

# Categorical Social Analysis

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# Overview

- Inverse of most CT 2011 presentations
  - Application area looking to apply CT formalisms, techniques & ‘stuff’
  - Issues discussed here are likely to appear unfamiliar
  - More a description of a research program than a presentation of results
- Somewhat similarities with physics applications, but also with essential differences
  - Not a mathematically mature field
    - Mathematical models exist, but have not produced comparable insights
  - Messily empirical, but without controlled experiments
  - Theory is largely qualitative, while current formalisms oversimplify the richness of the domain
- Ergo, the rigor & expressiveness of (higher) category theory has the potential to make a unique contribution

# What can CT bring to social science?

- Expressiveness
  - An inclusive, variegated mathematical language
- Calibrated generalization: up to equivalence
  - “Recursive weakening of the notion of uniqueness” (Baez 98)
  - Anticipate a succession of equivalence
- A core representation of identity, that can be elaborated
- Natural integration with adjacent fields, including CS (ABMS)
- Recursive locality

# What might social science bring to CT?

- A domain-specific source of coherence laws (Baez 98):
  - “ ... certain puzzles point to a need for a deeper understanding of the *origin* of coherence laws.”
  - “The deeper source of coherence laws is the target domain”
- Theory generalization
  - A novel domain in which to test and extend concepts & mechanisms
- A unique focus on endogeneity
  - Analogy: transition from classical AI to MABS

# Dimensions of Social Structure

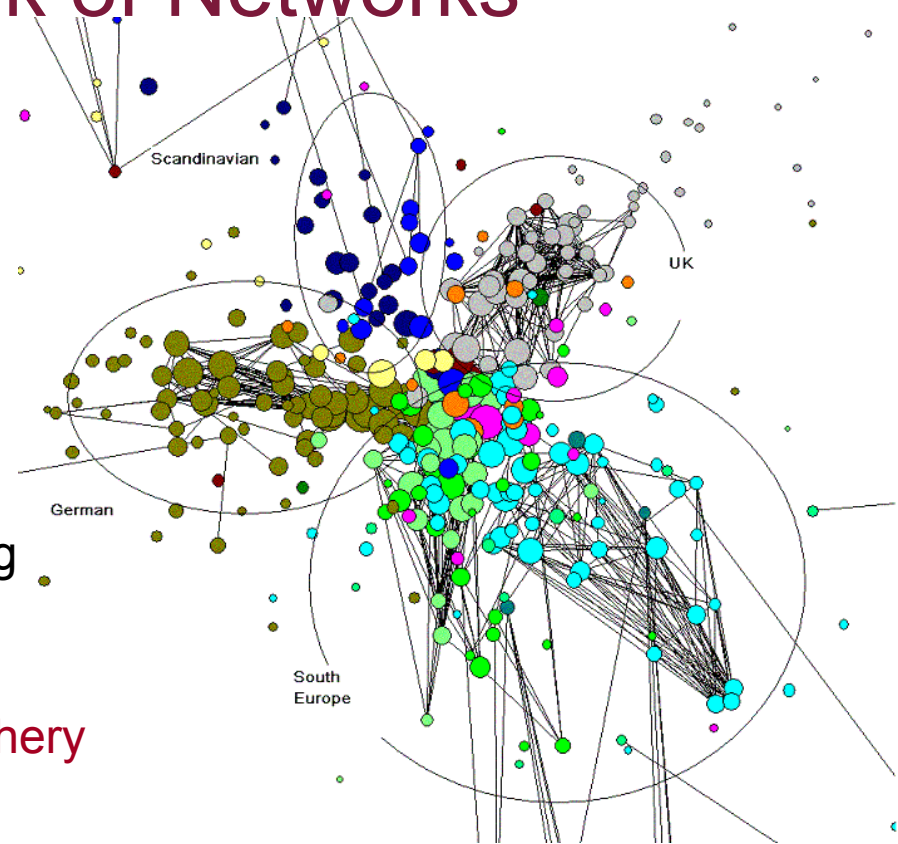
- **BioFunctional Differentiation**
    - Division of labor
    - Institutions
      - family
      - economy
      - state
      - religion
    - Roles
      - age
      - gender
      - organizational
      - capability specialization
    - Forms of cooperation
      - Evolving interdependencies
      - Unifying, differentiating
      - Diverging, converging
  - **Resource Hierarchies**
    - Class, status, party
      - deference practices
      - cattle
      - land
      - slaves
      - political office, position & influence
      - precious metals
      - symbolic shares of business ownership
      - electronic currencies
    - List not exhaustive
  - **GeoCultural Collectivities**
    - Civilization
    - Nation
    - Race & ethnicity
    - Language
    - Religion, philosophies & ideologies
    - Cultural traditions, rituals & practices
    - Spreads geographically
      - genetic inheritance
      - contagion
      - diffusion
      - imitation
      - learning
      - conversion
      - migration
      - conquest
- Candidate morphisms

