Determining the Effect of Observing Aggressive Behavior on the Actions of Infants

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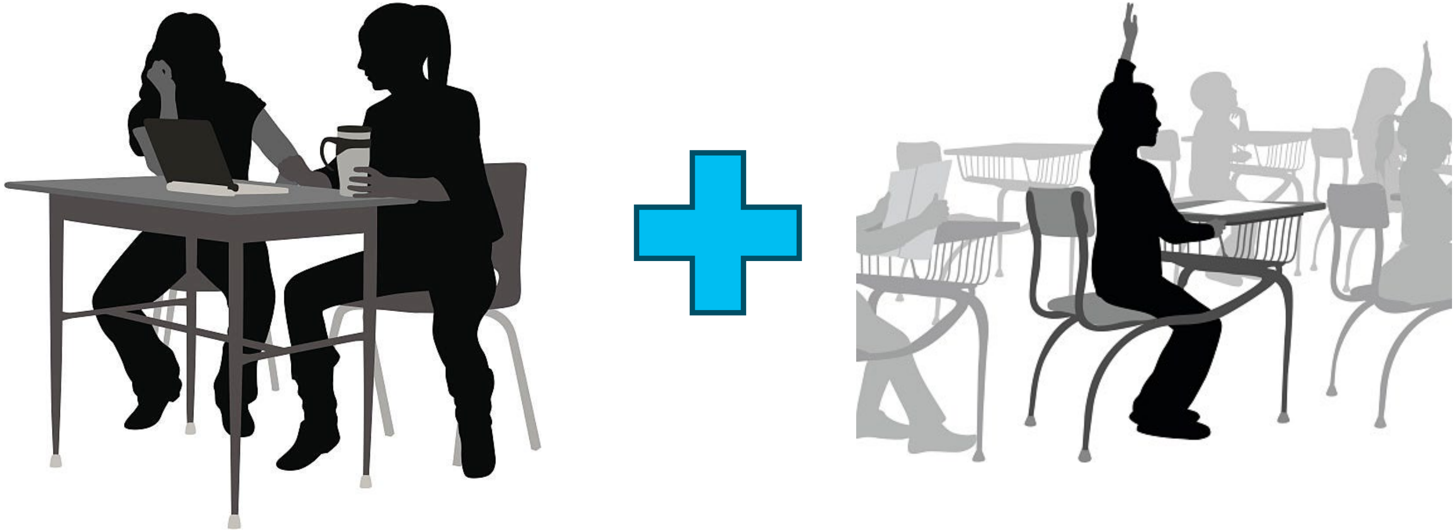
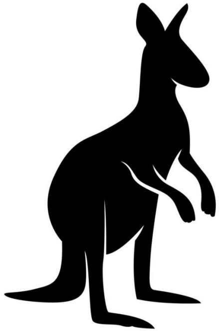
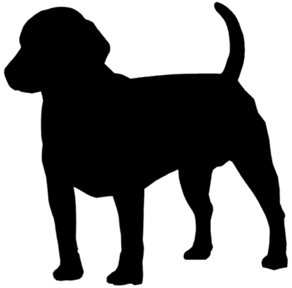
Our Introduction to SCUDEM



Deciding on Our Prompt





Developing Our Project

Real World Problem

Studies have observed characteristics in toddlers that suggest a tendency to act out against those they observe being aggressive to others

Context & Purpose

This subgroup can affect the larger population by correcting morally dubious behavior. Our model will address this impact by demonstrating the fluctuation in subgroup populations according to their interactions.

PROPOSAL

A model where we see the change in populations of infants that are intrinsically inclined to punish aggressive behavior, infants with aggressive behavior, and a neutral population of infants.

Model Inspiration

We will use a Competitive Lotka–Volterra model to see the population changes with time.

The “good” and “bad” populations will be competing against each other to get the neutral population.

ASSUMPTIONS

- There is a certain number of individuals that do not change (the total population).
- The likeliness to act is shared by a certain group of infants.
- Any individual can switch into another group (good, bad, neutral).

VARIABLES

t = time since interaction between infants began (days)

b(t) = number of "bad" infants at time t

g_1(t) = number of "good" infants in group 1 at time t

n(t) = number of "neutral" infants at time t

PARAMETERS

r_1 = number of individuals from the neutral population that become part of the “bad” population over time

K_1 = carrying capacity of “bad” population

α_{11} = effectiveness of “bad” population (bad → bad)

α_{12} = effectiveness of “bad” population (good → bad)

r_2 = number of individuals from the neutral population that become part of the “good” population over time

K_2 = carrying capacity of “good population”

α_{21} = effectiveness of “good” population (bad → good)

α_{22} = effectiveness of “good” population (good → good)

