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EECS 372

Designing and Constructing Models with Multi-Agent Languages

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**Safe Sex Attitudes and Behaviors**

[In the presence of an. Spread of STI and consequent/ safe sex attitudes and behaviors in a population/response to STI spread…?]

**Overview**

This NetLogo system?? model (aims to??) simulate the spread and development of safe sex attitudes and behaviors in response to the prevalence/**presence??** of a sexually transmitted infection (STI) **through/out??** a social network of young adults. It also takes into account how these variables influence one another and change over time using theories of attitude change and certainty. **(…and the interaction between the two??)**

This project specifically focuses on modeling college students in the United States. Male and female students come to universities with diverse backgrounds, including education and attitudes **towards(regarding???)** safe sex (behaviors?).

**Relevance and Motivation**

… focus more on the sexual attitudes and behaviors of agents in relation to the spread of STIs. Hopefully this will also more clearly distinguish my model from the AIDS or Virus model, which was a concern that both the TA and I had.

**Guiding Questions**

* What factors seem to be most influential in determining whether an individual will contract an STI?
* What factors influence the spread of attitudes towards safe sex?
* Are the two above questions interdependent? What implications could this have for targeting information campaigns to this age group?

**Model Parameters (from interface…??)**

Social network: users can control the number and size (members) of cliques, and whether they are initialized with some inter-group links. These cliques consist of agents that primarily interact with members of the same group.

:: Parameters to initialize a social network, consisting of discrete social groups (cliques).

num-cliques (range 1-20)

clique-size (range 1-35)

avg-num-friends (range 2- 1-cliquesize)

social-butterflies?

:: Enable to initialize a limited number of inter-group links between "clique leaders".

STI: users can control the likelihood of an infection spreading during an unprotected sex(ual??) encounter, and which genders (if any) show symptoms of the infection

:: STI characteristics

;; The chance out of 100 that an infected person will transmit infection

;; during one week of couplehood if they have unsafe sex

;infection-chance

infection-chance (0-100)

symptomatic?

:: Select a person to have an STI

select or infect-random

go-once or go

show-labels?

The agents also have facets of attitude, certainty, and justification. These are average values set for the overall model, and will be discussed in further detail below when talking about agent parameters.

set breed males ;; Default breed male, change half to female later

set coupled? false ;; Everyone is initially single

set partner nobody

set had-unsafe-sex? false ;; Whether this person had unsafe sex on the last tick

set infected? false ;; Initially, no one is infected

set known? false

;; Set genders of turtles to be 50% male, 50% female

ask n-of (count turtles / 2) turtles [set breed females ]

PLOTS….. Data of interest….?? Will be discussed below in further detail, but includes:

Components of safe sex behavior

average safe sex likelihood --> histogram

% of Population Infected

**Agent Parameters:**

Creating custom attitudes for each agent, rather than blanket assumptions about actions… sliders and normal distribution

***Initialize individual agents by setting gender and unique member variables***

**Attitude:**

users can separately define the initial likelihood a male vs. female agent will practice safe sex. \_(This attitude evolves during the course of the model.) -- remove?

:: Attitude: Intention/desire to use a condom

;; Used as an average for generating chance out of 100 that an agent

;; will use/wants to use a condom (depends on gender)

avg-male-condom-intention (0-100)

avg-female-condom-intention (0-100)

;; ATTITUDE:

;; The desire that an agent wants to practice/the likelihood they will practice safe sex??

;; changes on ticks....

attitude ;;attitude ; feelings about / desire/intention to use / condoms

**Certainty:**

agents have an initial confidence in their opinion, which might be influenced by factors such as parental guidance or religious background

:: Certainty: Could include parental influences, religious background, etc. -->> explain!! \*\*

avg-mesosystem-condom-encouragement (0-100)

;; CERTAINTY:

;; how emotionally attached/strongly an agent feels about their opinion/attitude

;; certainty - likelihood/degree to which attitude changes is inversely proportional to certainty

;; 100 - certainty = likelihood/willingness to change attitude

certainty ;; initially set to mesosystem-condom-encouragement

;; i.e. how much their upbringing encouraged safe sex

;; might consist of parents' beliefs, life experiences, religious attitudes, etc.

