



*Complex Adaptive System of Systems  
(CASoS) Engineering Initiative*  
<http://www.sandia.gov/CasosEngineering/>

# Opinion Dynamics in Gendered Social Networks: An Analysis of Female Engagement Teams in Afghanistan

Thomas Moore, Patrick Finley, Ryan Hammer, Robert Glass  
Sandia National Laboratories

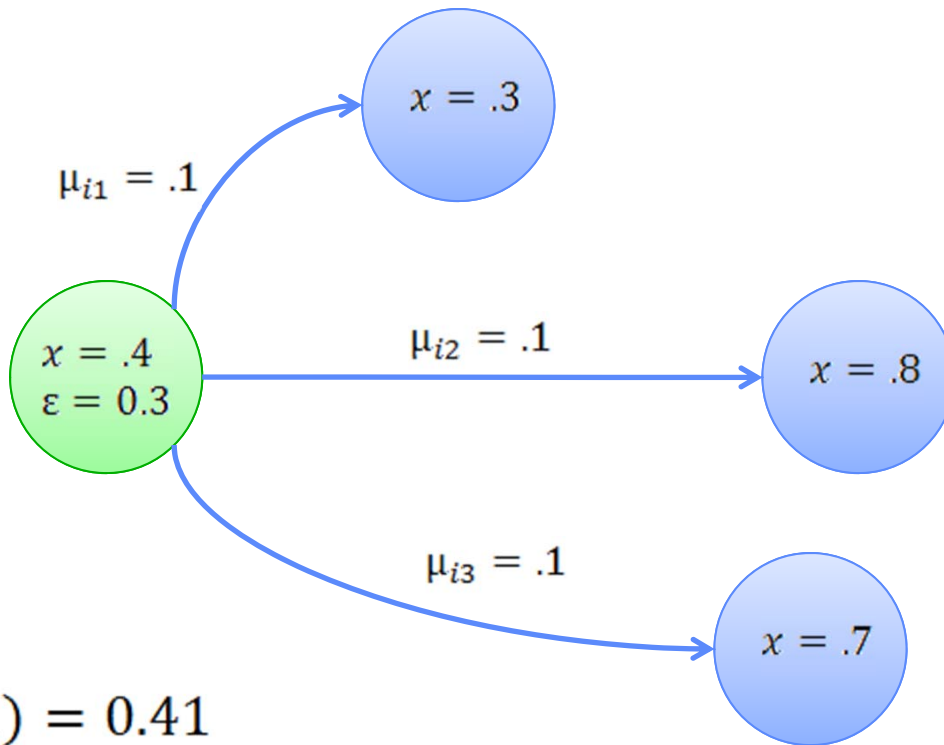
**2012 International Conference on Social Computing, Behavioral-  
Cultural Modeling, & Prediction (SBP12)**  
April 3, 2012

- Family of related techniques for modeling information flow through a group of individuals
  - Derived from statistical physics models
  - Opinions represented by numerical value
- Grounded in structural balance theory
- Individual opinions approach consensus values with neighbors
- Bounded confidence component can prevent consensus, create clusters

# Opinion Dynamics in Action

$$\{k \in S_i: |x_i(t) - x_k(t)| \leq \varepsilon_i\}$$

$$x_i(t + 1) = x_i(t) + \frac{1}{|S_i|} \sum_{k \in S_i} \mu_{ik} [x_k(t) - x_i(t)]$$



$S_i$ : Set of out-degree neighbors  
 $\varepsilon$ : Tolerance  
 $\mu$ : Plasticity

# Female Engagement Teams

- Began in Afghanistan in 2009 as outgrowth of Lioness Program
- Engage with women and men in Afghan communities
- Ad-hoc engineering for people, capabilities
- Primarily USMC initially, now multi-service and multi-national
- Multidimensional engagement
  - Information dissemination
  - Medical support
  - Passive information collection
  - Security support



2012 International Conference on Social Computing,  
Behavioral-Cultural Modeling, & Prediction (SBP12)

April 3, 2012

# Female Engagement Teams

- Supports UNSC Resolution 1325
- FETs demonstrated high degree of success on the ground
- Could FET success be due in part to topological characteristics of social networks in Afghan communities?