EQUATION

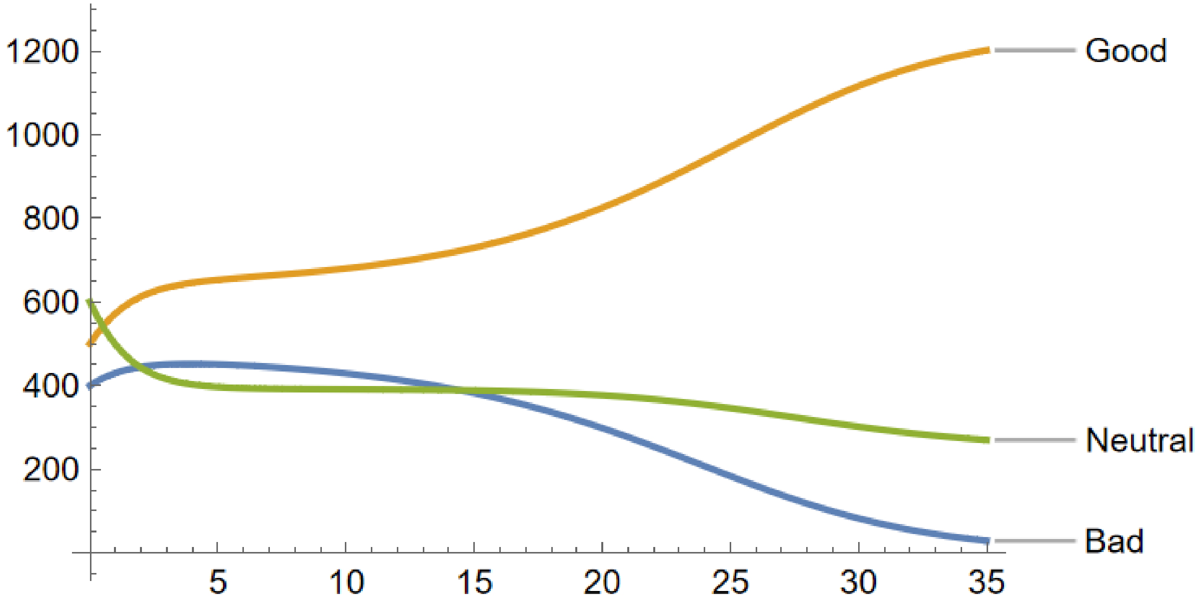
$$b'(t) = r_1 * b(t) * (1 - \frac{(\alpha_{11} * b(t) + \alpha_{12} * g_1(t))}{K_1})$$

$$g_1'(t) = r_2 * g_1(t) * (1 - \frac{(\alpha_{22} * g_1(t) + \alpha_{21} * b(t))}{K_2})$$

$$b(0) = 400 \, , g_1(0) = 500$$

$$n(t) = 1750 - (b(t) + g_1(t))$$

Rudimentary Model



Complicating the Model

We will now add two more populations of “good” infants. This will make the Competitive Lotka–Volterra model have more interesting effects on the populations.

The variables and parameters will follow the previous trend so we will not redefine them.

EQUATION

$$b'(t) = r_1 * b(t) * (1 - \frac{(\alpha_{11} * b(t) + \alpha_{12} * g_1(t) + \alpha_{13} * g_2(t) + \alpha_{14} * g_3(t))}{K_1})$$

$$g_1{}'(t) = r_2 * g_1(t) * (1 - \frac{(\alpha_{22} * g_1(t) + \alpha_{21} * b(t) + \alpha_{23} * g_2(t) + \alpha_{24} * g_3(t))}{K_2})$$

$$g_2{}'(t) = r_3 * g_2(t) * (1 - \frac{(\alpha_{33} * g_2(t) + \alpha_{31} * b(t) + \alpha_{32} * g_1(t) + \alpha_{34} * g_3(t))}{K_3})$$

$$g_3{}'(t) = r_4 * g_3(t) * (1 - \frac{(\alpha_{44} * g_3(t) + \alpha_{41} * b(t) + \alpha_{42} * g_1(t) + \alpha_{43} * g_2(t))}{K_4})$$

