Sexually Transmitted Disease's spread Inside a social network

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Background

- Dissemination of infectious disease have been widely studied in the literature.
- The Models developed so far are mostly agent based (Thomas 2010 ; Russels et al. 2008; Wilensky 1997, 1999).
- **Our intention : To use a network approach for understanding the diffusion process of the disease in relation to condom use behaviours**.

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- How peer effect of condom use affect the first relationship?

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Model

- The network is based on Barabasi Albert model, which is an algorithm for generating random scale-free networks using a preferential attachment mechanism.see (Barabasi 1999 : 79-92).
- Preferential attachment : The more a node is connected, the more it is likely receive new links.

Model

To answer to the proposed questions, we divide the model into two different sub-models that can be used separately or together :

- Infectious dissemination sub-model.
- Social dissemination sub-model.

Model

Infectious dissemination sub-model

- An individual can have a sexual relation with one of his neighbours depending on the neighbour's sex-appeal and his sex-appeal-sensitivity.
- A couple is formed for a commitment time, and an individual has to wait for an abstinence time before looking for another sexual partner.
- The infection propagates from an infected person to his partner with a normal distributed probability, if both of them don't use condom.

Model

Social dissemination sub-model

An individual can be influenced by his neighbours and change his condom use attitude according to

- His personality.
- The proportion of neighbours who may influence him.

Model inputs

- Average sex appeal
- Average infection chance
- Number condom use
- Number infected
- Average commitment
- personality

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Individual attributes are distributed according to a normal law (around the population average).

Results

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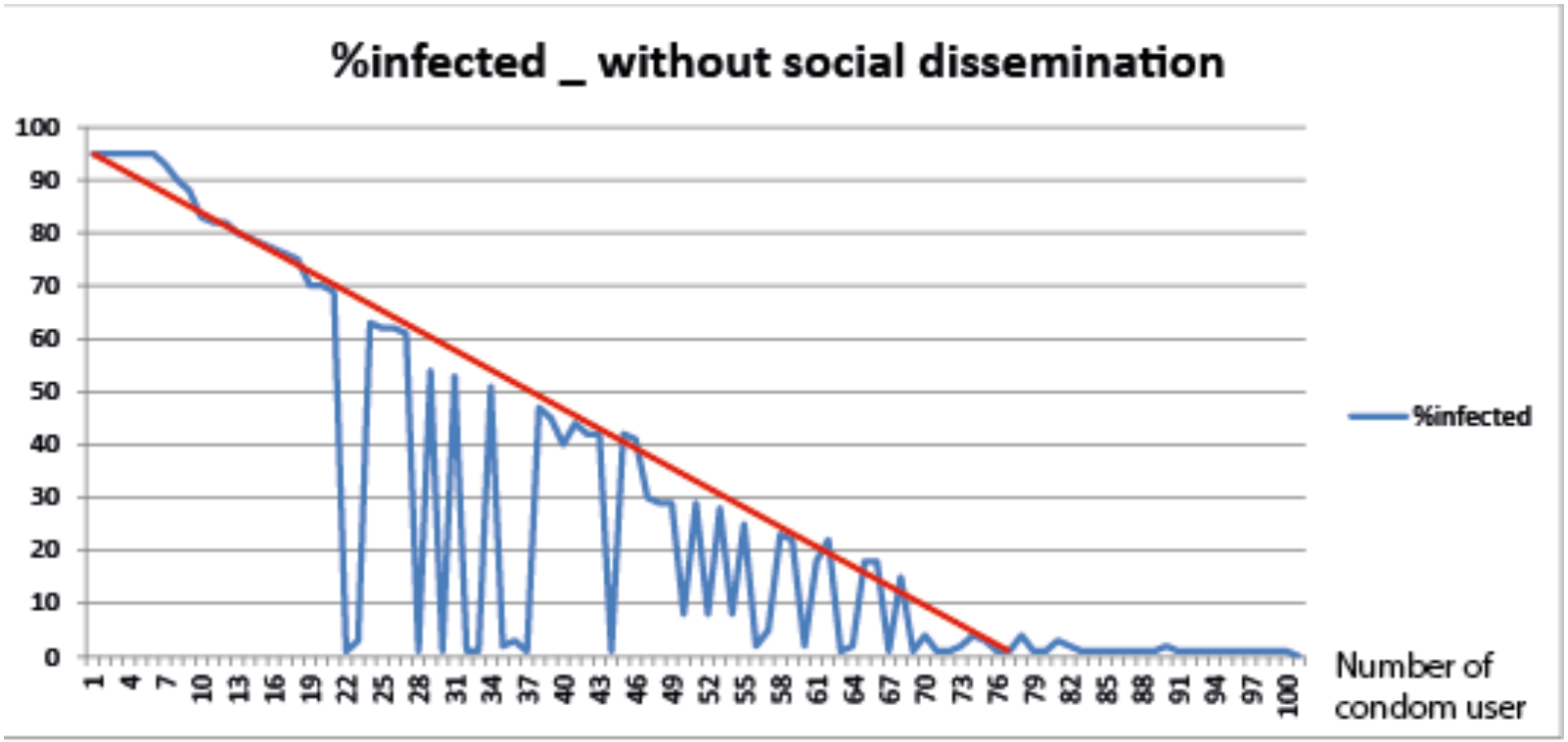
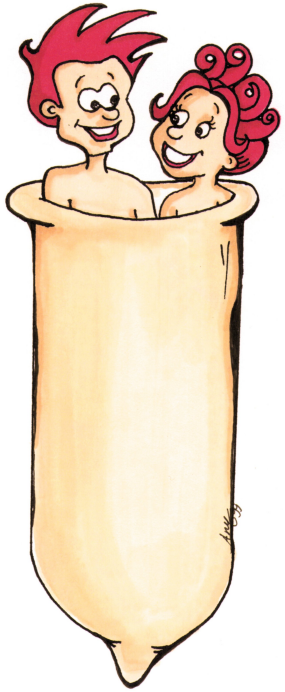