- Cross-cultural phenomenon
  - Gender assortativity shown in many different kinds of social networks (elementary and secondary schools, entrepreneurs, illicit activities)
  - Also shown in primate studies
- Subnetwork topologies and characteristics can be distinct
  - Increased transitivity
  - More emotional support, less instrumental support

# Gendered Networks in Afghan Communities

- *Purdah* constrains interactions between sexes for non-family members
- Solidarity among women can offset otherwise strongly patriarchal society
- *Pashtunwali* describes code of freedom, honor, revenge, and chivalry - individualistic
- Multi-level conflict resolution: familial, tribal, national
- Idealized egalitarian community structure



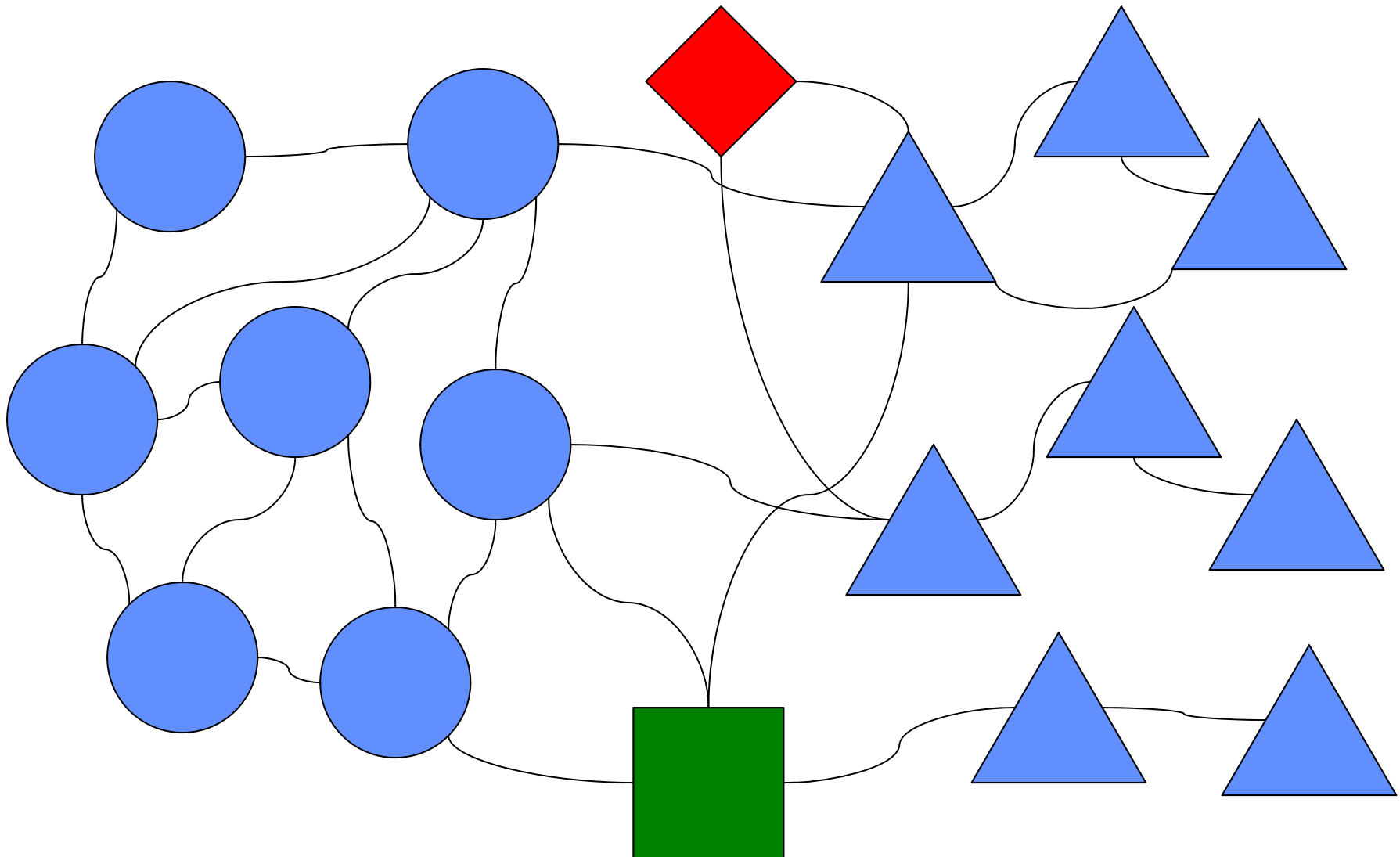
# Gendered Networks in Afghan Communities

- Female networks characterized by higher edge densities
- Male networks characterized by lower edge densities, distinct components
- More within group links than between group links