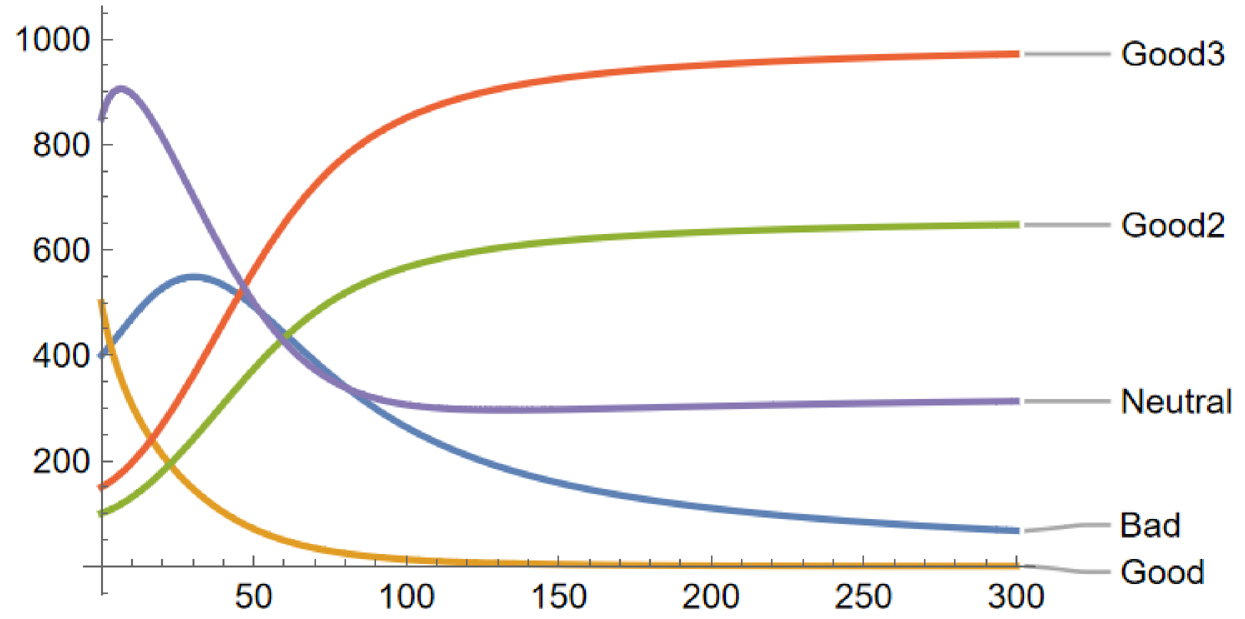
$$b(0) = 400\,, g_1(0) = 500, g_2(0) = 100, g_3(0) = 150$$

$$n(t) = 1750 - (b(t) + g_1(t) + g_2(t) + g_3(t))$$

Paramaters

b(t)	g_1(t)	g_2 (t)	g_3 (t)
$r_1 = 0.1$	$r_2 = 0.1$	$r_3 = 0.1$	$r_4 = 0.1$
$\alpha_{11} = 0.5$	$\alpha_{21} = 0.6$	$\alpha_{31} = 0.2$	$\alpha_{41} = 0.2$
$\alpha_{12} = 0.3$	$\alpha_{22} = 1.0$	$\alpha_{32} = 0.5$	$\alpha_{42} = 0.5$
$\alpha_{13} = 0.3$	$\alpha_{23} = 0.4$	$\alpha_{33} = 0.3$	$\alpha_{43} = 0.3$
$\alpha_{14} = 0.3$	$\alpha_{24} = 0.3$	$\alpha_{34} = 0.3$	$\alpha_{44} = 0.3$
$K_1 = 500$	$K_2 = 500$	$K_3 = 500$	$K_4 = 500$