# Cultural Components & Processes

- **Culture & Cultural Resources**
  - Practice, ritual, concepts, narratives, logics, communicative artifacts
  - **Modernity**: contradictory, loosely integrated, contested, weakly bounded, thinly coherent
- **Endogeneity of Collective Identities**
  - Multi-scale clusters of emotional attachments
  - Dynamic reconfiguration of roles, symbols and attachments
- **Multiple Interacting Discourses**
  - Cultures & identities as orienting constructs, discursively organized
  - Both are protean, fragile and diffuse
- **GeoCultural Markers**
  - Civilization
  - Nation
  - Race & ethnicity
  - Language
  - Religion, philosophies & ideologies
  - Cultural traditions, rituals & practices

# Culture as a Network of Networks

- Modeling the fine-grain basis of culture
  - Breiger notes the rich interrelationship between networks and culture
- Endogenous **observers** used to create **distinctions**
- Culture as a network of distinctions
  - Distinctions create boundaries of varying sharpness and permeability
  - Distinctions produce an **inside** and an **outside**, creating a cultural **core & periphery**
  - Networks consist of **bounded relations**
    - Self-similarity, complementary roles
    - More **coherent** than the larger world
- Culture can be viewed as a recursive network of communication and meaning



# Networks, Exogenous/Endogenous

- Structure, culture and agency all presuppose each other, but how?
- More general structure:
  - Many different kinds of groups, relations & institutions can be translated into networks
- More concrete:
  - Structures can be disaggregated into their constituent elements of actor and relations
- Constraining and enabling dimensions of patterned relationships

<b>Emirbayer &amp; Goodwin</b>	
Structuralist determinism Ignores or stipulates agent intent	Formalist/reified networks Reification can be endogenous & dynamic
Structuralist instrumentalism Narrow instrumental agency	
	Calibrated/strategic networks (Hay)
Structuralist constructionism Identity conversion, robust action	
	Fluid/reflective networks (Padgett)



# Discourse Communities

- Apter & Saich propose four historical mechanisms:
  - **Retrieval** involves the creation of a mythical past
  - **Projection** is the derivation of an identified future
  - Exegetical [ideational, ritualistic] **bonding** as a form of discipline
  - **Symbolic capital** as a form of power and identity
  - Such mechanisms can be generalized and focused
- Dynamic interplay of cultural resources and identities
  - **Entrepreneurial roles**
  - Creation, organization and shaping of public rituals
  - The emergence of ideal types
  - Coercive enforcement, economic reinforcement,
  - Organization, cross-articulation, evolution, reorganization
- Any nation &/or historical setting will contain dozens or hundreds of overlapping discourse communities

# Application Analogies from TQFT

- Think of any morphism  $g: A \Rightarrow B$  as a process carrying states of the system described by  $A$  to states of the system described by  $B$
- In TQFT, there is no background metric, only topology change
  - Analogous to transformations of social structure (inviting a topological mapping)
- Theories should contain no structures that affect local degrees of freedom while being unaffected by them
  - Prefer metric-free theories with local degrees of freedom propagating causally
- Composition in an  $n$ -category should satisfy equational laws only at the top level
  - Supports aggregate level validation
- The analysis should describe how a large complicated system can be built out smaller simpler one
- If we want a  $*$ -category other than **Hilb** ... we should use, not **Set**, but **Rel**
- These are general heuristics, but useful in the development of a methodology for categorial social analysis

# Propensity Networks

- Spin networks describe processes by which one spin network evolves into another
- The social analog appears to be **propensity networks**
- Propensity theory was formulated by Karl Popper as an alternate foundation (to frequentism & Bayesianism) of probability theory
- One of the strengths of propensity theory is in addressing single case causality
- Propensity measures the causal pressure exerted by certain conditions toward the realization of certain events
- They address the criteria of local degrees of freedom propagating causally