Figure: Cumulative hazards for different exits

Results

Yes but



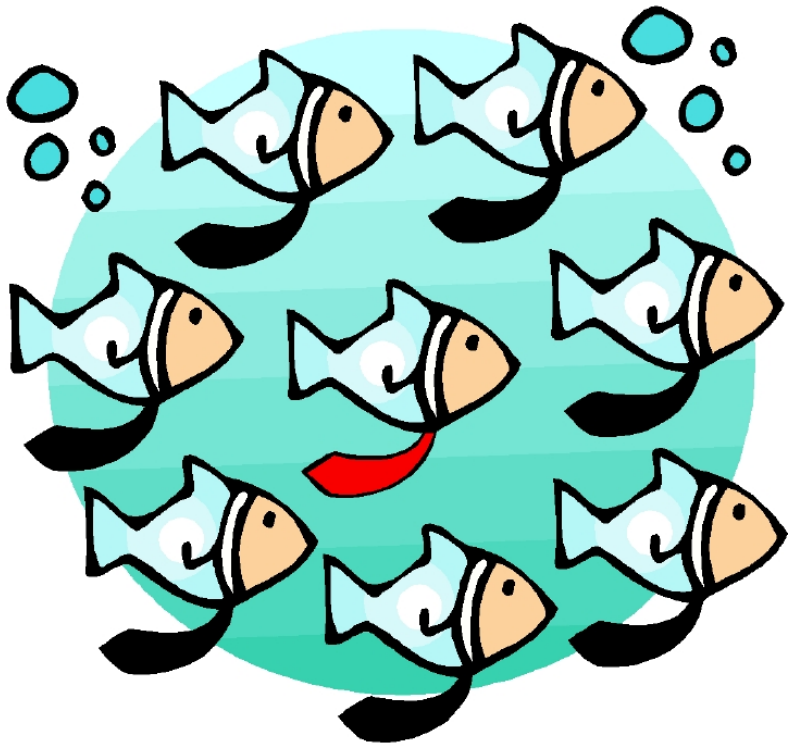
(a)

$\neq$

(b)