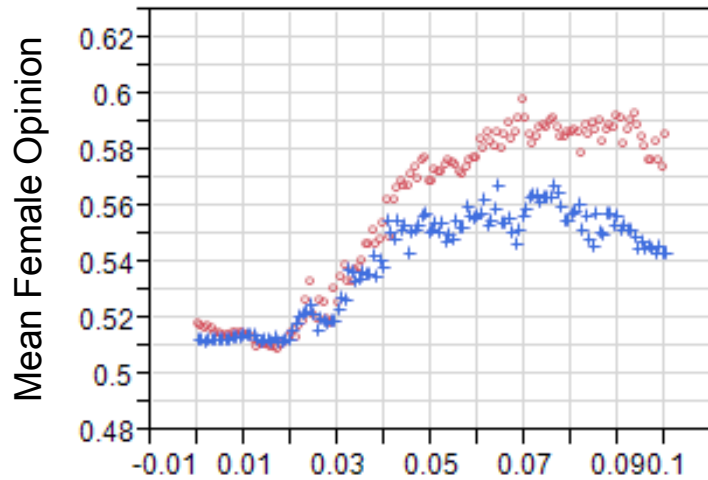
# Notional Network Illustration



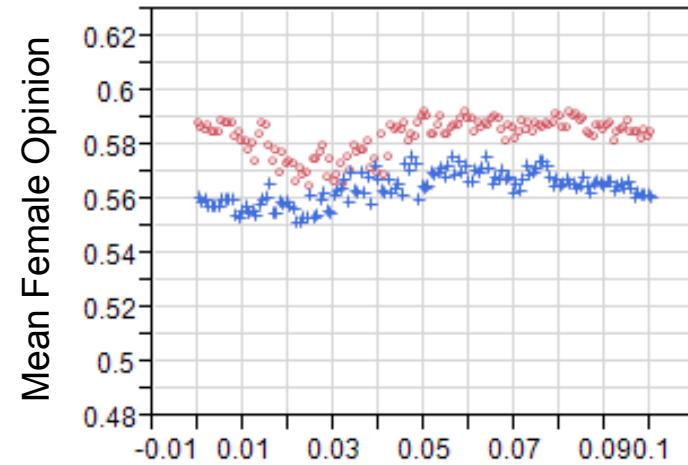
- Greater edge density in female network component can lead to greater solidarity, larger percentage of population in consensus
- Engaging with both females and males in community can permit international forces to efficiently effect changes in population opinions
- Opposition forces, when constrained to engaging only males in the community, can exert strong influence if unopposed
- FETs can counteract opposition influence, shift opinions favorably

