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# The Epistemological Basis of Stable Links

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# Research Motivation

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- Searching for a network theory to predict network change over time
- According to Monge & Contractor (2003), we can use...
  - Network at previous points in time
  - Endogenous variables
  - Exogenous variables
- Seeking empirical markers that “track the health” or stability of links outside of their current presence/absence



# Theoretical Technique



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- Use Evolutionary Theory (Campbell, 1965; Darwin, 1859)
  - Most general theory of change
  - Consistent rationale across levels
    - If pressure is not addressed at one level, it must be addressed at another
- Procedure
  1. Identify generalized selection pressures working against maintaining links -- what makes them unhealthy or unstable?
  2. What must nodes do if they are to overcome these pressures (what are the critical “resources” for links)?
  3. Can we measure the indicators of these overcoming strategies?
- Metaphorical example..
  - Since animals must eat
  - Measure their health by
    - observing success of food acquisition
    - Measuring food in the environment



# Evolutionary Epistemology



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- Since communication brings knowledge, the evolutionary pressures act via epistemology
- Evolutionary Epistemology (Campbell, 1965; Popper, 1972; Toulmin, 1958)
  1. Study of the adaptation, selection and retention of “fit beliefs”
    - approximations of reality that reduce chance of organism’s demise (Popper, 1972)
  2. New beliefs can be formed via the recombination of existing beliefs in arguments (Toulmin, 1958)
    - The potential implications via combination of a set of beliefs is not obvious and therefore not “redundant” (Savage, 1954)
  3. Recombination activities are arranged in a hierarchy -- more certain beliefs are “premises” for less certain “expectations”
    - updating process must admit of variation and selection at more than one level (Campbell, 1965)
    - Relative burden of overturning higher levels is higher



# Communication links and knowledge



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## Basic Assumptions...


- To survive in a network where nodes must make appropriate decisions, nodes need accurate, relevant information
  - Must have specific implications (be informative) -- judged by ego
  - Bearing on nodal decisions (be relevant) -- judged by ego
  - That reflect reality (be accurate) -- judged by environment
- Communication from other nodes provide *claims*, not knowledge (Toulmin, 1958)
- Nodes convert claims into knowledge via the application of *tests*
- Nodes survive on the basis of the quality of their testing procedures

## Stable Links occur when...(Monge, Heiss, & Margolin, 2008)


- Nodes that hold them survive
- Alters avoid failing ego's tests

## Consequences of unfit links

- Irrelevant and uninformative links are unstable (vis-à-vis ego)
- Inaccurate links lead to ego's demise



# Thus, stability should be associated with the “availability” of tests



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- A potential measure of stability that is not purely based on history or inertia

So ....

- What constrains or provides resources for reliable tests?
  - Independent observations
  - Independently tested rules/laws/principles (Popper, 1934)
- What constrains or provides resources for relevant, informative tests?
  - Search space of all potential observations (March & Simon, 1958)
  - Search space of all potentially applicable rules/laws/principles

# Trade-off Between Algorithmic and Adaptive Sources of Information



A

B

## Algorithmic:

- Test results (obs) can be parsed from existing expectations (control for the algorithm)
- Ego must search for relevant and informative tests

## Adaptive:

- Alter (B) can be relevant and informative, but only by taking into account ego's (A) existing expectations (some error correlation)



# Example



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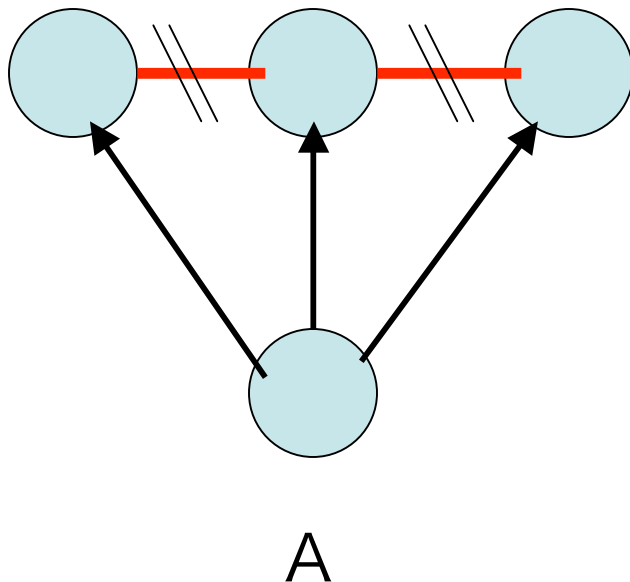
- Mortgage loans -- rating a borrower
- Algorithmic: Computer spits out a credit score that may or may not be informative and relevant; not adapted to the trends in loan-making
- Adaptive: Moody's provides a debt rating that "takes into account" "relevant" economic and fiscal information based on judgment of how the rating will be used
  - How does a lender evaluate Moody's "judgment" given that it is *supposed* to change



