TELL ME Simulation Model

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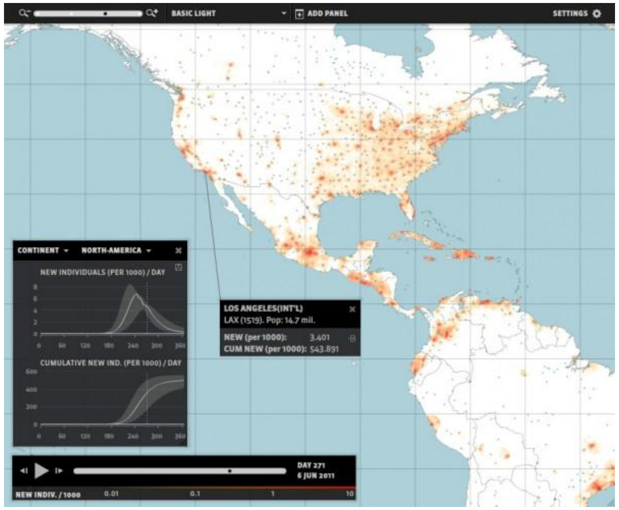
Why build a model?

Excellent existing models about epidemic spread

- some models connect personal behaviour (exogenous)
- no models connect communication

TELL ME prototype connects theory about:

- communication
- personal behaviour
- epidemic spread



GLEAMviz: http://www.gleamviz.org/simulator/

Design process

Knowledge sources:

- reports and datasets concerning attitudes and behaviour
- literature (esp. psychology)
- TELL ME resources (D1.1 review, ISS re datasets)
- discussions with groups of experts concerning broad design elements
- selected experts concerning specific design issues

Two key groups of experts:

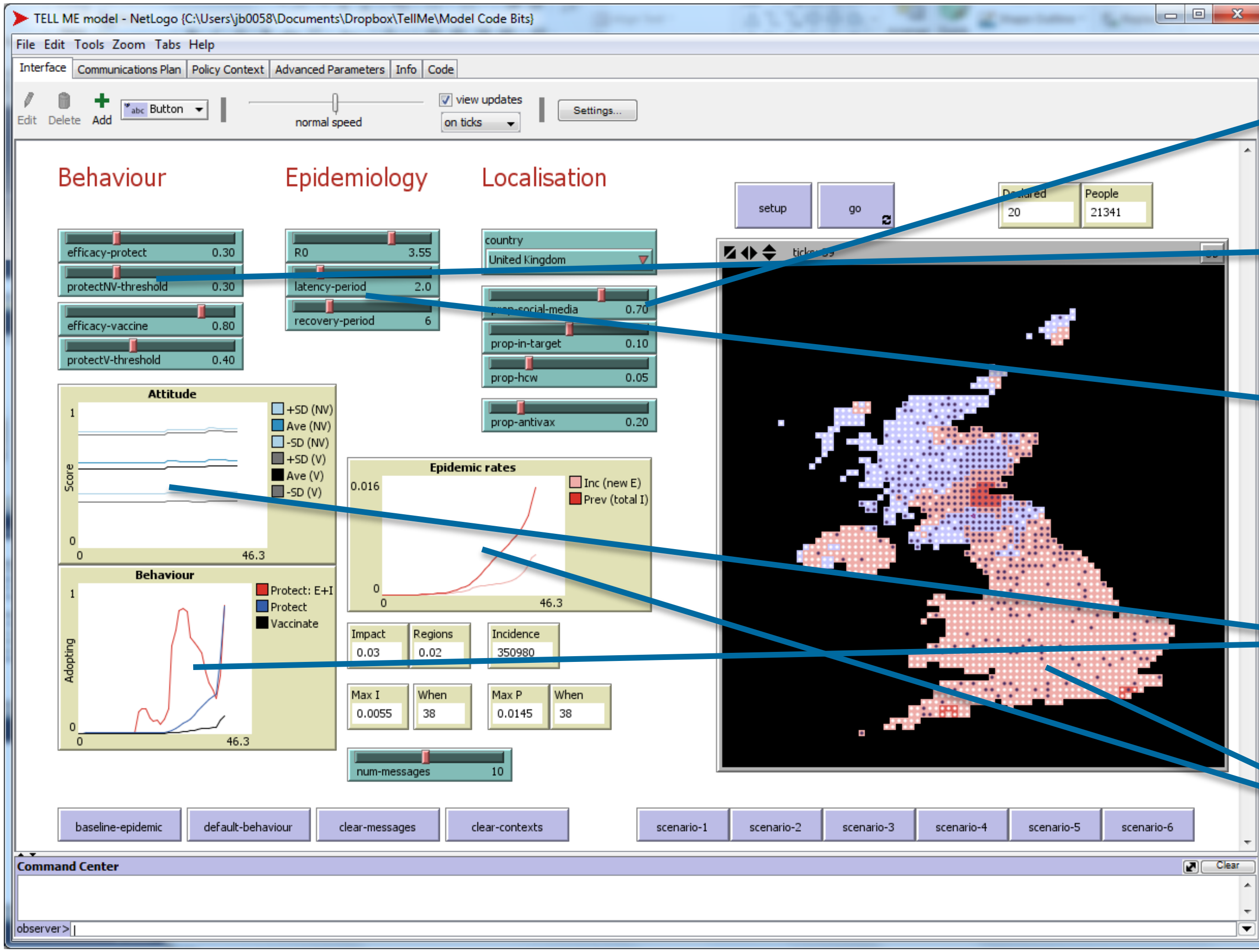
- communication, behaviour, epidemiology
- TELL ME partners
- stakeholders group
  - UK officials + 2 partners + e-com project