# Effect of Message Content: Influencing tolerance with culturally sensitive humanitarian interventions

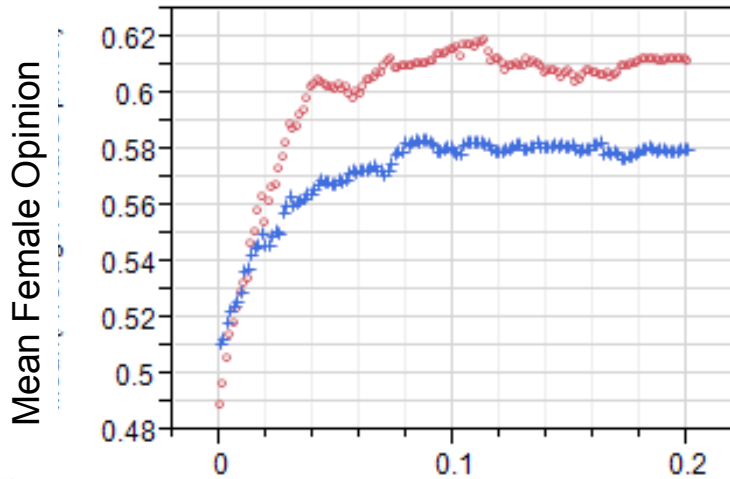
## Female Edge Density



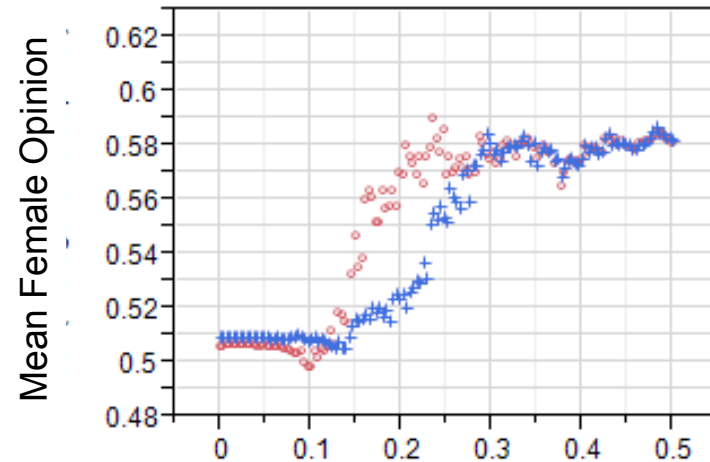
## Male Edge Density



## FET Edge Permeability



## Community Tolerance

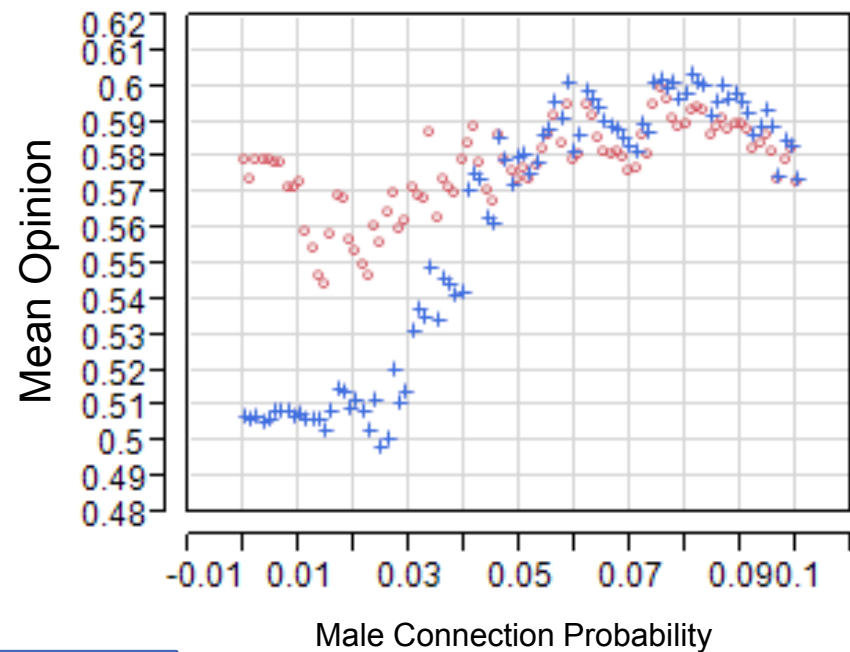
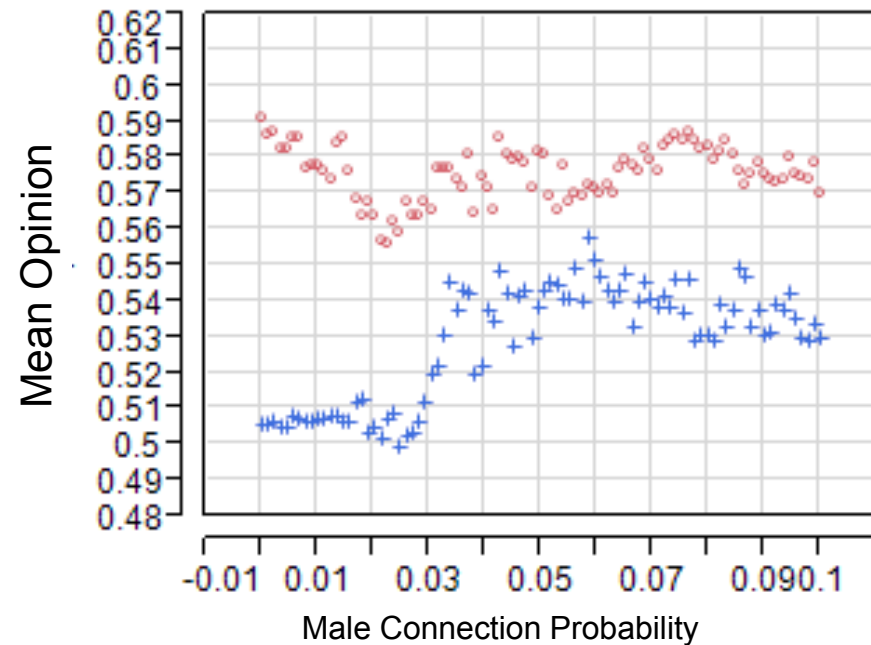