**Justification:**

users can indicate the percentage of agents that receive sexual education including condom use. (The current value in America is about 48%)

:: Justification: accurate knowledge about safe sex practices and benefits

;; JUSTIFICATION:

;; the logic or reasoning why they have their opinion, what they have to back up their opinion/attitude

justification ;; initially set to the level of accurate education this agent has about safe sex and condom usage

Not as visible from UI:

In this model, turtles can have multiple friends, but only one sexual partner at a time.

Relationship type is determined by link breeds, and / Color of link indicates type of relationship between the two agents / is distinguished by color: a blue link denotes friendship, and magenta link denotes a sexual partnership link is magenta.

Color - Color is determined by likelihood of practicing safe sex / Color of the agent reflects their individual likelihood of practicing safe sex (labels can also show the exact values, if on)

;06C106 green - 100% likely to engage in safe sex (using a condom)

;FFFFFF white - 50% likely of having safe sex

;C10606 red - 0% likely to use a condom (100% likely to have unsafe sex)

Shape - Shape is determined by gender and sick status. Infected turtles have a dot on their shape, and the color of the dot indicates whether or not they “know” they are infected (white: known? = true; black: known? = false;)

;; color of dot changes based on whether the agent knows they are infected

**Model setup explanation**

Mostly discrete social circles, with some social butterflies that have links to members of other social groups.

Turtles start with a certain number of friend links, and no sexual partner links. Establishing networks consisting of "friendship" links and "sexual partner" links (differentiated by color). Also friend links are gender independent, sexual partners arent

**Agent behavior and rationale: -----**

**Agent Behavior:** *How do the agents behave/work?*

The turtles do not move, but

On each tick:

* Agents talk to their friends (indicated with blue links), and potentially update their opinions about (and consequently likelihood to practice) safe sex.
* Agents look for a sexual partner (male-female coupling).
  + If they are not coupled, they might try to find another single turtle of the opposite gender /someone to mate with (based on their personal coupling tendency). First they look at friends of the opposite sex, if they have none, then they choose a person of the opposite sex within their friend group, and if there isn’t one, then they resort to choosing the closest non-linked opposite sex turtle. The probability of successfully coupling decreases for each of these 3 types of potential partners. If both partners are willing to become a couple, they form a sexual-partner link (if the two turtles were previously friends, this destroys their friendship link).
* Agents make friends
* Agents potentially break up
* If they are in a couple/have a sexual partner/link …. If they already have one, they have sex. The likelihood that the couple will engage in safe sex depends on the willingness of both???? participants.
  + If they mate, there is a probability they will use a form of protection. This probability will be influenced by attitudes and behaviors towards safe sex that a given turtle has, and these attitudes/behaviors are influenced by the other turtles (“friend group”) that the turtle is linked with.
  + If the turtles are coupled, on each tick, they have sex, and have a chance of using protection based on…. If the couple does choose to use a condom, there is a chance that they will use the condom correctly, based on stats from WHERE??? If one of the partners is infected, on each tick with their partner, there is a chance that they will spread the disease to them. This chance is based on whether or not the couple chose to use a condom, whether or not the condom was used correctly (which influences how successful the condom is at preventing infection), and the infectiousness of the disease.
  + If one of the partners is infected and the couple has unprotected sex, there is a chance that the other partner will become infected. An infected agent is distinguished by a dot on their shape.
* Check infected only after having sex ….. or somewhere….. and talking to friends, because symptoms take a bit to show up…?? Only agents of genders that are symptomatic (set by the symptomatic? slider) will know they are infected. If an agent knows s/he is infected, s/he will always want to practice safe sex for the rest of the simulation.
  + Depending on the disease and whether an agent is male or female, the agent will feel symptoms. It will be assumed that if the agent detects symptoms, they get checked by a doctor, are diagnosed, and are gradually cured of the infection. (clarify this!!)
  + If an agent has unsafe sex and doesn’t notice any consequences (either is not infected, or is not symptomatic), that agent’s inclination to practice safe sex will decrease.

**TODO:**

**NEED TO MAKE SURE DOT STAYS BLACK FOR 1 TICK**

**Use word “robust”**

**Check that “Opinion” isn’t used in a confusing way**

**Rationale for agent rules:** *Why did you give the agents these rules?*

I will do further research in order to determine and more accurately base some of the assumptions of this model in scientific literature.