# Identifying GeoCultural Morphisms & Functors

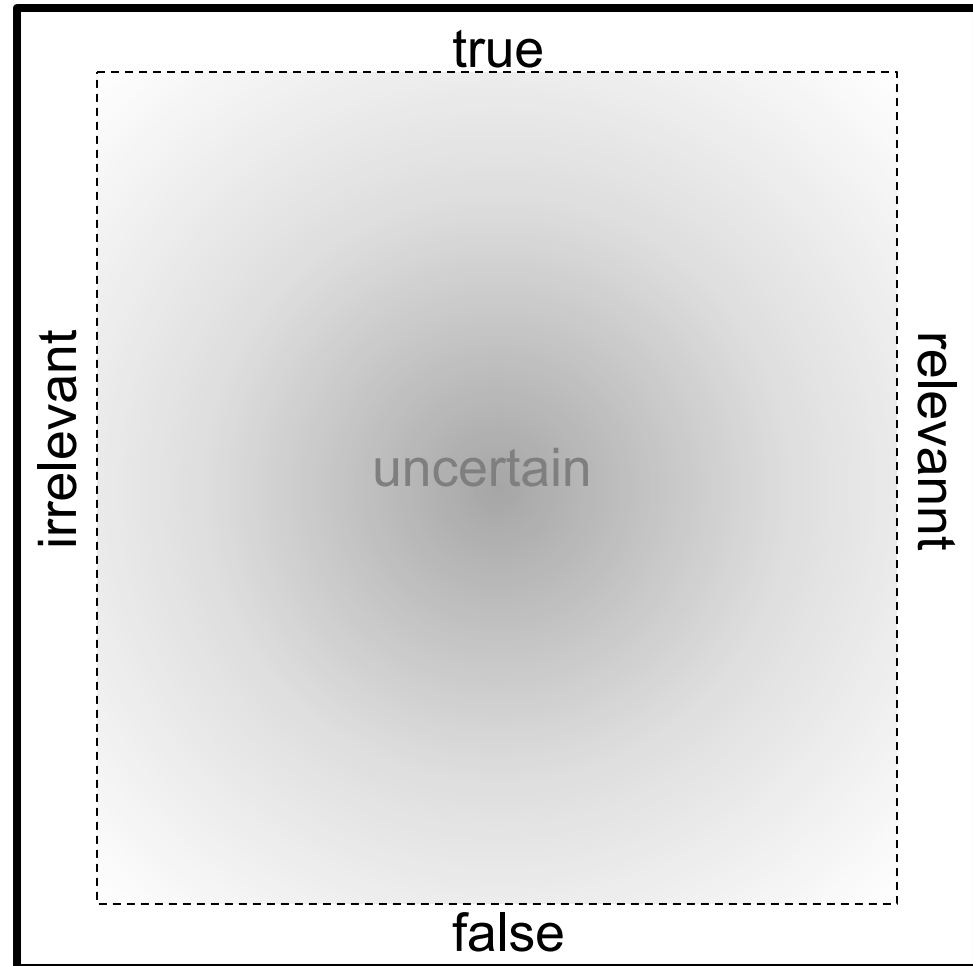
- In cultural dynamics, what travels?
  - Genetic inheritance
    - Diseases, immunities, strengths & vulnerabilities
  - Contagion
    - Emotional manias & fears
  - Imitation
    - Language, ideology, technology, structure
  - Diffusion, trade
    - Technology, innovations & skills
  - Learning, reason
    - Language, concepts, skills
  - Missions, conversion
    - Religion, ideology
  - Migration
    - People, cultures
  - Conquest
    - Peoples; structures & cultures imposed
- How does it move?
- Receptiveness of target space?
- How does it change collective orientations?
- How is receptiveness achieved?
- Relationship between migration and conquest?
- Relation among contagion, efforts at conquest and refugee emigration?
- What interdependencies and interactions can be identified?
- Can a periodic table or other systemization be constructed?

# GeoCultural Dynamics

- GeoCultural dynamics as a higher categorial social application
  - Geocultural region defined by a suitable combination of markers
  - GeoCultural morphisms & factors require a mapping from the social to the categorial domain
- What categories can most effectively represent social dynamics?
  - Candidates:
    - Set, Rel, Gpd, Actr?
    - Top, Hilb, Rel, nCob
    - MC, SMC, MCC
  - Double can blend important interaction
  - No single representation will suffice
- One approach
- Weak 2-Category levels
  - 0-cells GeoCultural region
  - 1-cells GeoCultural morphisms
  - 2-cells GeoCultural functors
- Full scale analysis will require cross-layer interaction