Results

Peer effect



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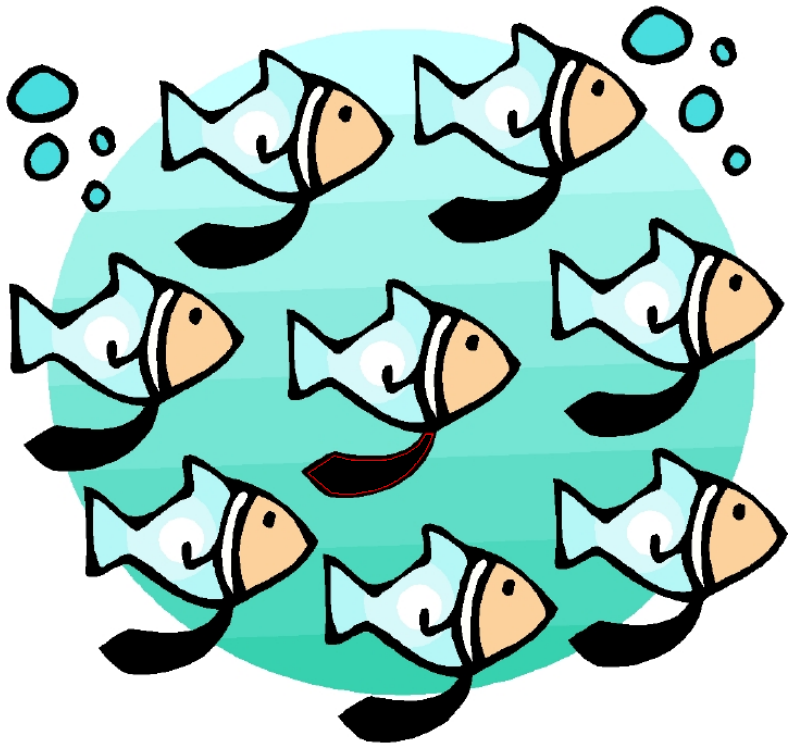
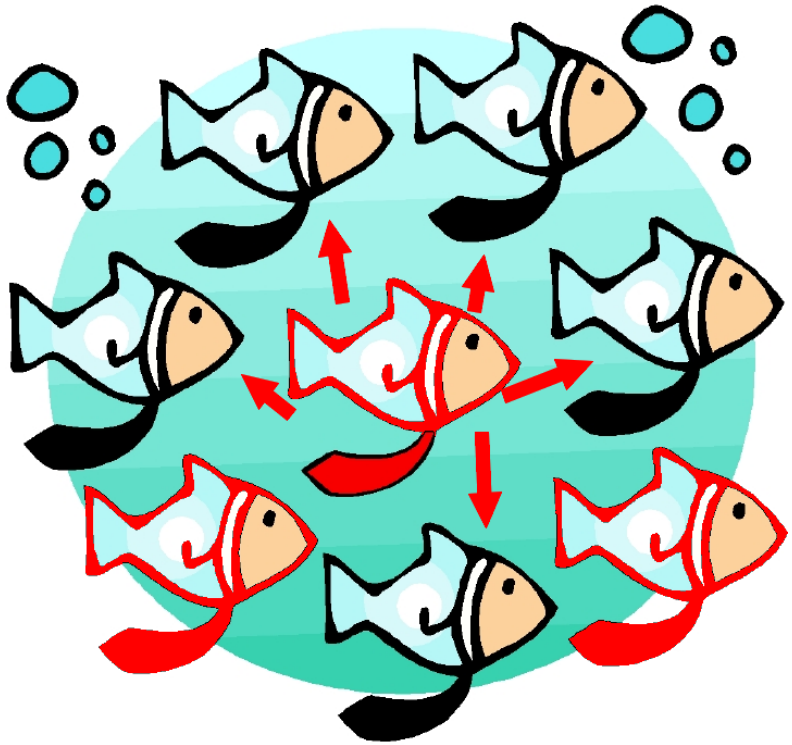
Peer effect



