From Simple Rules to Complex Behaviors: Child Maltreatment Prevention Through the Complexity Science Looking Glass

Part II: An Agent-based Model for Simulating Child Maltreatment

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The Research Question Asked

Can we develop a computer model to explain how the different factors and their interactions might lead to child maltreatment?

The Theory and Conceptual Model

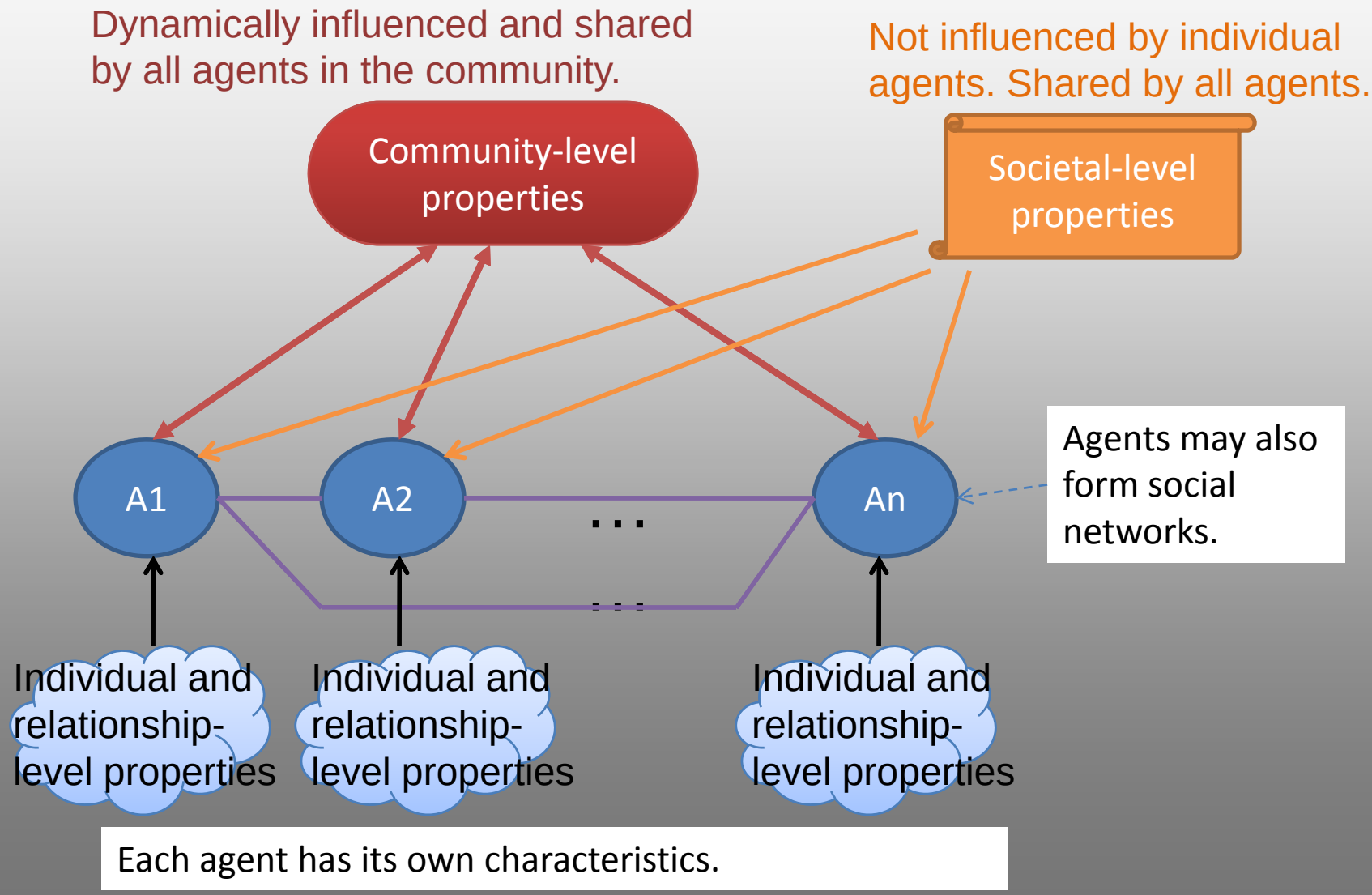
- The social ecological model of child maltreatment.
  - Child maltreatment is a complex phenomenon affected by a multiplicity of factors at all levels of the social ecology (e.g., individual, relationship, community, and societal).
- The complexity theory.
  - Child maltreatment is a result from a dynamic system of interacting individuals with continuous feedback loops into the broader system.
- The conceptual model this work is built on
  - Child maltreatment occurs when there exists unmet child need, i.e., the capacity of parent care is not sufficient to meet the child need.