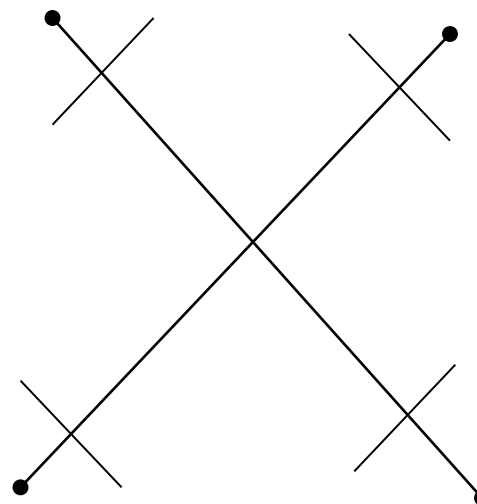
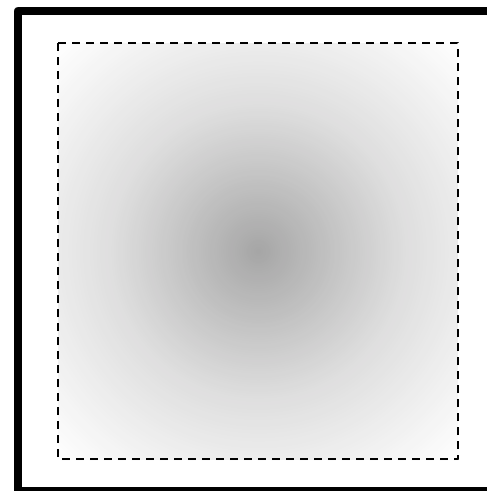
# Integrating Logics

- Core capability combines binary & probabilistic reasoning
  - Integrates distinct morphisms
- Blends integrated reasoning with ambiguity uncertainty effects
- The two-dimensional location allows calibrated action refinement



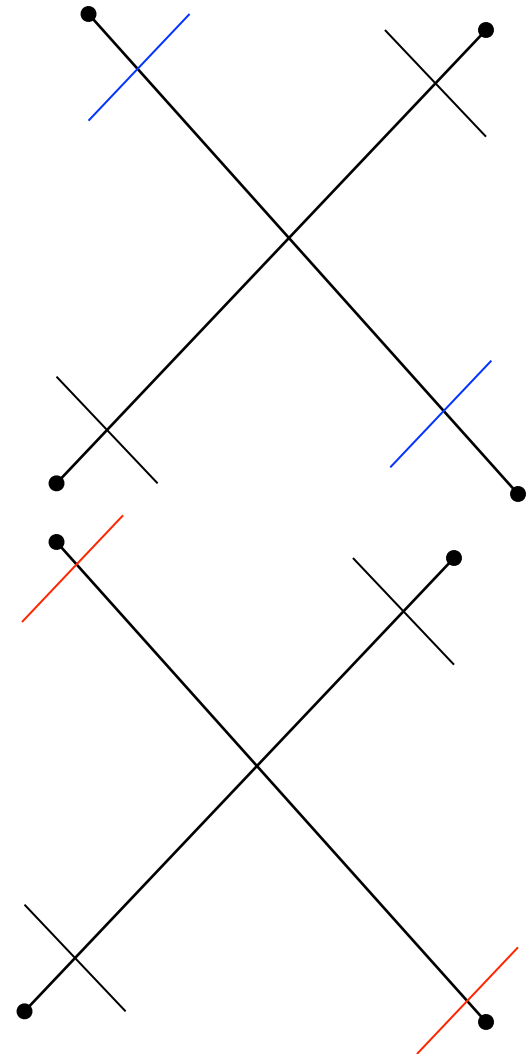
# True Collars

- The integration of probability and uncertainty does not seem to require a new category
- Collars appear to provide an effective mechanism (cf., Grandis 2007; Cheng & Gurski 2007)
- Collar based decisions
  - **0-cell**  $T_F := \text{Vect}(T, U) \mid T \ \& \ U = [-1, 1]$   
and are mutually orthogonal
  - **1-cell**  $TU_C: A_c \Rightarrow TF \mid A_c$  is a morphism  
with collar enrichment
  - **2-cell**  $TU_D: A_D \Rightarrow A_c \mid A_d$  is a functor with  
decision enrichment



