Comments on Bayesian Entrepreneurship

Todd Zenger

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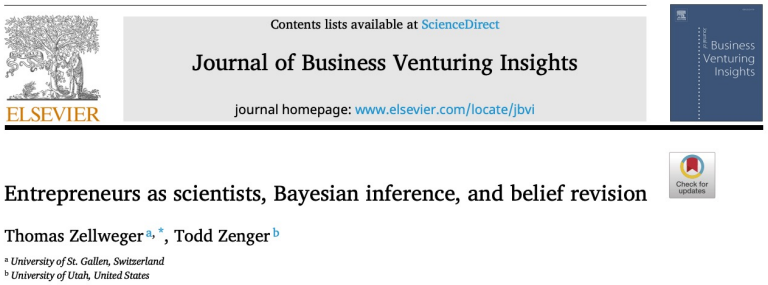
Bayesian Entrepreneurship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Entrepreneurs as scientists, Bayesian inference, and belief revision

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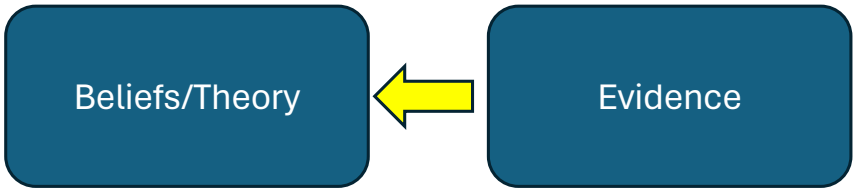
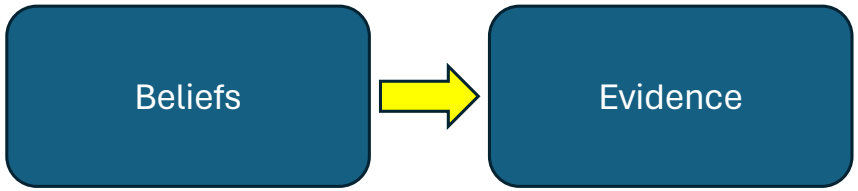
- Appreciate the effort to capture the full scope of the entrepreneurial process. Appreciate opportunity to think deeply about these issues.
- Bayesian learning is an important element of what entrepreneurs do. "The essence of Bayesian entrepreneurship lies in its iterative process of belief adjustment" (Agrawal, et al). Beliefs should match evidence and new evidence should adjust beliefs.

- Central question: Is Bayesian the right umbrella term to describe all (or the core) of what entrepreneurs do?
- A challenge: Important tenets of what is placed under the Bayesian umbrella were developed to be distinctly (or at least mostly) non-Bayesian.





The entrepreneur faces a world of vast data, and the task is to fit a model to the data. Evidence shapes beliefs, updates probabilities, with theories updated to fit data.

The entrepreneur uses causal logic to imagine a counterfactual state, about which there is at present little to no data. Must determine if this theory/logic will help achieve this counterfactual state, by using the theory to generate costly data.

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ENTREPRENEURS AS SCIENTISTS: A PRAGMATIST APPROACH TO PRODUCING VALUE OUT OF UNCERTAINTY

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ENTREPRENEURS AS THEORISTS: ON THE ORIGINS OF COLLECTIVE BELIEFS AND NOVEL STRATEGIES

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What do (should) entrepreneurs do?

- Use causal logic to form a contrarian belief about a future state--one counter to present facts in which an identified problem is solved.

- Engage in experimentation, Bayesian learning, belief revision, and, when necessary, theory replacement to elevate confidence in a theory to a level that justifies and garners the resources necessary to allow a full test.
- Observation: the belief formation, learning, and theory revision process necessarily involves learning from very sparse data.

Learning with little data: Causal theories as the cheat code

- Causally constructed theories enable learning from limited data
- Griffiths and Tenenbaum (2009):
  - “causal induction from small samples can be explained as the result of a combination of strong constraints from relatively sophisticated causal theories with statistical inference.”
  - “No conventional statistical recipe or computer learning algorithm can compete with a child’s capacity to discover the causal structure underlying everyday experience…”

Causal theories are what accelerate learning, especially in data starved settings

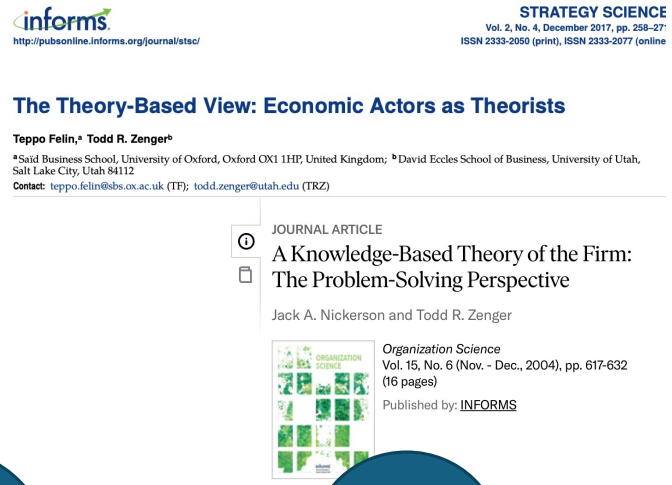
Bayesian networks to causal models: not a trivial shift