Focus of broad discussions:

- demonstration model
- design documents
- communications language

Prototype: main interface

(Eventually) help health agencies plan communication to minimise epidemic impact



Inputs

Communication effects

Behaviour adoption and its effect

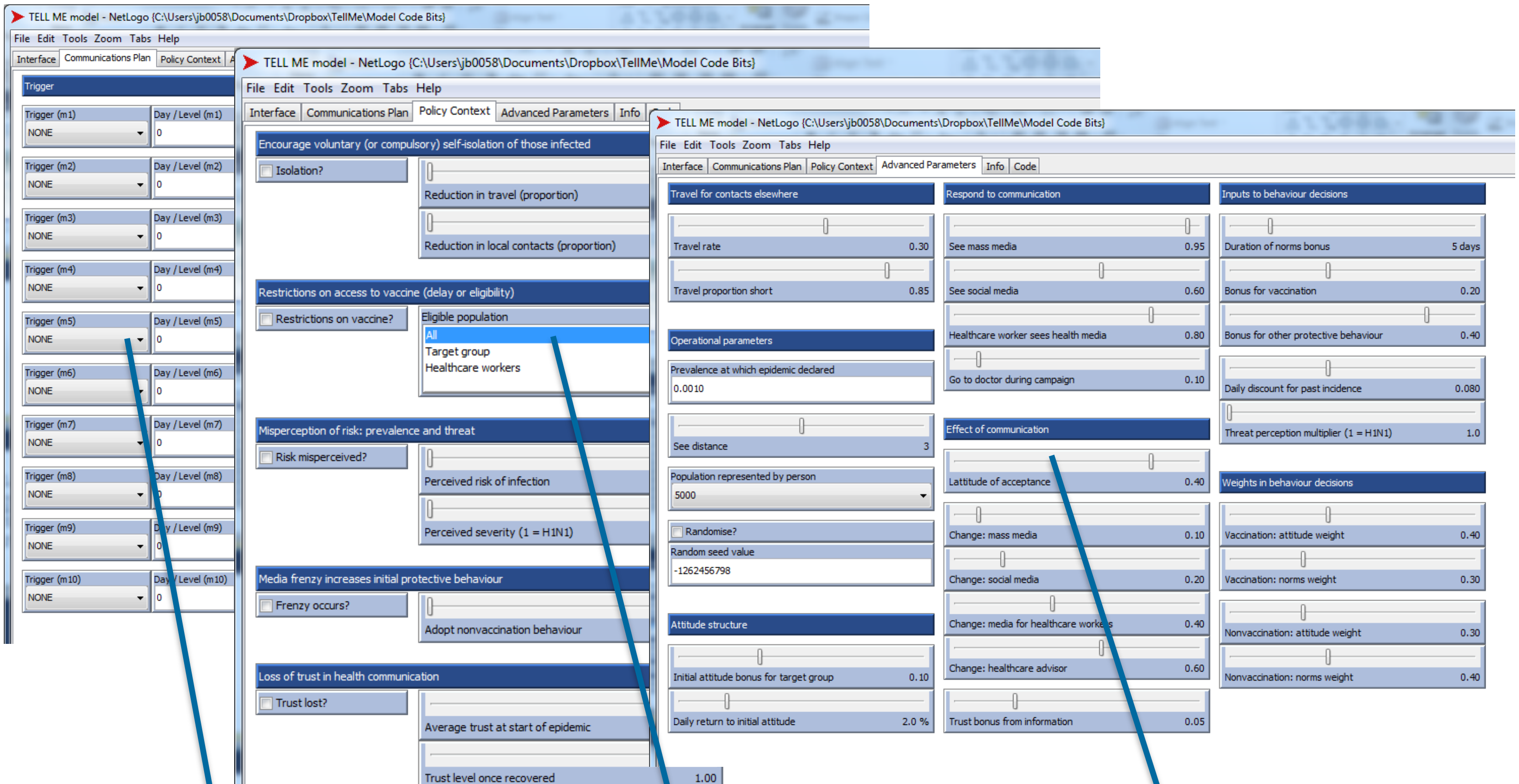
Epidemic features

Outputs

Communication effect: attitude and behaviour

Epidemic progress

Detailed input screens

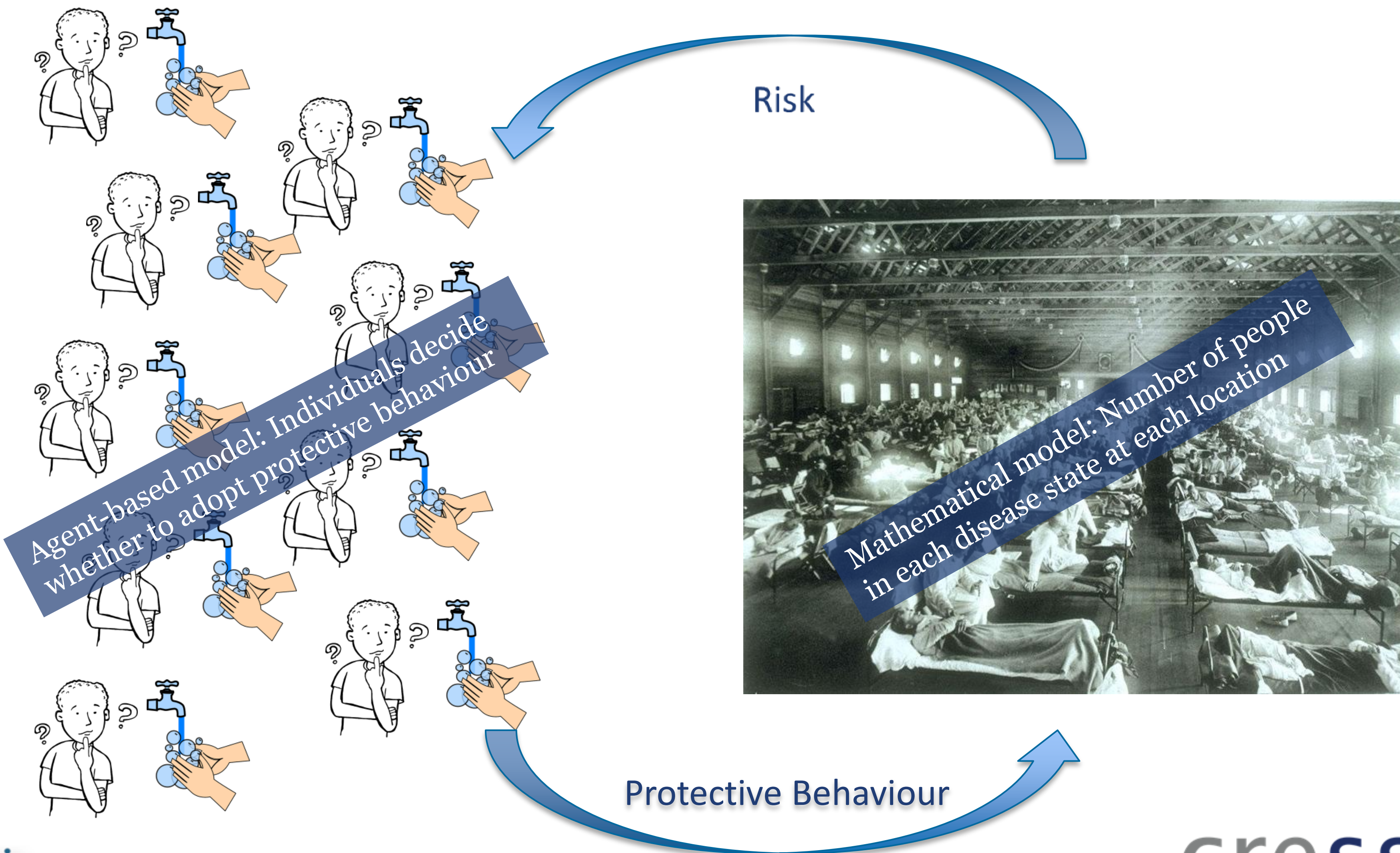


Communication plans (message sets)

Situation elements (eg isolation, trust)

Customisation as data available

Two connected models



Agent-based model for protective behaviour

Thousands of individual heterogeneous agents (simulated people)

- properties based on population structure
  - location, healthcare worker, ...
- behaviour relevant characteristics
  - attitude, media access, ...

Agents change characteristics in response to communication messages

Agents decide whether to adopt protective behaviour based on psychological models

- consider own situation
- based on own characteristics

Protective behaviour: implementation

Well established models from psychology about the influences on behaviour

- Theory of Planned Behaviour
- Health Belief Model
- Protection Motivation Theory