Comments for the Agent Model

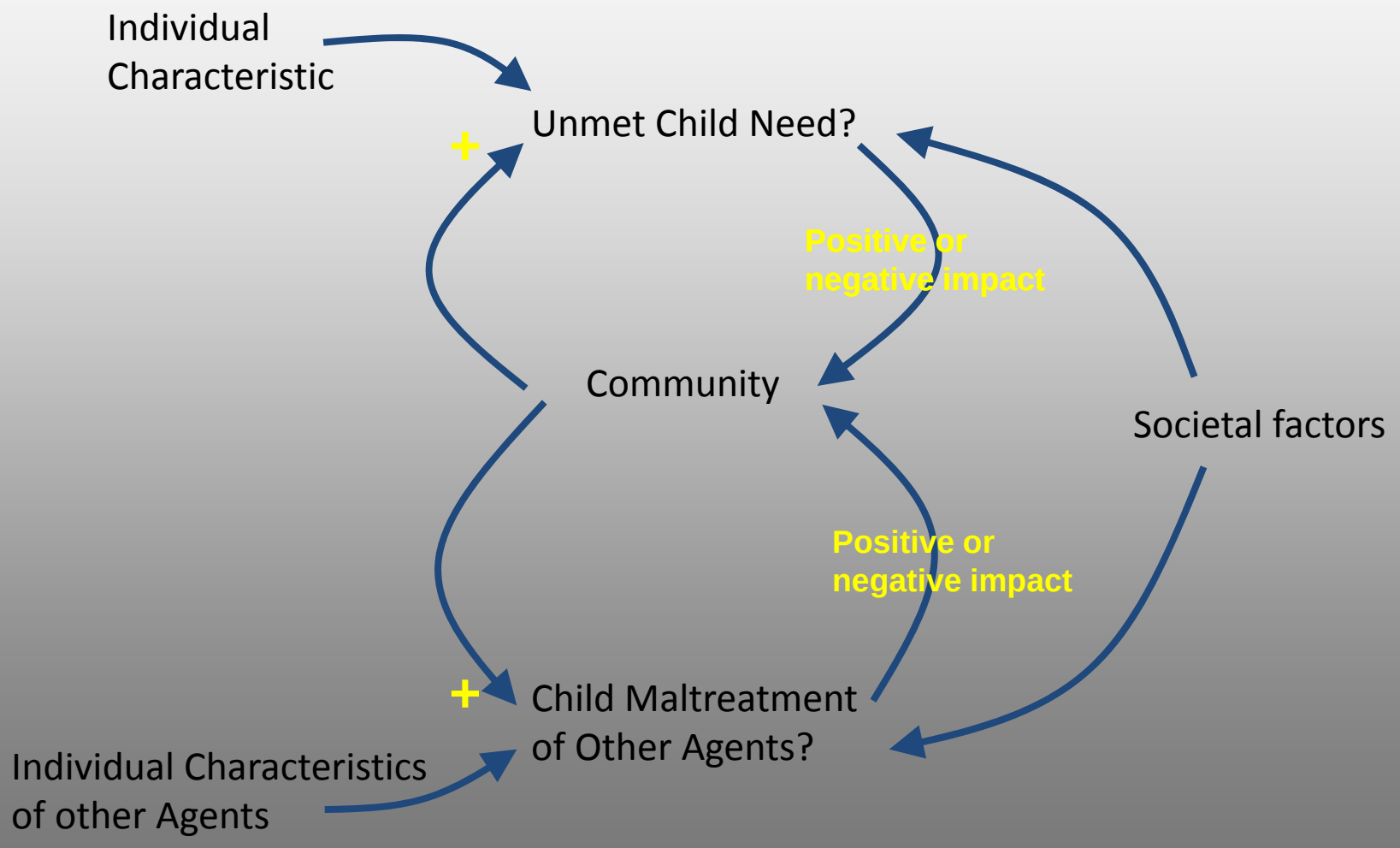
- This work is at a very early stage.
  - We are open to any new ideas and still exploring new ways to expand/revise the model.
- The agent model is an abstraction of the reality. It does not intend to model every detail and every aspect of the phenomenon of child maltreatment.
- At this stage, this work is better to be viewed as posing questions (or inspiring new thinking) instead of providing solutions to the research problem of child maltreatment.