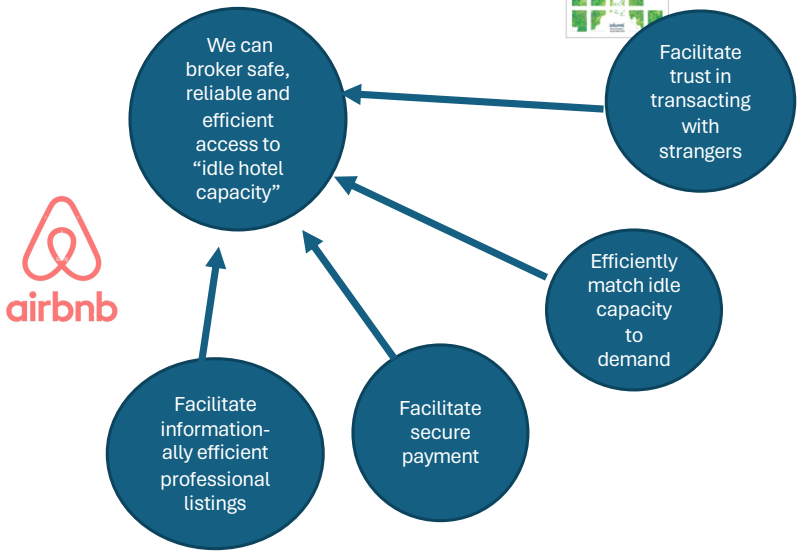
- In 1991, it suddenly hit me that all the difficulties would vanish if we made Y a function of its parent variables…At the time it seemed like heresy … I can still remember my student at the time …asking incredulously, “Deterministic equations? Truly deterministic?” It was as if Steve Jobs had just told him to buy a PC instead of a Mac.
  - Judea Pearl, *The Book of Why*

What's an entrepreneurial theory?

- A system of conditional beliefs or assumptions that are jointly sufficient to solve a problem.

If these four sub-problems are solved (or assumptions can be made true), then magic happens – the larger problem is solved