# Correlated Error -- Structural Strategy



- According to the theory, stable links will be associated with a nodal strategy for mitigating correlated error...
- Structural strategy:



- Must have at least 3 nodes for every knowledge domain (to break ties -- Berelson & Steiner, 1964)
- No transitive ties allowed
- Not a general solution
  - Highly asymmetric
  - “k-star” is not a dominant network form (Robins et al, 2007)



# Correlated Error -- Rules/Principles Strategy



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- If nodes do not use the structural strategy, what is an alternative
  - Just as node A may hold an understanding of the algorithm of the telescope, A and B can hold a set of shared principles that each assumes the other relies on
  - B uses the principles to make the claim relevant and informative
  - A uses the principles to form tests by hypothesizing antecedents and deducing implications from the claim...



# Correlated Error -- Independent Content



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- Some of these implications are *redundant* with B's calculation of relevance and informativeness because they rely on the same principles....
- But, if there are a *sufficient number* of independent implications, A is relatively safe.
  - There is more information B “would have had to take into account”
  - A can assume that some portion of these testable implications are independent, so picking a few at random produces a reasonable likelihood of validity



# Example



- If Moody's is looking for "bad credit risks" this could be wholly accounted for by relevance
- If Moody's identifies independent characteristics of risk, and the bank knows what these are..
- Bank can hold Moody's "accountable" to these principles (Lerner & Tetlock, 1999)
  - If rating is inconsistent with principles, Moody's loses credibility
  - If rating is consistent with principles, rating is probably ok



# Empirical Markings



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- The number of independent implications deducible from a set of theoretical principles is called the “empirical content” of the theory (Popper, 1972)
- Can we observe empirical content within a dyad?
- Looking for a specific kind of homophily
  - Shared attributes (principles) that are *cohesive*, *restrictive*, but *non-redundant* (not mutually informative)
- Looking for discursive markings of principle building, sharing and rejecting

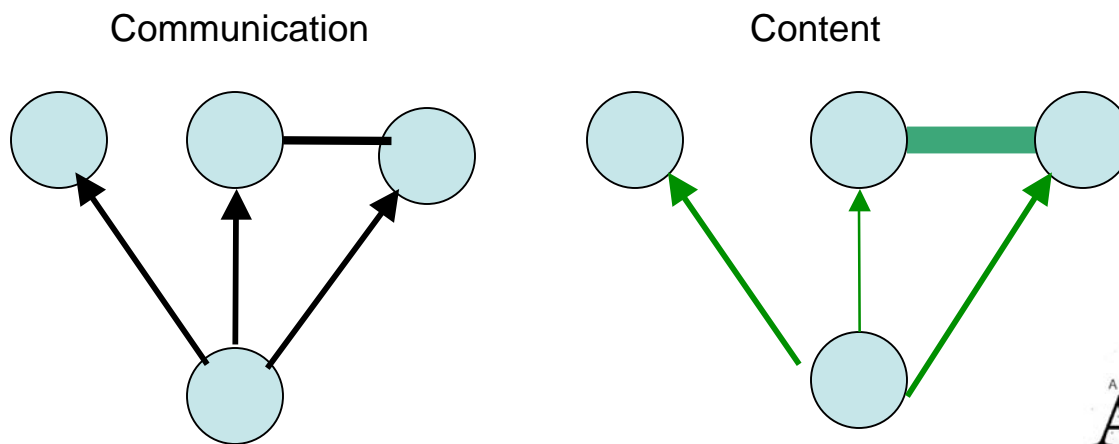
# If we can identify dyadic content and structural strategies to reduce correlated error...

... then we can map two networks

1. Communication network
2. Correlated Errors

Made from content network and structure of communication network

- Where these match, particularly in large clusters, links are *unstable*
  - Small environmental disturbances or changes in the network may cause them to collapse





# Thank you for your time!



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