Framework of the Agent-based Model

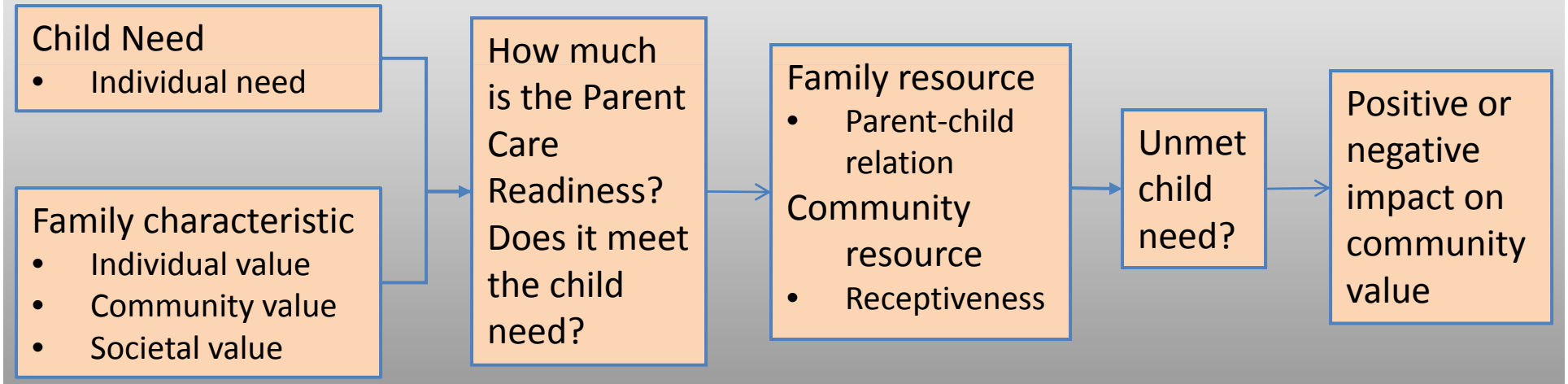
(Each agent is a family unit)



Feedback Loop at the Community Level



How Does a Single Agent Work?



Some Major Parameters in the Model

- Child's average need
- Individual value
- Max capacity of family care
- Parent child relationship
- Max community resource
- Receptiveness to community support
- Family type, e.g., "individual-oriented", "community-oriented", and "societal-oriented"