## Blue & Pink Collars

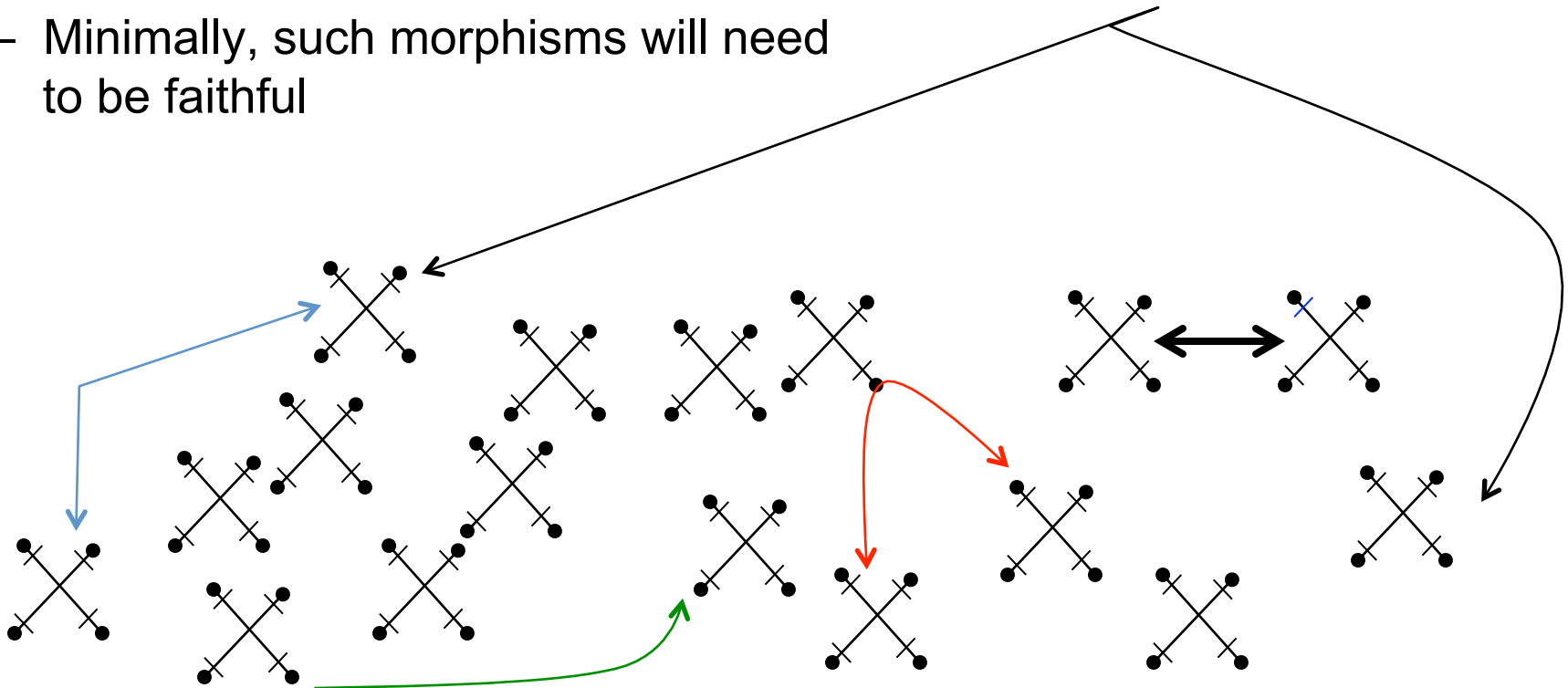
- Third capability is the interaction and coordination of diverse social actors across multiple regions and scales
- Allows the expression of social divergences
  - Collar sizes, as well as how they are applied, vary by culture, era & individual





# Endogenous Influences

- In an endogenous model, actors try to influence each other concerning, *inter alia*:
  - Where their equivalent referent lies within the truth space
  - What size the collar should be (how to weigh evidence)
- Thus, dynamics are subject to local entanglements
  - Minimally, such morphisms will need to be faithful