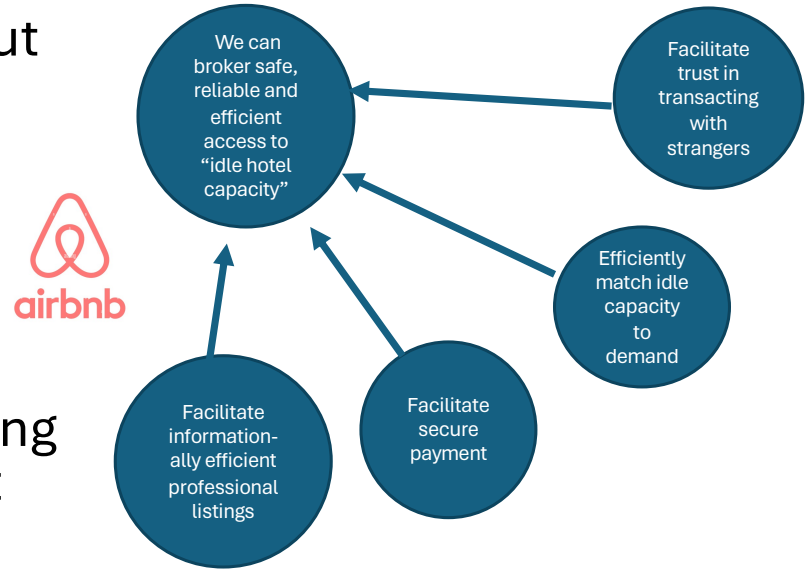


Theories guide testing and data gathering

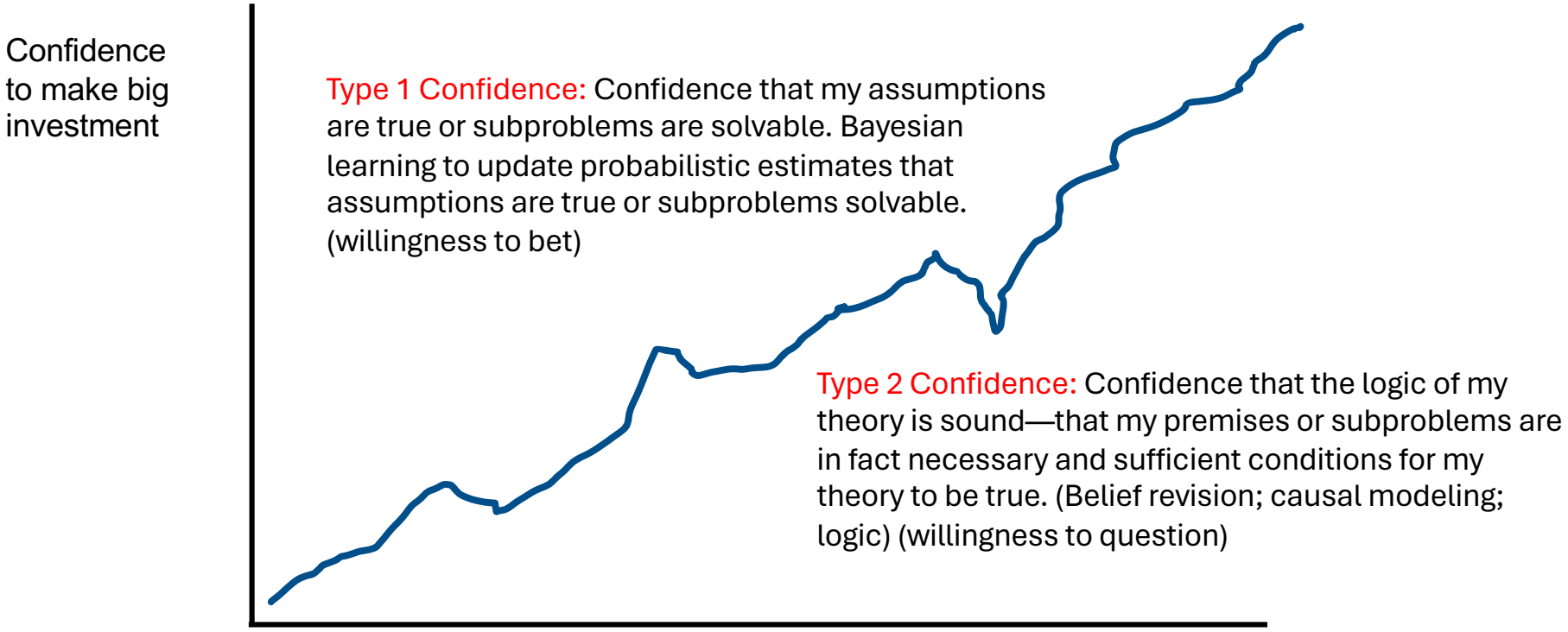
An effective theory identifies assumptions to test, experiments to run, data to gather, and provides the backdrop by which to recognize surprises.

- Causal logic often untestable without testing the whole thing, essentially launching the business

- Assumptions and subproblems are likely to be testable in the present using Bayesian learning. Start with weakest premise.

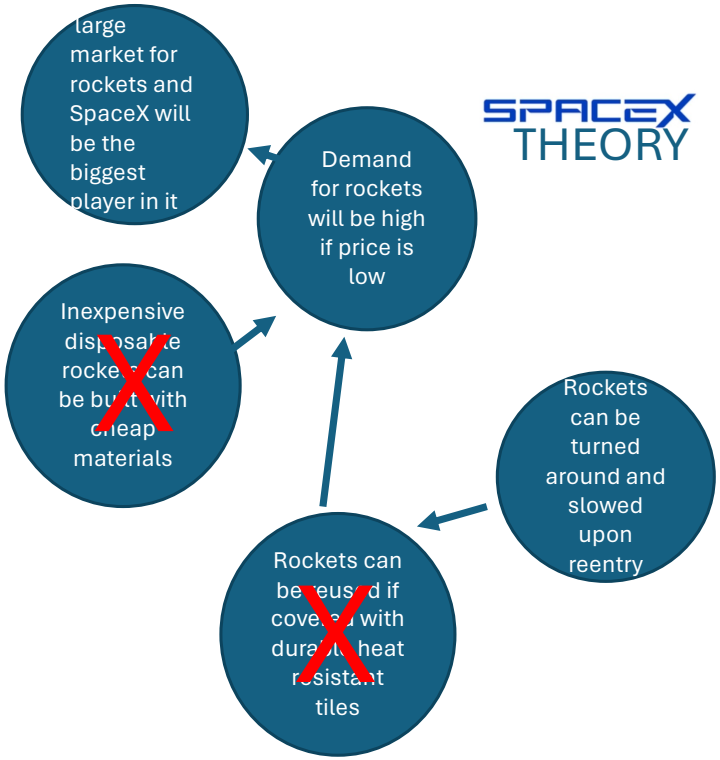


Entrepreneurial learning as seeking to gain confidence in a theory's usefulness

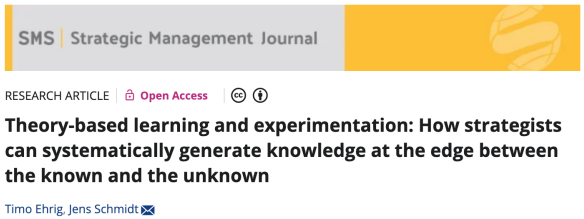


Ehrig and Zenger, 2024, Strategic Learning

Not just searching across models, but within (Belief revision)