TELL ME model uses hybrid

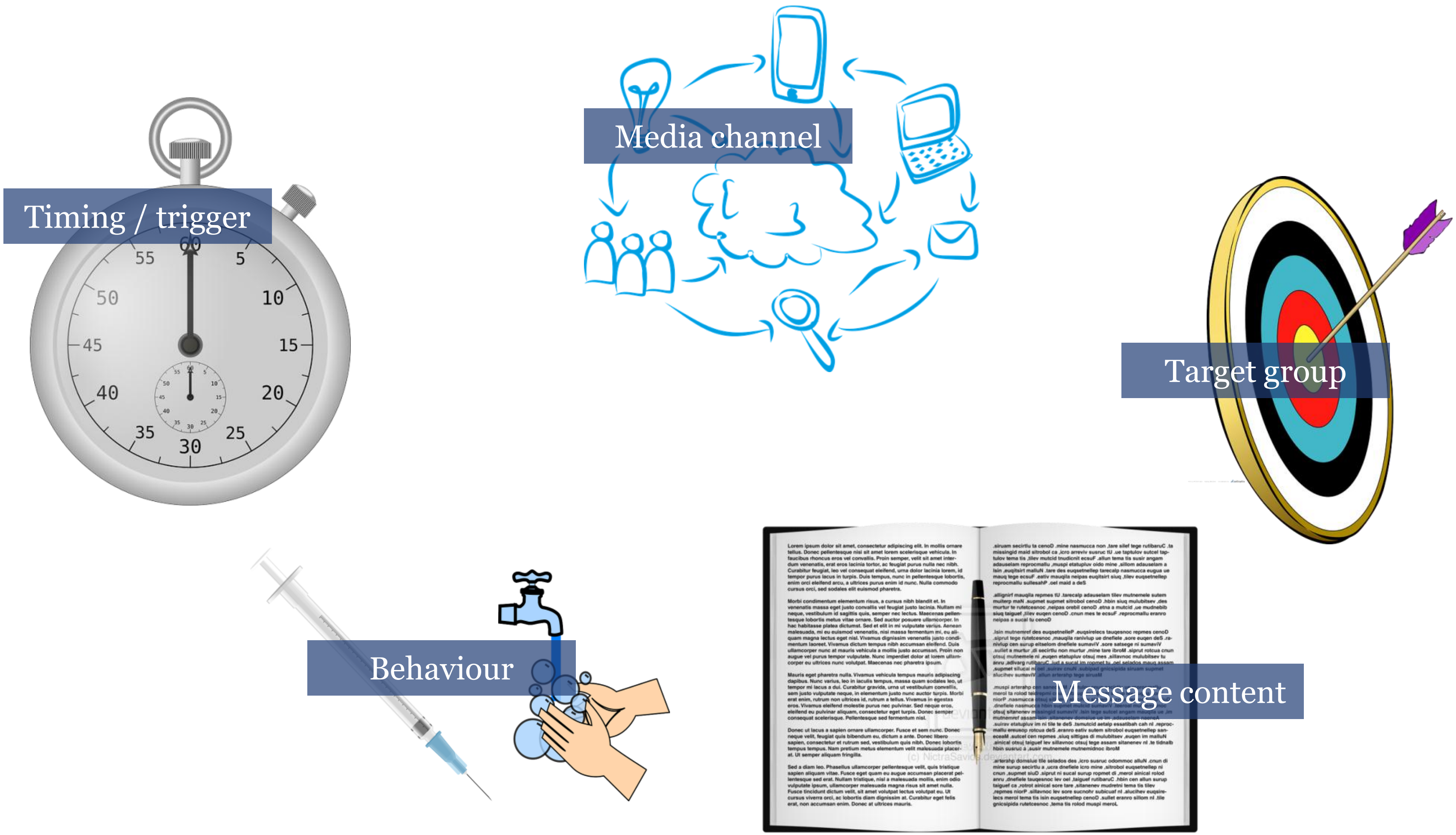
- those factors that have large effect size and chan
- factors selected are:
  - attitude (score 0 to 1)
  - perceived norm: proportion of nearby agents who have adopted behaviour
  - susceptibility: discounted visible cumulative incidence
    - today's new cases count more than yesterday's, which count more than the previous day's and so on
  - severity / worry: multiplier on weight for threat component

Behaviour decision: compare weighted average of factors to a threshold

Connection from mathematical epidemic model

Communication plans

Communication plans described as package of messages with five properties



Communication effect

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Messages act on simulated people (agents) who are exposed (target, media)

If content promotes benefits

- attitude increases if the message is not too far away from the person's current attitude score
  - technically - proportional within latitude of acceptance (SJIT)

If content emphasises responsibility

- for the next few timesteps, the agent adds a bit to their calculated behaviour score (through the norms component)

If content provides epidemic status information

- future messages are more trusted

If content recommends adoption of some behaviour

- for the next few timesteps, the agent recalculates their behaviour score with a high risk component

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Mathematical model for epidemic spread

Standard SEIR model

- Susceptible
- Exposed
- Infectious
- Removed (immune, dead)