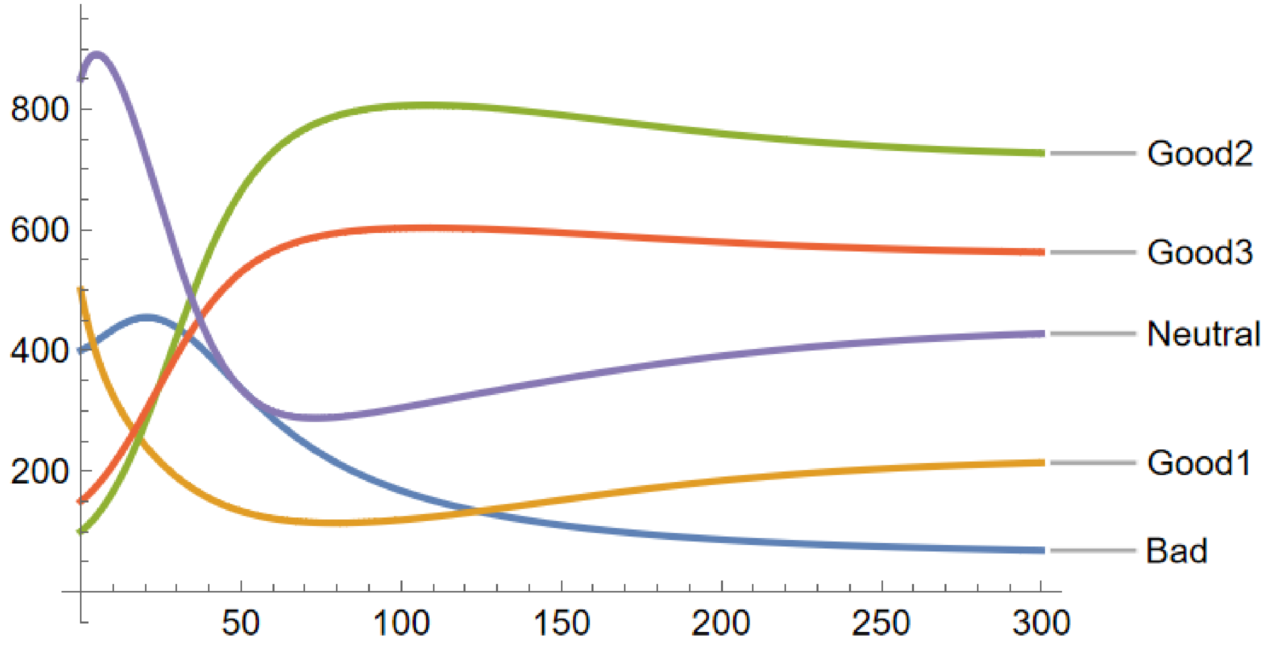
ADJUSTED TRANSFORM



DIFFERENT PARAMETERS

b(t)	g_1(t)	g_2 (t)	g_3 (t)
$r_1 = 0.1$	$r_2 = 0.1$	$r_3 = 0.15$	$r_4 = 0.1$
$\alpha_{11} = 0.5$	$\alpha_{21} = 0.6$	$\alpha_{31} = 0.1$	$\alpha_{41} = 0.1$
$\alpha_{12} = 0.4$	$\alpha_{22} = 1.0$	$\alpha_{32} = 0.5$	$\alpha_{42} = 0.5$
$\alpha_{13} = 0.3$	$\alpha_{23} = 0.1$	$\alpha_{33} = 0.3$	$\alpha_{43} = 0.3$
$\alpha_{14} = 0.3$	$\alpha_{24} = 0.3$	$\alpha_{34} = 0.3$	$\alpha_{44} = 0.3$
$K_1 = 500$	$K_2 = 500$	$K_3 = 500$	$K_4 = 500$

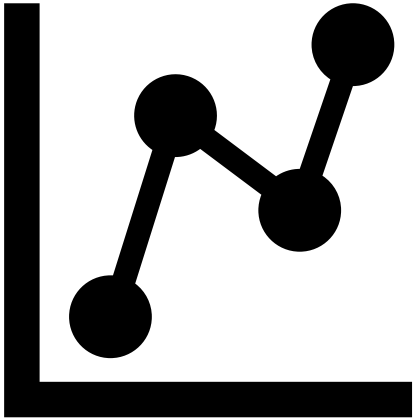
DIFFERENT ADJUSTED TRANSFORM

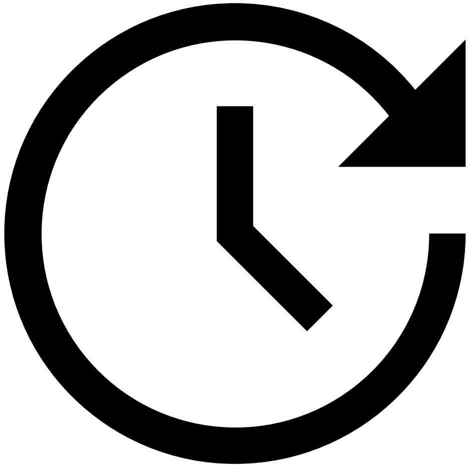


IMPLICATIONS

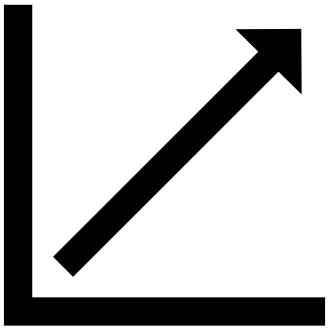
- With time, our society will get better and better as a result of these interactions
- Bystanders and those unwilling to take a strong stance in the face of conflict will eventually die out—be replaced by people characterized by extreme aggression
- May increase the amount of friction in society due to a lack of moderate/neutral people—increases the amount of crime and violence in society

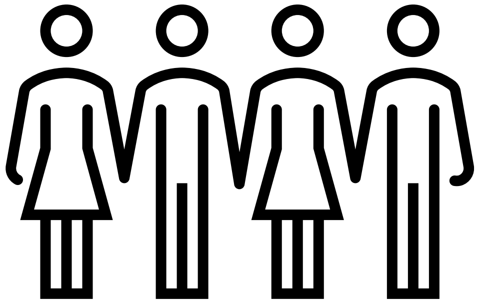
Our Difficulties & Possible Improvements





What Did We Learn?
How Did We Grow?






THANKS FOR WATCHING!