Results

Peer effect

Granovetter 1978 : N noir / N Total > Threshold

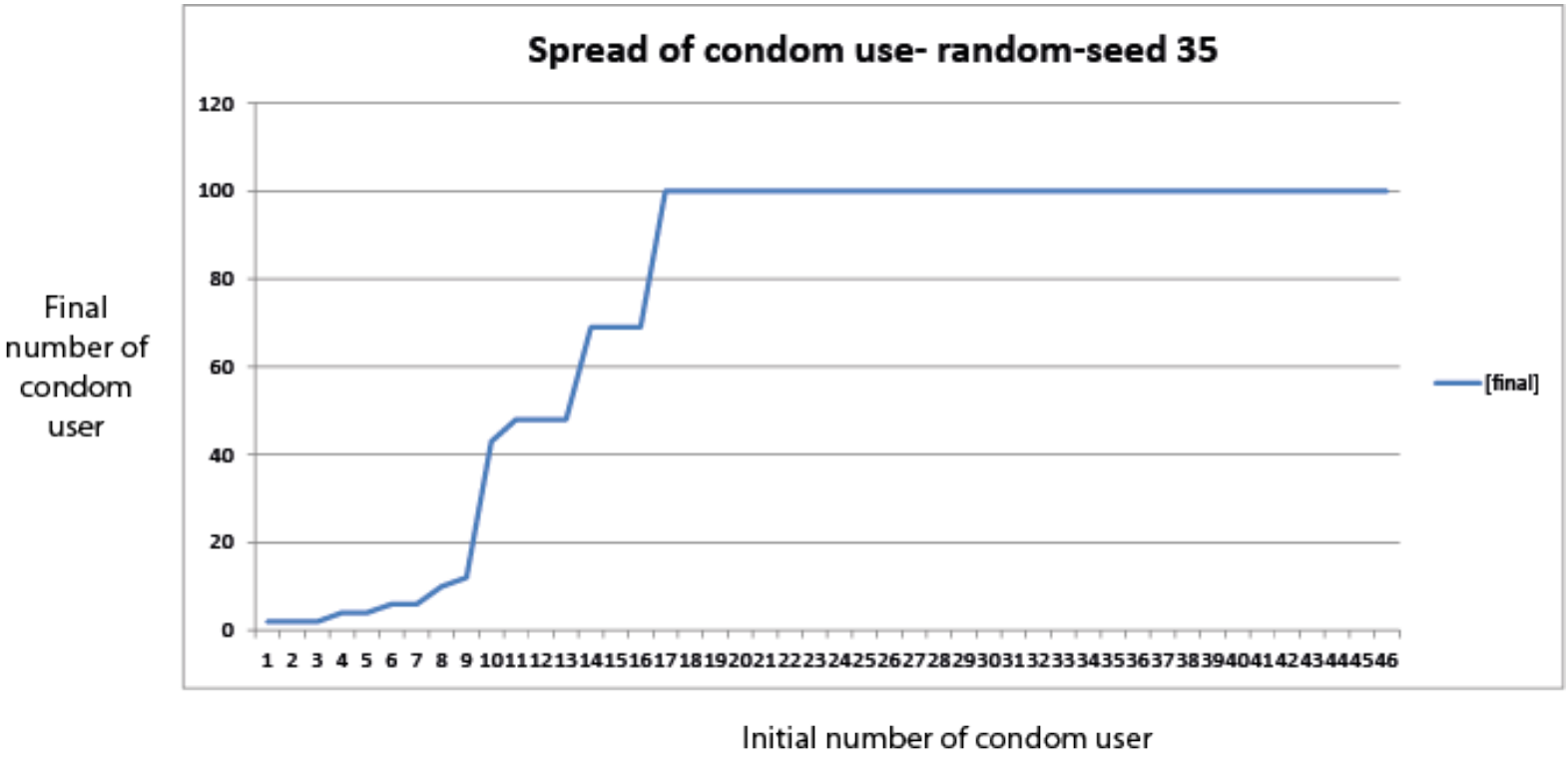


Results

Netlogo Model

Results

Peer effect



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