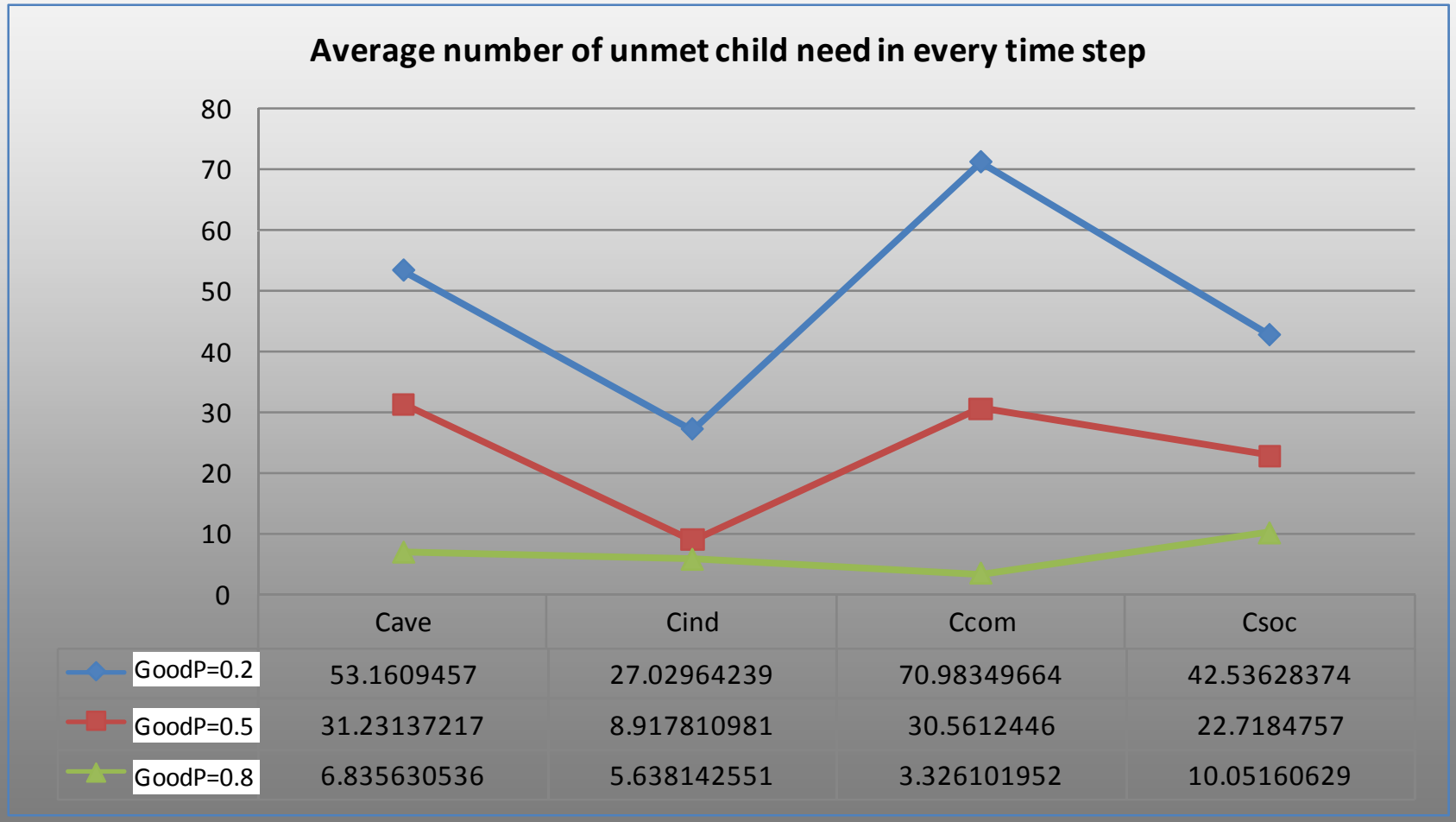
What Can We do Using this Model?

- Set up a virtual/simulation community
  - Different types of communities are composed from different types of families
- What if analysis – what if we increase/decrease the value of an element? Will it move the system in a more desirable direction?
- Sensitivity analysis – which element is more "critical" in affecting the result?

What is not in the Model (yet)

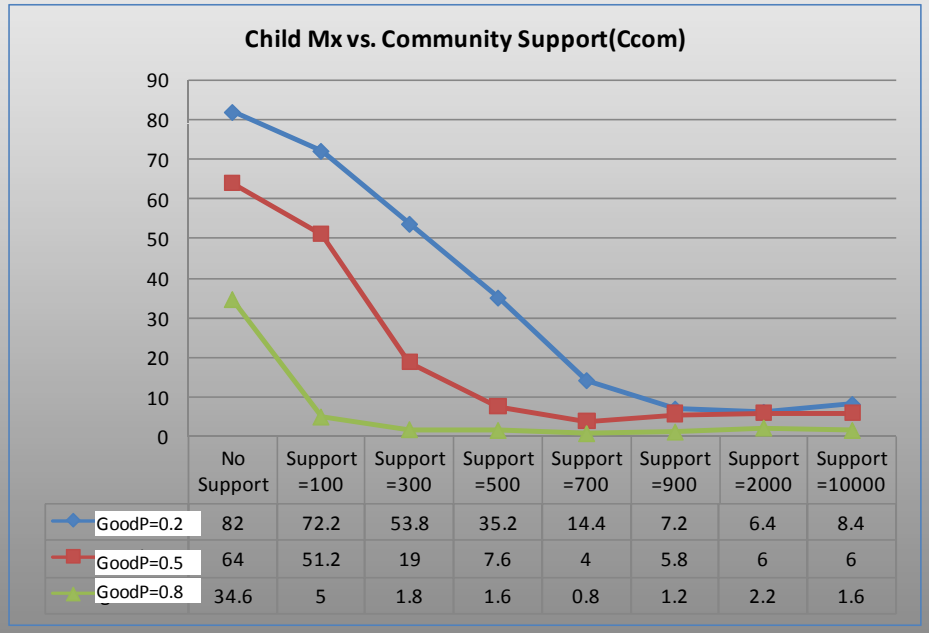
- Agent interact through the community feedback. No local interaction among agents.
  - How may different families influence each other in child maltreatment? Any theory or conceptual model on this?
- No “memory”, no adaptation
  - History of child maltreatment is not modeled
  - No learning/adaption yet
- Naïve dynamic interaction between parent and child