-- Determining what factors inform/influence attitudes towards safe sex (and consequently behaviors), and to what extent they do so [potential options: attitudes of parents/friends/sexual partners, infection history of self or friends, education/awareness of safe sex practices]

**Explanation of theories of petty, etc. \*\*\***

Attitude – asdkfj

Certainty – asdkfj

Justification – asdkfj

Likelihood – asdkfj

**Likelihood**

description of coming up with the formula for likelihood, deciding on attitude, justification, certainty, etc. possibly include a chart

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Initial factors** | **Increase** | **Decrease** |
| **Attitude** | Condom desire | Talking to peers with similar attitude   * (only slightly above? Or also slightly below, but on same pole as you?   If they have sex with a partner that is infected and use protection…??? proposed  Super boosted if contract an STI and know it | Proposed: Think you “got away with” unsafe sex   * but actually, increases justification, just attitude gets more negative? So initially likelihood should take safe sex justification and use it to potentially bump up lower likelihoods, which are most influenced by attitude…? |
| **Certainty** | Mesosystem influence | Every time you repeat your attitude to someone else  If you feel like others have the same/similar attitude as you  Super boosted if contract an STI and know it | Attitude challenged   * *(in opposite direction?? Does it have to be < 50 vs. > 50?)* |
| **Justification** | Sex ed including condoms | Super boosted if contract an STI and know it | Current: Think you “got away with” unsafe sex   * but actually, increases justification, just attitude gets more negative? So initially likelihood should take safe sex justification and use it to potentially bump up lower likelihoods, which are most influenced by attitude…? |

***Evolution of equation***

* rather than whole change happen only fraction of change - dampening
* First bug: realizing that including certainty was making negative people eventually go up to positive 🡪 certainty only impacts how much their **attitude/likelihood???** will change by talking to peers 🡪 **attitude/likelihood???** (change?) is a function of certainty, so updated **attitude/likelihood???** only depends on previous attitude and justification
* Second: distinguishing between likelihood and attitude
* likelihood higher than either attitude or justification alone…?? - can't force numerical score though (????) \*\*\*
* Third: incorporating if attitudes are too different
* Making sure the likelihood went in the right direction, dealing with scales 0-100 when maybe should’ve done -50 to 50 or -100 to 100
* Dealing with 0’s in equations

**Model/System Behavior:** *How does the overall system behave/work?*

Ideally supposed to show… system behavior: The NetLogo system will model the spread of sexually transmitted diseases (STIs) between young adults (male and female), based on their attitudes and behaviors regarding safe sex. … and the interaction between the two? ( partial duplicate from above). Actual results indicated… go into results.

**Things to try:**

If you start with at least 1 person infected, can everyone have a positive attitude without infection spreading significantly? How long does it take for the most opposed person to change their mind significantly? How can this time be reduced?/what parameters can be changed?

Can everyone get negative? With a STI present in the population? Without a STI present?

Can everyone get positive? With a STI present in the population? Without a STI present?

Can some cliques form attitudes significantly different from those of other cliques?

Can there be someone who just refuses to change his or her mind?

Making sure that these outcomes, which I felt were reasonable, could happen, also helped me adjust formulas…. (discussed above)

Model/system behavior con’t:…

Simplifications here???

**Analysis & Sample Trials / Sample Outcomes**

Members of the same social group influence one another’s attitudes

Still has a negative attitude towards wearing a condom, because he doesn’t realize he is infected

Dot color indicates whether the agent knows they have an STI (based on being symptomatic)

Once an agent realizes they have an STI, they form a strong desire for safe sex

**Sample Outcome/”case study”**

Do a sample simulation?? With pictuers!!

Female 0 is infected. She is not symptomatic. She mates with male 0, and he becomes symptomatic, immediately changing his attitude towards safe sex from pretty negative to strongly positive. By talking to his peers, he persuades them to improve their attitudes as well. Since he is very certain of his opinion, he talks to all his friends. However, direct experience is more powerful than second hand experience, so they are not super duper impacted by his story, but their attitudes may improve slightly. If they are very polarized (super negative), they will react negatively to talking to male 0, and become more certain of their negative attitude???

**Analysis of home life influence vs. education influence**

Lkj;lkj;lkjl

**Model output:** *Do you think your model currently provides a good description of the system’s behavior? Why or why not?*

However, there were a significant number of assumptions/limitaitons/simplifications to this model….

Transition to assumptions/simplifications? Or rearrange order talked about?

Talk about simplifications.