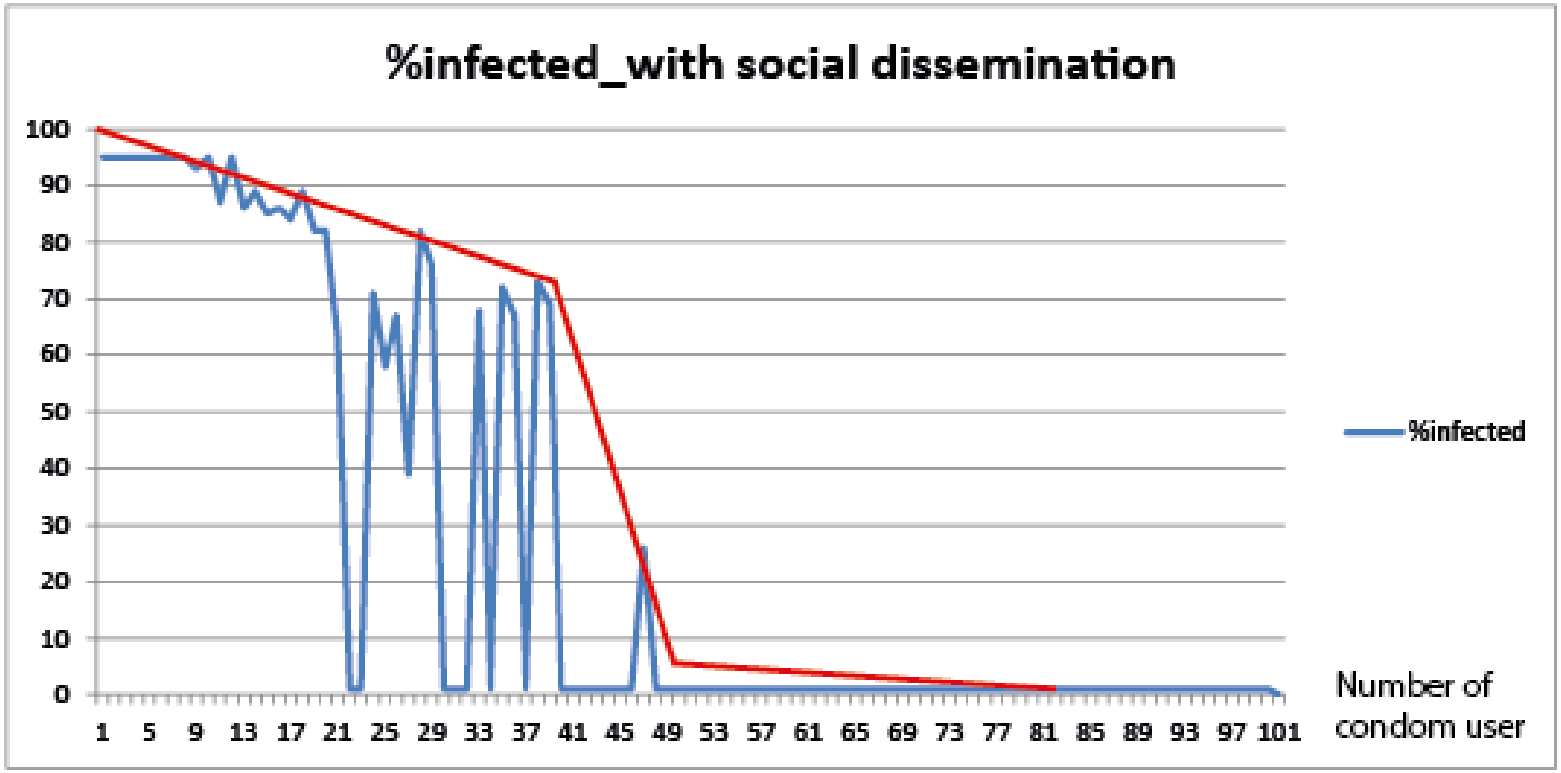
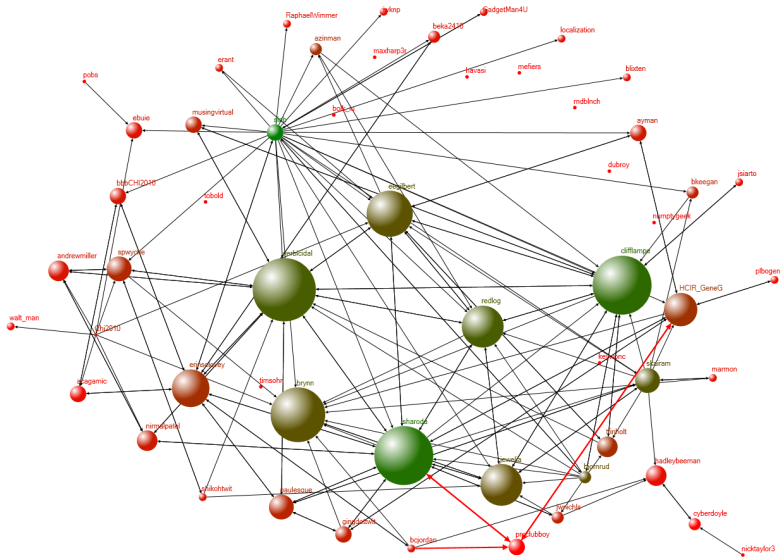


Network Position

- Random seed
- Fixed network position
- New fixed position...?



