
- Cognitive and social psychologists (and a sizeable fraction of new experimental economists) use theory rather differently.

Two styles of theory



A third way

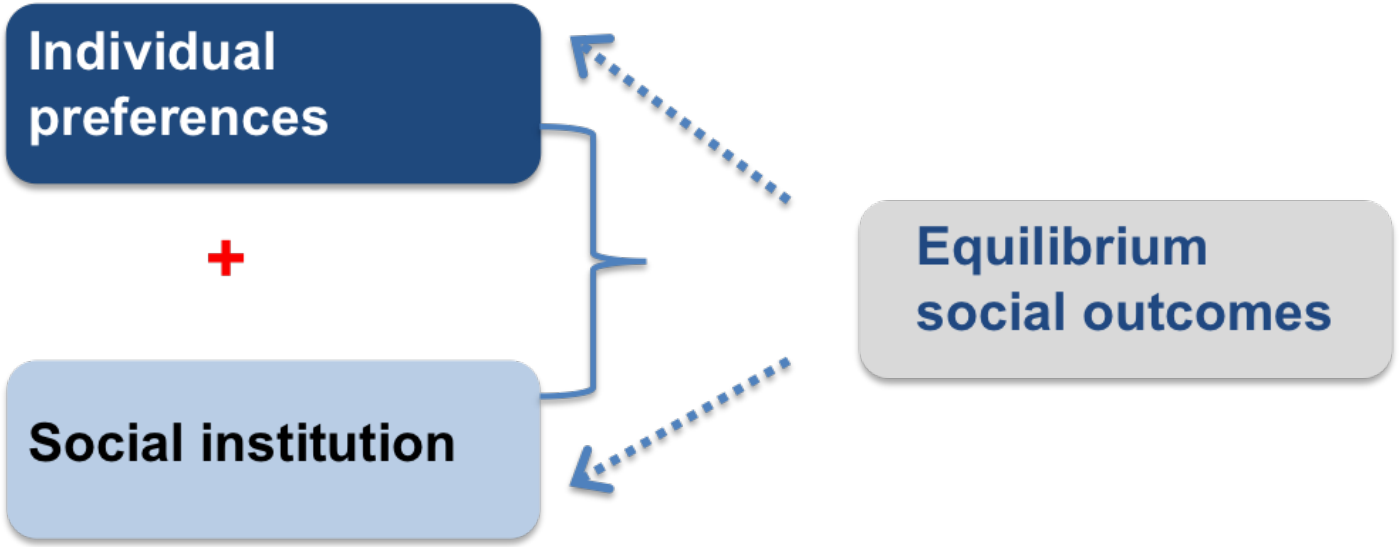


Figure: Behavior adapts in response to SR equilibrium payoffs.

Lyrics from "Experiment!" by Cole Porter, 1933.

...do what all good scientists do.
Experiment!
Make it your motto day and night.
Experiment, and it will lead you to the light.
The apple on the top of the tree is never to high to achieve
So take an example from Eve— experiment.
Be curious, though interfering friends may frown
Get furious at each attempt to hold you down.
If this advice you always employ, the future can offer you infinite joy
And merriment.
Experiment, and you'll see!