However/Despite these/ because of all of these limitations/assumptions, in combination with a lack of research (and likelihood of inaccurate research given the private nature of the topic), difficult to determine if my model output is valid.

However, did do analysis… and results of analysis indicate…

Going back to guiding questions, was most interested in how intervention could help increase attitudes, certainty, and justification (and consequently likelihood of safe sex behavior) ina social network demographic.

**Assumptions, Simplifications, (consequent??) Limitations**

**Assumptions:**

* Only 1 type of STD, not specific – other models can handle this better (virus, aids, etc)
* Clarify that only Form of safe sex protection?? in question/explored in this model … is specifically/**only**??? condoms, because most prevalent and accessible / cheapest?? (form of safe sex protection) in the demographic I’m interested in modeling, [[as it does not require an age limit, prescription, etc…. and college campus usually have condoms freely available.???]]
* Should agents be able to have multiple sexual partners? --> NO
* if they know they are infected, want to use safe sex…. If they are symptomatic, they will know they have an std, and will want to ALWAYS practice safe sex from there forward (assuming that people are kind and not malicious)…. This doesn’t always convince someone entirely, could be explored further
* Should people get treated and cured…?? No… Assume no testing/curing takes place? just whether they get an std??? not susre……\*\*\*… the turtles don't get cured of this std, because after having an std, they always want to practice safe sex, so its about the same effect anyway (if i dont get condom accuracy stuff in). (following duplicate below) turtles also don’t randomly get tested, nor is likelihood of getting tested based on gender – this is better covered by other models (aids)…. It will be assumed that if the agent detects symptoms, they get checked by a doctor, are diagnosed, and are gradually cured of the infection. (clarify this!! – duplicated above)
* Social networks are static/limited: no friendships die, no social group membership changes, an agent can’t be part of more than one social group
* Different sexual behaviors (monogamy, abstinence), likelihood of using protection for different sex acts and likelihood of transmission through them (would get pretty explicit)
* sexual partners don’t break up due to different attitudes!!! This could be big area of conflict, suggest an extension

make friends (will only be called if the turtle has not reached their maximum friend limit) and their tendency is acceptable

turtles also don’t randomly get tested, nor is likelihood of getting tested based on gender – this is better covered by other models (aids)

Additionally, there is a chance that a turtle will randomly get tested, despite whether they are currently symptomatic – this probability may also be impacted by their attitudes towards safe sex…. No, took this out

Explain how **percentages of types of sexual education throughout america/ levels of knowledge of safe sex when entering college were created. decided** Don't need stats on percentages of prevalence of STIs in target demographic, to start out simulation (rather than having person choose to infect people) …. since could vary, and want to also simulate without an infection present, which could potentially be younger kids??

**Extensions/didn’t get to**

interaction between sexual partners and peers equal or no?

sexual partners don’t break up due to different attitudes!!! This could be big area of conflict, suggest an extension (duplicate above)

media/environment influences - since a lot of articles written during time that hiv/aids was exploding, prior to that condom use/protection/safe sex more about preventing pregnancy…

Social networks limited: 🡪 extension potential for both generation and analysis

Creating “advocates” – at NU, SHAPE program

More realistic interactions between groups, less social butterfly potential?

strength of relationships 🡪 stronger relationship sexually = less to use condom? Stronger with friends = more likely to talk about it?? Didn’t find research to support these, but seems intuitive

the ONLY way someone can know theyre infected is through beings ymptomatic.. incorporate telling past partners if you realize you have an std, more responsible behavior. But also include a likelihood of people to do this.

**Evolution of Model:**

I had originally been primarily interested in seeing how an STI that is symptomatic for only one gender travels through the population and potentially reaches some sort of stable state. However, based on the feedback I have received, I think I will focus more on the sexual attitudes and behaviors of agents in relation to the spread of STIs. Hopefully this will also more clearly distinguish my model from the AIDS or Virus model, which was a concern that both the TA and I had. I still need to find some supporting articles/other research in order to root some of the assumptions of my model.

Turtles will move around randomly mostly within a specified area, in order to try to recreate circles of friends or divisions of populations. This has not yet been implemented, but the NW extension or links may be used to confine movement. 🡪 got rid of movement, they stay in one place

network connections could potentially be a reasonable way to model friend circles, which could influence behavioral choices and attitudes towards sex and using protection.

Rather than having turtles generate a network, just generate it for them to simplify.