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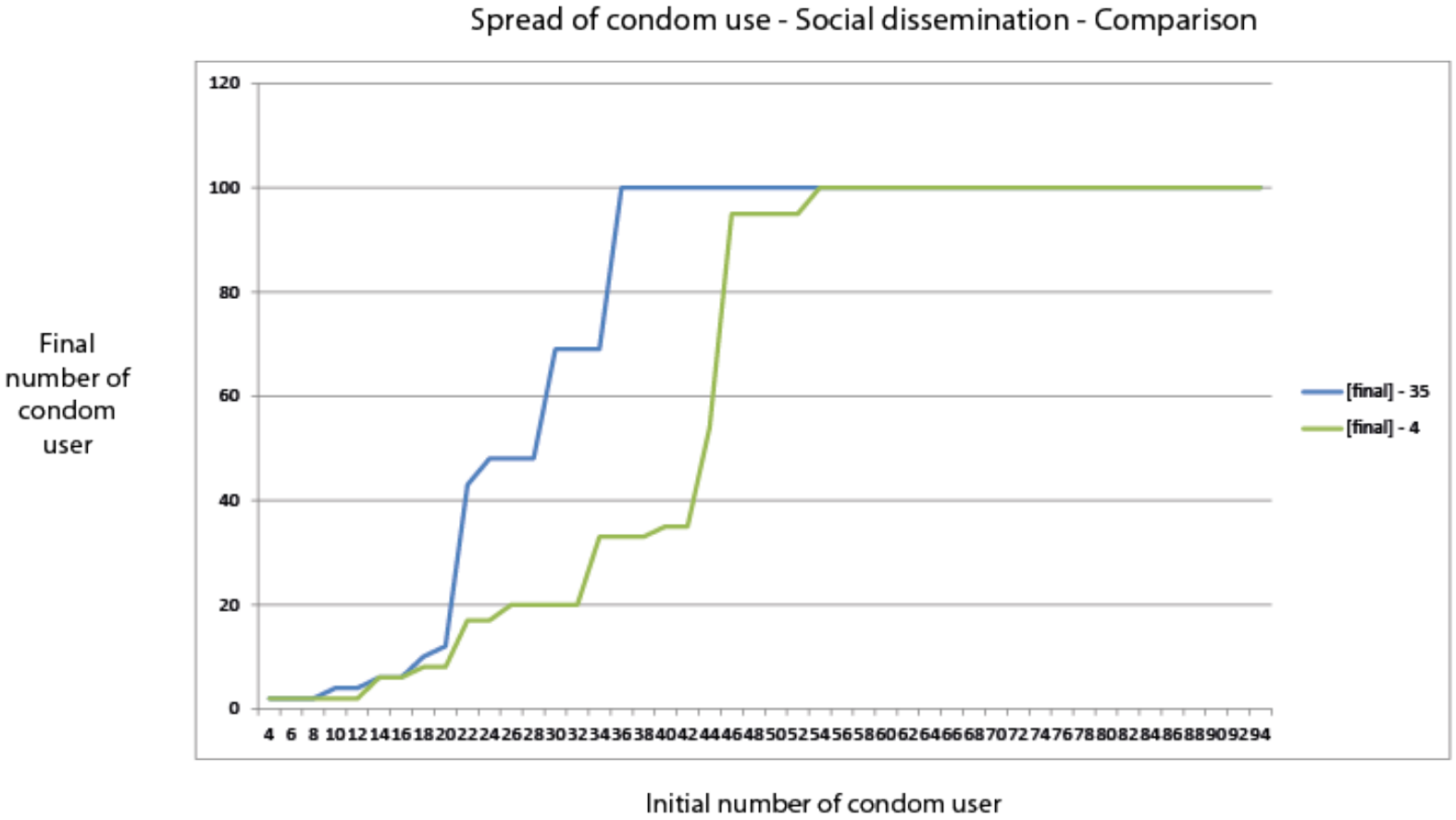
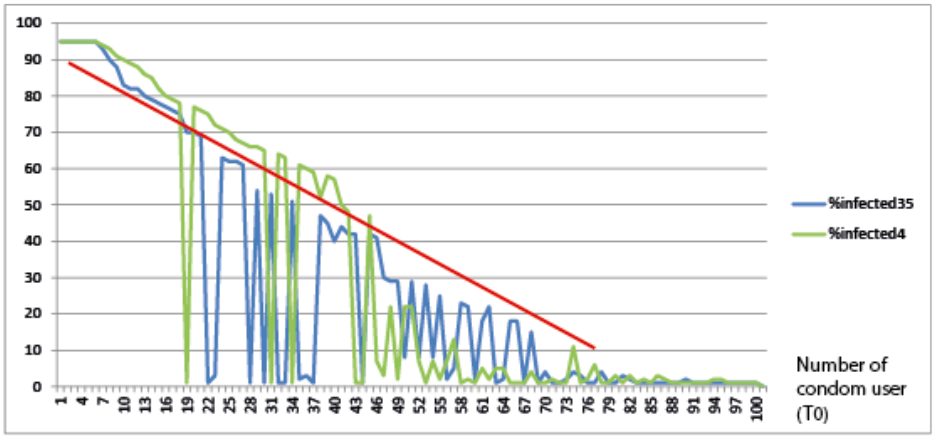
Peer effect