Pivoting within a theory, replacing premises, rather than pivoting among theories or searching across theories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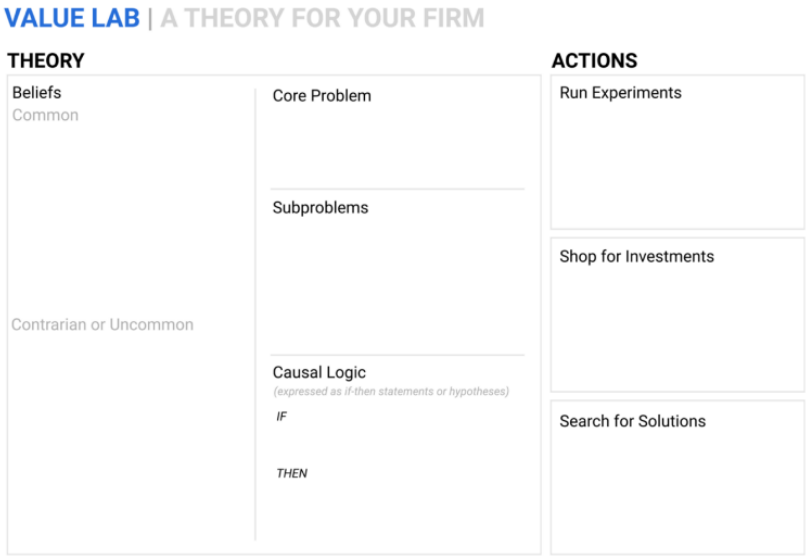
Theory-based learning and experimentation: How strategists can systematically generate knowledge at the edge between the known and the unknown

Timo Ehrig, Jens Schmidt

Carlos Alchourrón, Peter Gärdenfors, and David Makinson (1985)

Most helpful intervention…push causal logic

- Don’t just envision a future state wherein a problem is solved, but help people craft the causal logic of how to achieve this state!



Felin, Gambardella, Zenger, 2021, MBR

Messy connection between theory and data

- “an action … once taken impacts the world in a way that changes the context for future actions. This modification of the context means that the action taken under uncertainty—the experiment or ‘treatment’—is not repeatable.” (Levinthal and Adner, 2024)

HEISENBERG EFFECTS IN EXPERIMENTS ON BUSINESS IDEAS

Orie Shelef
Robert Wuebker
Jay B. Barney

Learning from surprises

- "One good reason for running an experiment or for spending one's time just observing phenomena closely is that you may be surprised. The best things that come out of experiments are things that we did not expect to come out—especially those that we couldn't even have imagined in advance as possibilities." (Herbert Simon, 1989 – The Scientist as a Problem Solver)
- A distinctly non-Bayesian process

Modeling the Change of Paradigm:
Non-Bayesian Reactions to Unexpected News[†]

By Pietro Ortoleva*

Bayes' rule has two well-known limitations: 1) it does not model the reaction to zero-probability events; 2) a sizable empirical evidence documents systematic violations of it. We characterize axiomatically an alternative updating rule, the Hypothesis Testing model. According to it, the agent follows Bayes' rule if she receives information to which she assigned a probability above a threshold. Otherwise, she looks at a prior over priors, updates it using Bayes' rule for second-order priors, and chooses the prior to which the updated prior over priors assigns the highest likelihood. We also present an application to equilibrium refinement in game theory. (*JEL* D11, D81, D83)

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"Ultimately, our aim is not to determine whether entrepreneurs are or are not strict Bayesians, but rather to provide a pragmatic theory—a theory for use—one that elevates the value creating capacity of entrepreneurs."

Bayesian vs. Scientific? Help the entrepreneur find, build and gain confidence in theories sufficient to garner the resources required to fully test their causal logic (launch the business), and to do this through a rational process (Bayesian updating, theory composition, belief revision)

Thank you

Causal theories as the entrepreneur's cheat code

Griffiths and Tenenbaum (2009)

- "people can infer causal relationship from samples too small for any statistical test to produce significant results…"
- People "can solve problems like inferring hidden causal structure that still pose a major challenge for statisticians and computer scientists."
- "No conventional statistical recipe or computer learning algorithm can compete with a child's capacity to discover the causal structure underlying everyday experience…"