○ Push Opinion and Tolerance  
+ Push Opinion Only

# Who Should FETs Communicate With?

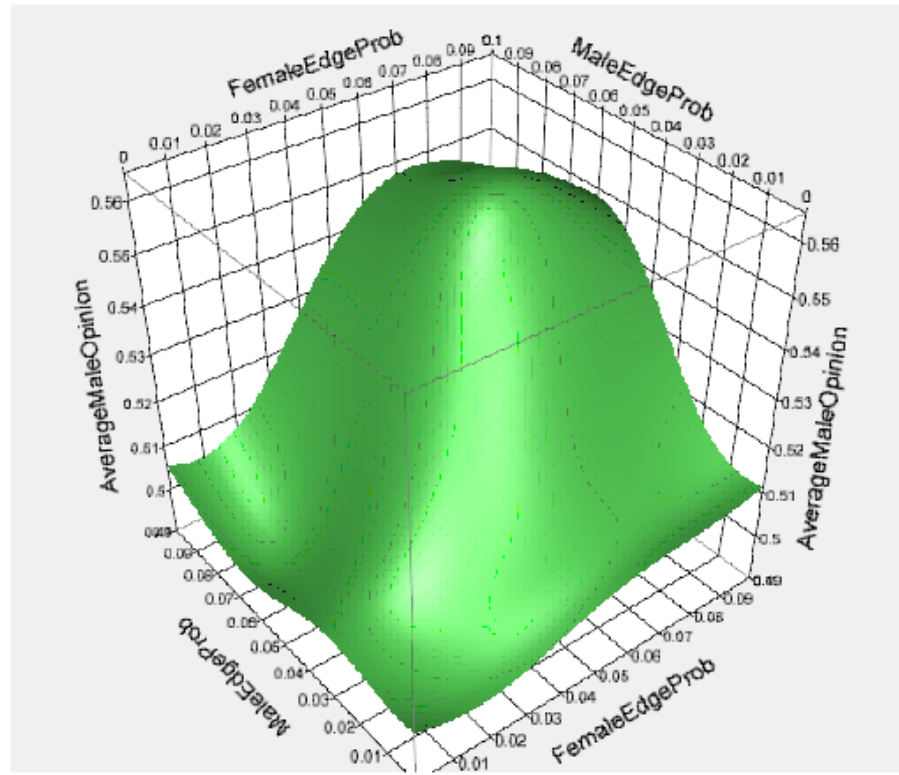
Communicate Only with  
Female Network

Communicate with Female  
and Male Network

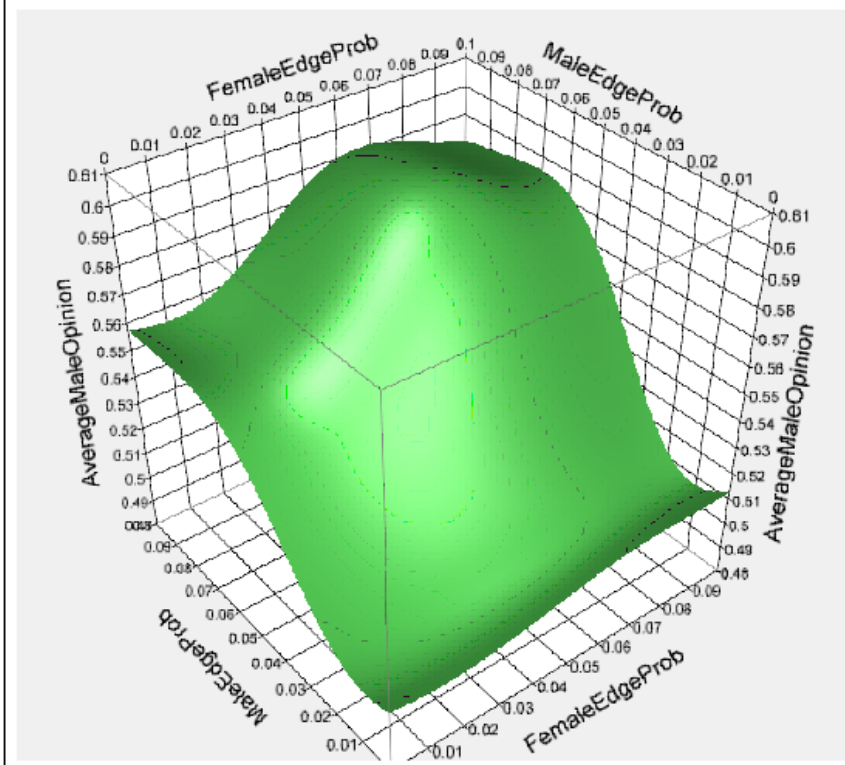


○ Female Network  
+ Male Network

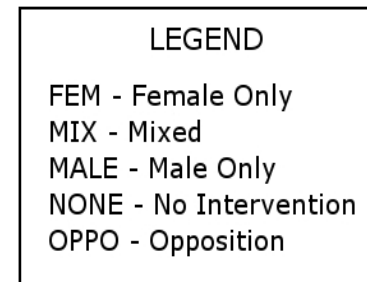
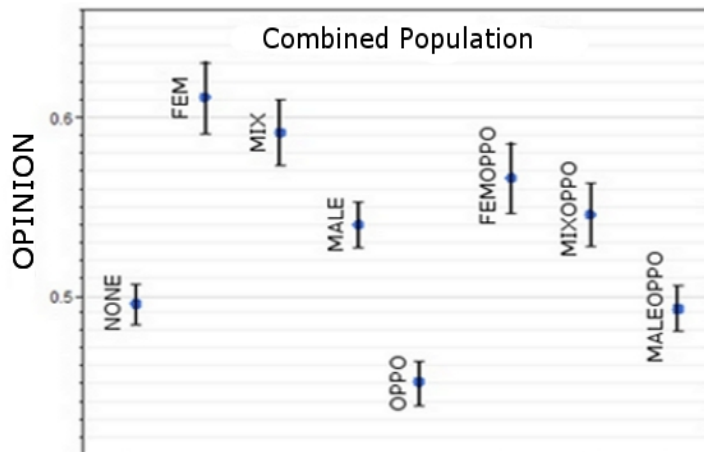
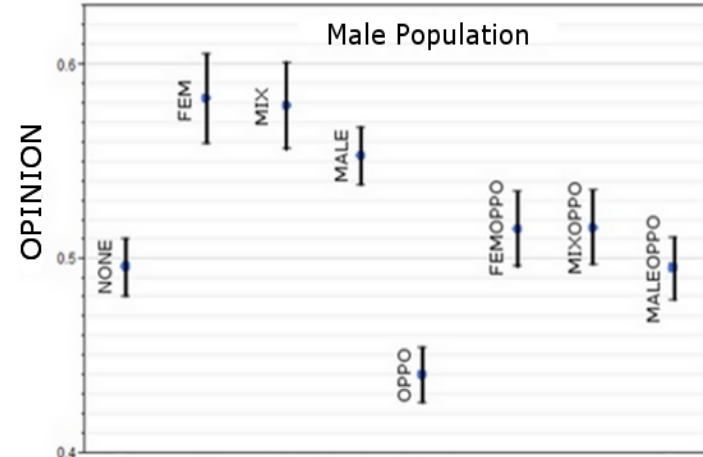
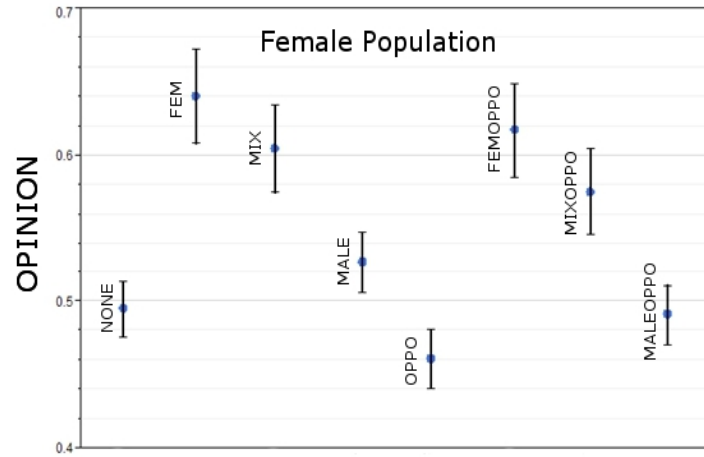
# Male Opinions: Female vs. Female and Male Engagement



Female Only



Mixed Engagement





- Additional network topologies
  - Richer community structure
  - Alternative degree distributions
- Multi-valued opinions
- Opinion-behavior mapping
- Generalize model with application to other kinds of interventions
  - WHO interventions
  - Microcredit-style economic dynamics

- Thanks to:
  - International Data Farming Workshop 23/NATO MSG-088 Meeting 5 participants, especially Gary Horne and Steven Anderson
  - Ted Meyer, Naval Post-Graduate School
  - Narelle Silwood, New Zealand Defense Technology Agency