Result Illustration 1 – The impact of community type

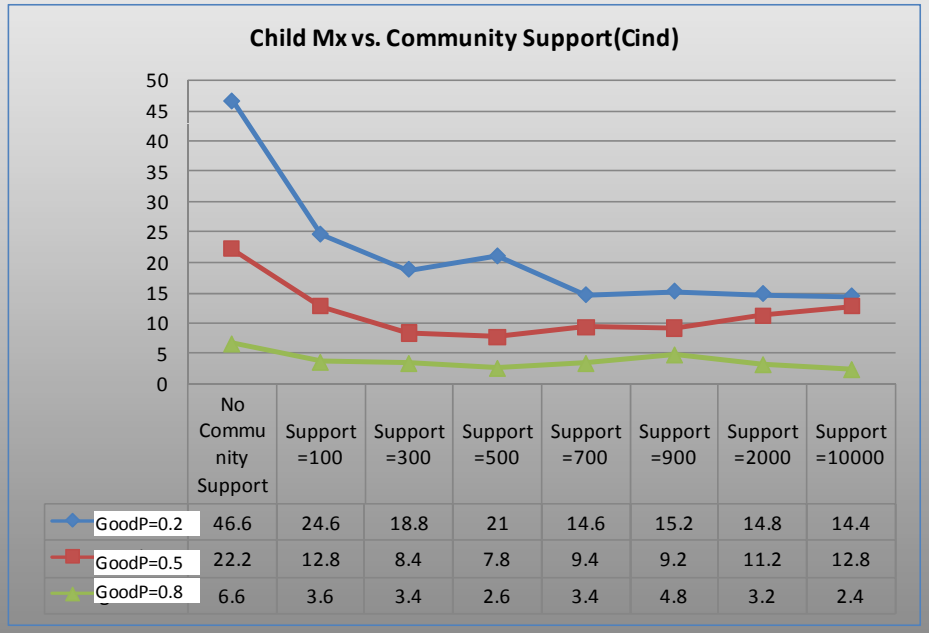


	Cave	Cind	Ccom	Csoc
GoodP=0.2	53.1609457	27.02964239	70.98349664	42.53628374
GoodP=0.5	31.23137217	8.917810981	30.5612446	22.7184757
GoodP=0.8	6.835630536	5.638142551	3.326101952	10.05160629

Result Illustration 2 – The role of community support



	No Support	Support =100	Support =300	Support =500	Support =700	Support =900	Support =2000	Support =10000
GoodP=0.2	82	72.2	53.8	35.2	14.4	7.2	6.4	8.4
GoodP=0.5	64	51.2	19	7.6	4	5.8	6	6
GoodP=0.8	34.6	5	1.8	1.6	0.8	1.2	2.2	1.6



	No Community Support	Support =100	Support =300	Support =500	Support =700	Support =900	Support =2000	Support =10000
GoodP=0.2	46.6	24.6	18.8	21	14.6	15.2	14.8	14.4
GoodP=0.5	22.2	12.8	8.4	7.8	9.4	9.2	11.2	12.8
GoodP=0.8	6.6	3.6	3.4	2.6	3.4	4.8	3.2	2.4

What Comes Next?

- We seek any productive comments/ suggestions:
  - What else could (or should) be incorporated into the model?
  - Is this model worth pursuing in it's current form?
  - Are there other more relevant issues or questions in CM prevention worth modeling instead?
  - What patterns exist "on the ground" in CM that are worth modeling?
- Discussions……

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