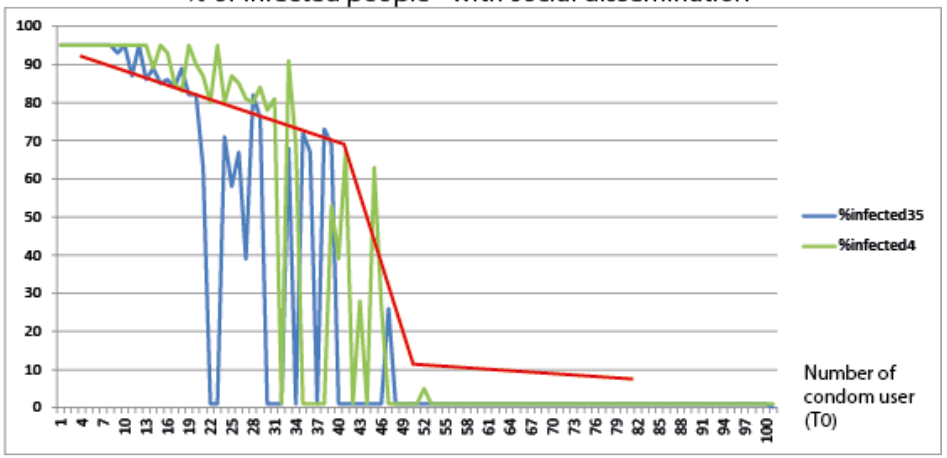
Results

Peer effect

% of infected people - without social dissemination



% of infected people - with social dissemination



Limitations

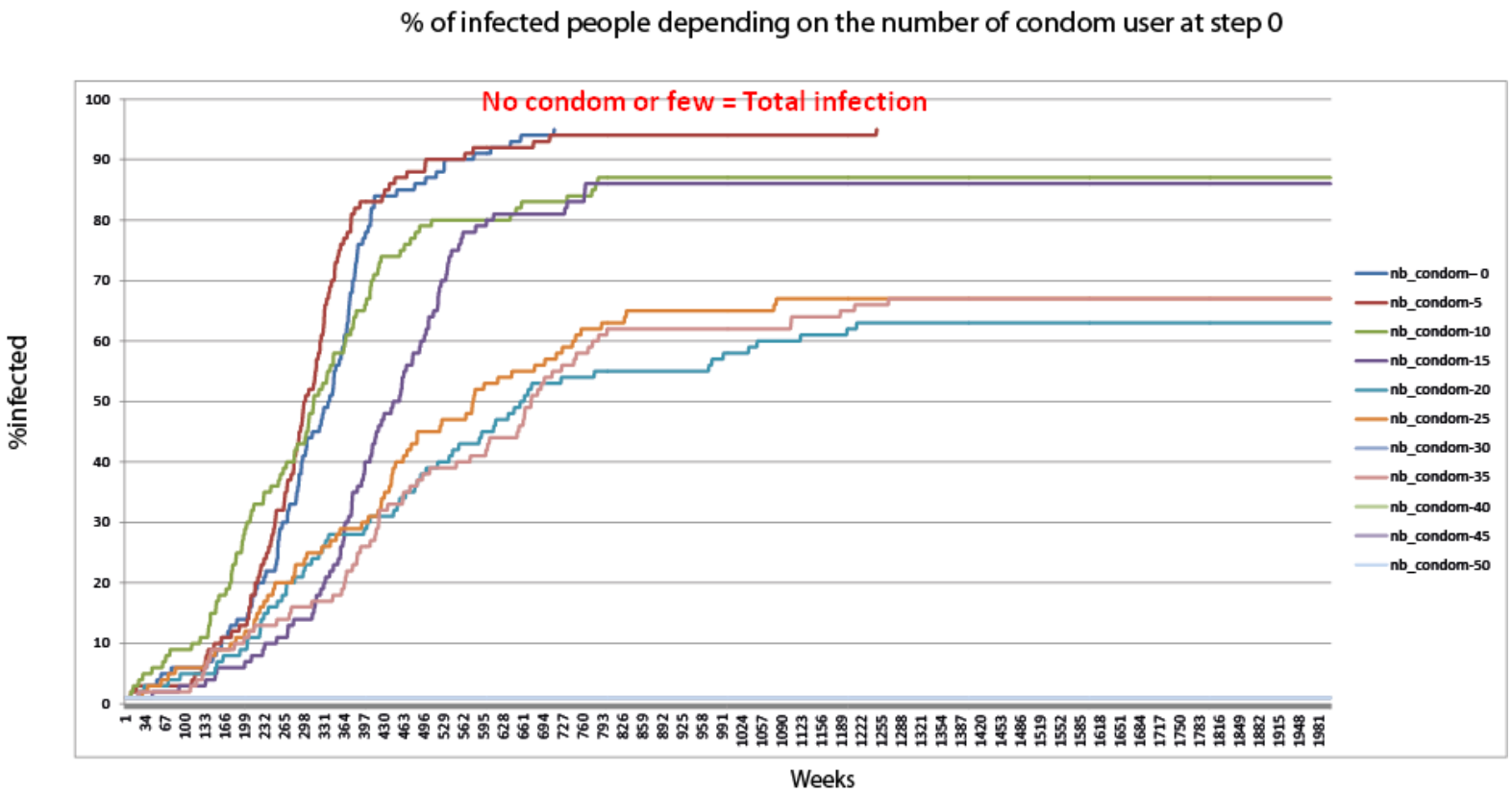
- Network position.
- Small number of individuals.
- Different dissemination speed : representative?
- Random distribution of parameters.

Perspectives

- Connections with Graphstream.
- Sensitivity analysis on network position.
  - Hubs.
  - Centrality.
- Spatiality.
  - Hot spots .
  - Mobility model.
- Dynamic network.
- Adjust parameters to littrature : empirical validation.

Perspectives

Public health policies



Betweenness centrality - a connection with Graphstream

What does the position of a node in the network have over the propagation of the disease?

We use an interface with Graphstream in order to answer to this question.

Betweenness centrality - a connection with Graphstream

How it works?

- Firstly : we get the topology of the network in Graphstream.
- Secondly : We compute on each node the betweenness centrality. It is the number of all shortest paths passing through a given node. This is used originally in social network and was introduced by Freeman (1977).
- Thirdly : we inject a bias on the value of some nodes according to their centrality.
  There is many kind of bias : positive or negative, and on the social diffusion of the condom use or on the disease's diffusion.
- Problem: We could not make sensibility analysis with these parameter. Error in Java and NetLogo.

References

- Barabasi, A., Albert, R., Jeong, H., 1999. Mean-field theory for scale-free random networks. Physica A : Statistical Mechanics and its Applications 272, 173187.
- Wilensky, U. (1997). NetLogo AIDS model. http://ccl.northwestern.edu/netlogo/models/AIDS. Center for Connected Learning and Computer-Based Modeling, Northwestern Institute on Complex Systems, Northwestern University, Evanston, IL.
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- Freeman, L.C. (1977). A Set of Measures of Centrality Based on Betweenness, Sociometry, p.35-41.

Thank you for your attention