Mostly discrete social circles, with some social butterflies that have links to members of other social groups. [repeat sentence from above] (in creating this functionality, used Sophia sullivans final project on modeling commons as a starting point, then adjusted breeds and other parameters as necessary).

-- Determining what factors inform/influence attitudes towards safe sex (and consequently behaviors), and to what extent they do so [potential options: attitudes of parents/friends/sexual partners, infection history of self or friends, education/awareness of safe sex practices]

(duplicated from above)

🡪 Implementing (or deciding whether it is valid to implement) whether a particular gender is symptomatic of an STI, therefore becoming aware of it, getting treated, and potentially changing their future behaviors 🡪 originally this was up in the air, but I considered it essential for what I wanted to model, as symptomaticness of stis can play a big role (citation???) especially for young adult minds that Ihave not fully developed and may not see positive

Since sexual partner links will break any sort of link between 2 turtles when the relationship ends (rather than going back to being friends), turtles also have the chance/opportunity to make more links than their original number – this helped fix/account for all links between genders breaking and becoming discrete, gender-segregated friend groups, which isn’t realistic.

Limitation/assumption or evolution progress?? Not sure

cliques aren’t formed on the basis of shared attitudes (but would they really, in real life? Possibly based on education received, but it was hard to accurately do that through my implementation)

gender balance (or not balance?) cliques?? no, it is randomized

**decided to eliminate:**

vocality - used certainty instead for simplification. but could be an extension? this model assumes that the agents are willing to talk about the sensitive topic of safe sex behaviors with their peers, which may not be true at all se

If a turtle is closely linked to another turtle of the appropriate gender to mate with, there is a probability they will mate. 🡪 got rid of strength of relationships

-- Investigating whether a female being on birth control is a valid parameter that might impact whether she chooses to engage in safe sex 🡪 didn’t find any supportive research

was interested in media/environment influences - since a lot of articles written during time that hiv/aids was exploding, prior to that condom use/protection/safe sex more about preventing pregnancy…. but left as extension for user

-- Implementing likelihood of proper use of sexual protection based on statistics, and consequently different potential rates of transmission

If the coupled turtles use protection, there is a probability of using it correctly – if protection is used correctly, it is assumed that the disease will not be passed on. If the protection is used incorrectly or no protection is used, there is a higher probability that the infection will be passed to the partner of the agent. 🡪 couldn’t find stats for std prevention, just pregnancy, this could be an extension \*\*

**NetLogo Features**

should I have 2 breeds of sexual links? or just one with a type and color….? 2 breeds

**References, Related Models**

used sophias as a starting point, but only took relevant stuff, mostly just network generation and creating spatially separated clusters - e.g. no equivalent to bosses in my model, so removed...

**Questions:** What questions do you have about your model?

**Next steps:** Briefly list your next steps for improving the model.

**Thorough description/explanation of Agent Parameters:**

**had-unsafe-sex?:** Whether this person had sex without a condom on the last tick

**infected?:** If true, the person is infected (and infectious)

**known?:** The person is infected and knows it (due to being symptomatic)

Note: The agent will not "know" they are infected (and set the known? to true) until check-infected is called…and even then, they will only be aware of their infected state if his/her gender is symptomatic. ……An agent will not ever know if they are infected (their known? variable never = true) if they are not symptomatic/of a symptomatic gender, which may enable an STI to more easily spread through a population \*\*\*\*\*\*

Note: In this model, agents that know they are infected always use condoms to protect their sexual partners

**coupled?:** If true, the person is in a sexually active couple.

**partner:** The person that is our current partner in a couple.

**couple-length:** How long the person has been in a couple.

**friendship-tendency:** How likely this person is to make a new friend. (doesn't change)

**coupling-tendency:** How likely the person is to join a couple. (doesn't change)

**commitment:**  How long the person will stay in a couple/relationship. (doesn't change)

**num-friends:** The ideal/goal number of friends that an agent wants to have

Friendships can only break if the friend was of an opposite sex, they formed a sexual relationship, and then they broke up, which breaks all links between them. Setting this parameter allows agents to try to keep their desired number of friend connections. Sexual partners are not counted in the friend count. This value is set to the initial number of friends/links an agent has, which is generated randomly on a normal distribution at setup….???

**group-membership:** which cluster/friend group the friends and leaders are mainly part of

This still applies to social butterflies - assume they have a core friend group

in addition to more out-group links than others