$$\beta_r = \beta\left(1 - P_r e\right)$$

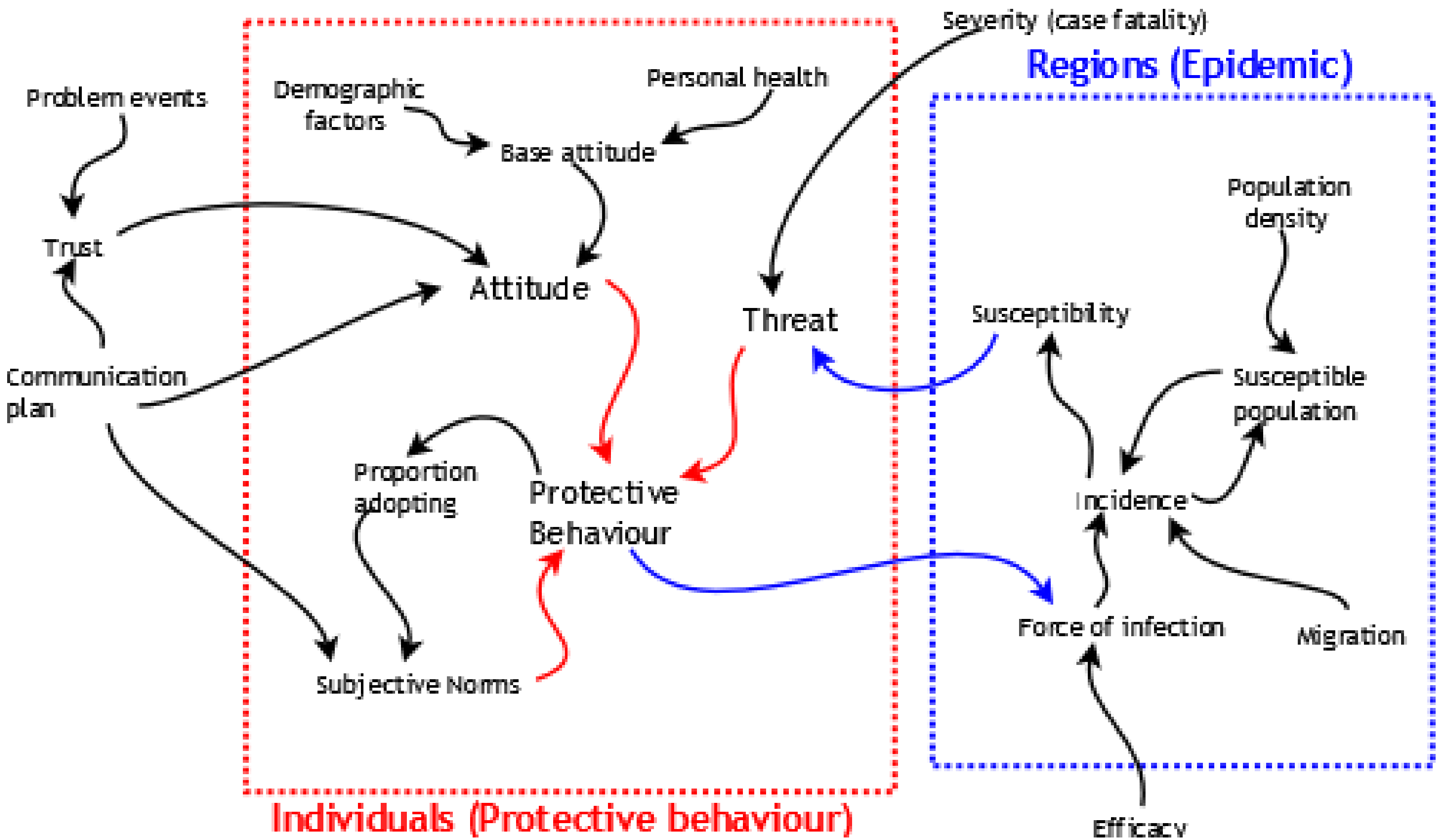
Connection from personal behaviour agent-based model

S → infectivity rate contact with I → E → latency → I → recovery → R

Spatially explicit difference equations keep count of the population in each disease state

Broad model logic

Putting all the pieces together



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Demonstration

Predefined scenario

Problem: Calibration

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Large number of parameters
- Communication effect: trust, attitude proportionality, latitude size, ...
- Behaviour model: weights, incidence discount, ...

Parameters specific to:
- infection (SARS, H1N1...)
- type of behaviour (vaccination, hygiene, masks...)
- culture (Europe, Asia,...)

Some longitudinal data
- 9 studies with both prevalence and behaviour
  - 3 diseases in 5 countries
  - mix of behaviours

No longitudinal communication data

Prototype is NOT suitable for prediction

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Summary

First model to link three inherently connected components of the system of an influenza epidemic:

- Communication
- Personal protective behaviour
- Epidemic progress

Will deliver: model + documentation + predefined scenarios

Initial uses:

- Identify gaps in the theoretical understanding of behaviour
- Understand the important of effective communication
- Guide data collection to support future models that compare communication options