Modeling early social processes as antecedents of health inequalities

Network on Inequality, Complexity and Health
Contributors

Jeanne Brooks-Gunn, Columbia U
Sarah Cherng, U Michigan
Amanda Dettmer, NICHD
Margo Gardner, Columbia U
Rick Riolo, U Michigan
Carl Simon, U Michigan
Steve Suomi, NICHD
Poor children sustain higher rates of acute, chronic and disabling diseases

Poor children have higher cumulative CHD morbidity throughout adulthood

Social partitioning of child health and development
(Chen et al, 2002)
Childhood experiences of adversity/trauma predict leading causes of adult mortality (Felitti et al, 1998)
Beyond the visible, surface forces driving health disparities...

- Toxins
- Access to health care
- Diet
- Housing
- Violence
- Stress and adversity
... Deeper currents of social inequality

- Conserved, species-typical patterns of group behavior, such as social hierarchical ordering
- Biological embedding of chronic subordination and social marginalization
Evidence for early hierarchical relationships and their consequences

1. Inference of stable dominance relations by human infants (Mascaro & Csibra: PNAS, 2012)
   • Interactions between animated agents in conflict situations
   • Looking times index violated expectations
   • Able to infer asymmetric and stable relationship between two agents
   • 12 month old human infants cognitively primed to recognize status asymmetries

   • Exposure to childhood bullying predicted higher rates of adolescent self harm, even controlling for emotional problems, low IQ, and family environmental risks factors
3. Health and development socially partitioned even within kindergarten classrooms (Boyce et al: PNAS, 2012)

- Naturalistic observations of agonistic interactions indexed class hierarchies
- Teachers’ “learner-centered practices” — based on egalitarian pedagogical philosophies
- Greater depression, inattention, and academic difficulties among those in subordinate social positions
- Flatter gradients in depression among children of teachers with egalitarian pedagogical practices

Experiences of social subordination, enacted and cognitively encoded early in life, have graded, deleterious influences on mental health
Evidence for health and behavioral effects of social marginality

   • Unmarried, infrequent religious activities, no organizational affiliations, few social interactions
   • Social isolation predicted mortality with effect sizes approximating those of smoking and HBP

- Conventional explanations: mental illness, family problems, violent media, copycat effects
- Five necessary but not sufficient conditions for rampage school shootings:
  ✓ Extreme marginality in social worlds that mattered
  ✓ Psychological problems that magnify the impact of marginality
  ✓ “Cultural scripts”—models for linking manhood and public respect
  ✓ Failure of community, school and peer surveillance systems
  ✓ Gun availability
- Without any single factor, school shootings would not have occurred

Social marginality is a key antecedent to school violence and early mortality
Motivations for development of an agent-based model

• Explore the origins and processes of social subordination and marginalization

• Understand how social affiliations (friendships) and social dominance relations may interactively contribute to such processes

• Conduct simulated experimentation with school-based interventions
Model overview

1. Children (agents)
   - Health (depression)
   - Affiliative (friendship) target (inverse of aggression)
   - Social position target (competitiveness)

2. Hierarchies
   - Affiliative (friendship) networks
   - Social dominance position

3. Social processes
   - Agent decisions (hybrid of rational expectations and heuristics): who to interact with and type of interaction
   - Transfer of agonistic and affiliative positioning
   - Changes in depression level
Model elements

Social dominance
(“agonistic resources”)

Social affiliation
(“affiliative resources”)

Health
(e.g., depression)

- Compete
- Play with target
- Play alone

Utility function ($U_A$)

Aspired position

Current position

Relative weight: dominance vs affiliation

Model elements

A

B

C

A

B

C

Social dominance

Social affiliation
Validation targets
(from the work of Dodge, Strayer, Pellegrini, Vaughn, Maccoby and others)

- An average of 10-15% of children play alone most of the time
- Modal play group size is 2-4 children
- Ratio of affiliative to agonistic/competitive play is ~4:1
- Negative association between social position and depression
Principal questions and experiments

1. Do few friendships and social subordination lead to decrements in child mental health?
2. How might class size affect the relation between social position and depression?
3. How might teachers’ pedagogical practices affect the relation between social position and depression?
4. How might class size and teacher practices affect the emergence of social marginality?

Provisional findings from a model still in development...
1. Depression by social position and friendship status

- More dominant social positions associated with less depression
- Greater popularity and network affiliation associated with less depression
Class size reduction in California followed by increase in 3rd grade math scores
2. Depression by social position and class size

- Social position x class size interaction
- Highest depression among subordinate children in large classrooms
- Lowest depression among dominant children in large classrooms
- Effect of social position minimized by smaller classrooms
Leveling effects of teacher pedagogical practices and philosophies
3. Depression by social position and teacher practices

- Social position x teacher practices interaction
- Lowest depression among dominant children
- **Unexpectedly**, highest depression among subordinate children with teachers employing strong egalitarian practices
- Are subordinate children in “level playing field” classrooms more depressed due to less opportunity for changes in position?
- Or might teacher practices be adequately operationalized?
Social marginality, class size and teacher practices

Marginal children
4. Social marginality by class size and teacher practices

• Class size × teacher practices interaction
• Highest number of marginal children in larger classrooms with teachers employing few egalitarian practices
• Lowest social marginality with small classrooms
• Effect of class size minimized by teacher egalitarian practices
Conclusions

• An evolving ABM capable of modeling complex social interactions—both affiliative and agonistic—and their effects on child mental health outcomes

• Model allows simulated, *in silico* experimentation with school policy, pedagogical practices and teacher philosophies

• Experiments shifting social marginality and child mental health at the classroom level could suggest *in vivo* interventions to minimize risks of school violence and the emergence of psychopathology
Might ABM observations suggest useful experiments in animal models?

Sources: S Suomi, J Levine, 2012
Social relationships are important!