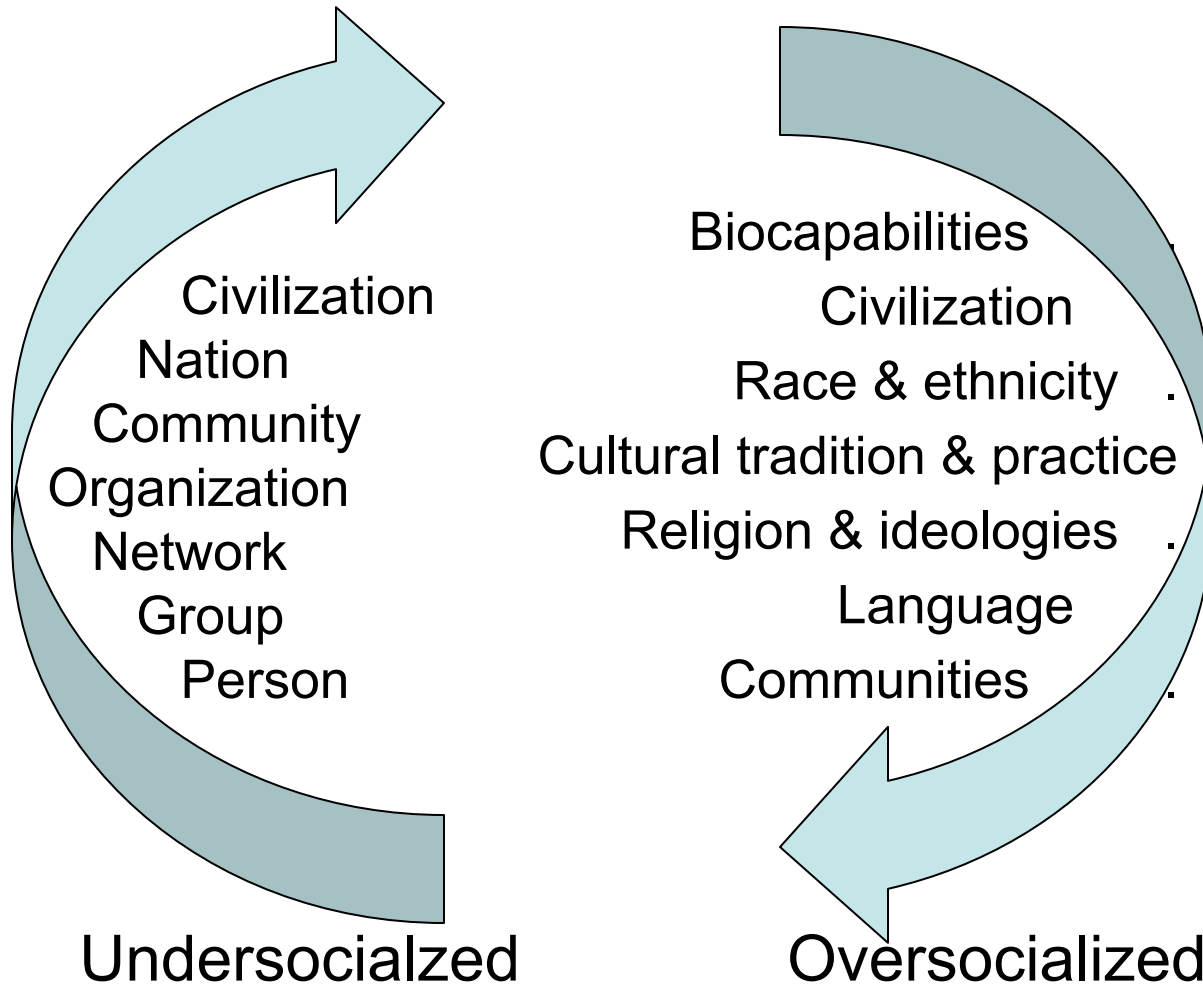
# Security Community Components

- **Actors**
  - Alliances
  - Nations
  - Institutions
  - Movements
- **Relationships**
  - Neighbors
    - Power
  - Resources
  - Dependencies
- **Cultural values**
  - FOR: Multilateralism, regional autonomy, market economy
  - AGAINST: expansionism, insurgency

# Social Coherence Laws?

- The deeper source of coherence laws is the application domain
- A reasonable strategy for identifying them is to focus on social processes that are themselves inherently dual
  - Polarizations, tensions, conflicts, approach/avoidance and idea types policies provide a natural focus
  - Relationship between generational mobility and rebellion (Pareto) would be a promising area
  - Sorokin's epistemological dynamics would be another
    - Long wave alternation of ideational and sensate cultures
  - Social theorists often regard **agency** and **structure** as fundamentally dual, based upon the direction of causal flow
    - **Undersocialized** vs. **oversocialized** agents may operate cyclically, albeit at varying time frames

# Actors & Structures as Causally Dual



## Conclusion

- Social analysis has a need for the conceptual clarity that category theory & higher categories can provide
  - This coupling has the potential to provide innovative and more effective forms of social analysis
  - Progress in analysis can, in turn, place computational social science on more solid footing
  - The combination may contribute to the emergence of stronger and more integrated social theories
- Mathematically, new categories, that are even weaker, seem likely to emerge