

# Agent-based simulation of social interactions to model diffusion of compliance with a transport policy measure

Yos Sunitiyoso, Erel Avineri, Kiron Chatterjee

Centre for Transport & Society  
University of the West of England, Bristol

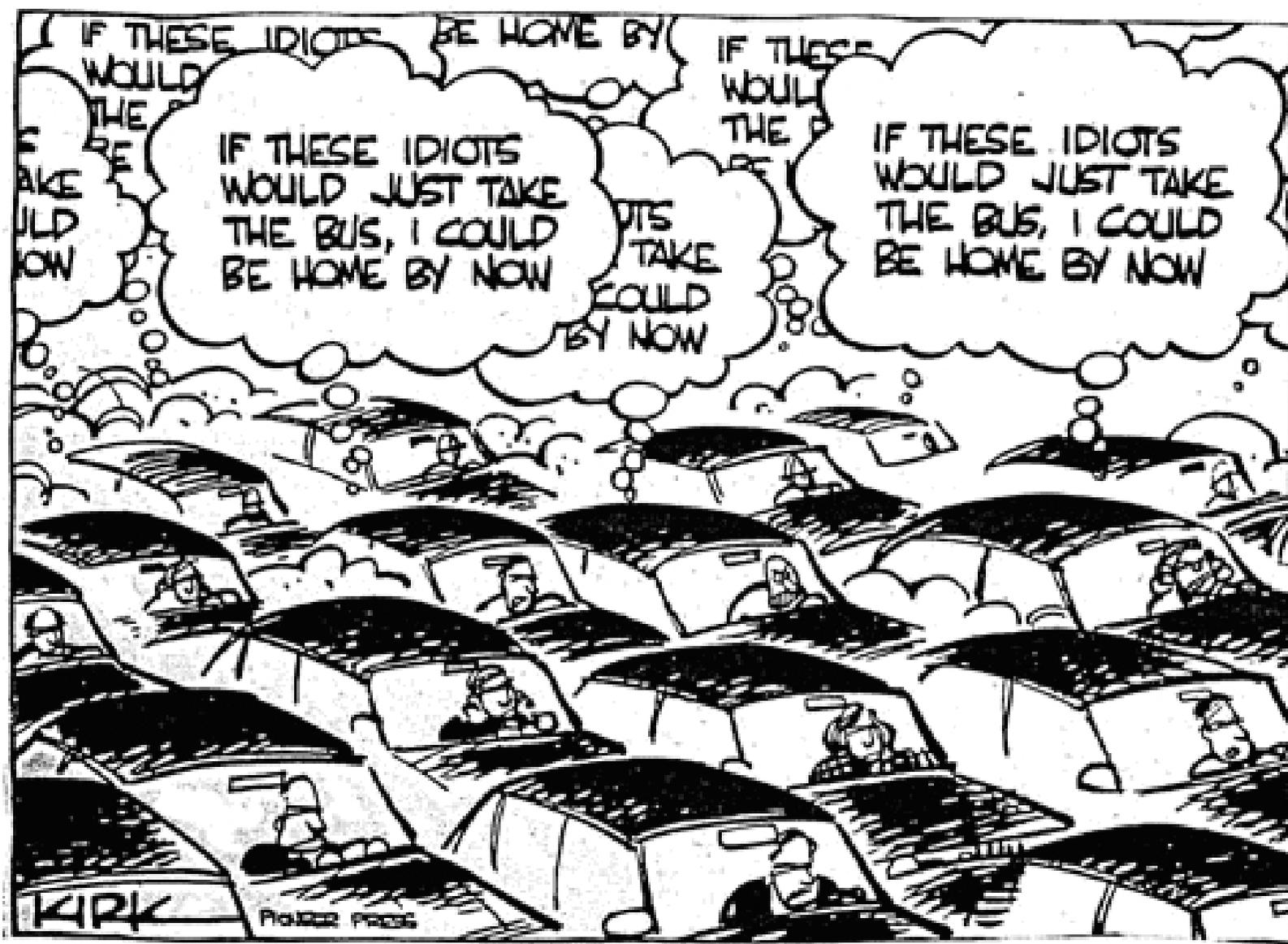


Faculty of the  
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# Mode choice & transport policy

- Modes of transport: private car, public transport, walking, cycling
- Transport policy relevant: mode choice affects
  - general efficiency with which people can travel, whether choices are available
  - environmental impacts of traffic, utilization of roads, liveability of cities
- Domination of car creates car dependence given its immediate advantages: “cheap”, independence, convenience – contribute to traffic congestion
- Key role of public transport (bus) : make use of road space more efficiently, more users - better service
- Modal shift has been emphasized in the UK and EU Transport White Paper



Source: [www.transcoalition.org](http://www.transcoalition.org)

# Demand management measures

- **Structural intervention (“hard” measure)**  
change incentive patterns: change payoff structure, reward-punishment, situational change
  - Congestion charging
  - Parking restriction
  - Residential or workplace relocation
- **Psychological intervention (“soft” measure)**  
influence attitudes and beliefs: increase awareness, providing information and advice on alternative
  - Travel awareness campaign
  - Travel plan
  - Car-sharing

# Diffusion of compliance

- Diffusion process of compliance with a policy measure may have important role in encouraging behavioural change
- Strategies that require households to diffuse information both between households and ultimately across communities are likely to be effective
- Spreading information by word-of-mouth is an effective way for diffusion and reinforcement
- Involving key people ('trusted others' in the community) will provide more advantages
- This is related with the idea of minority influence where 'trust' is one of factors that builds someone reputation

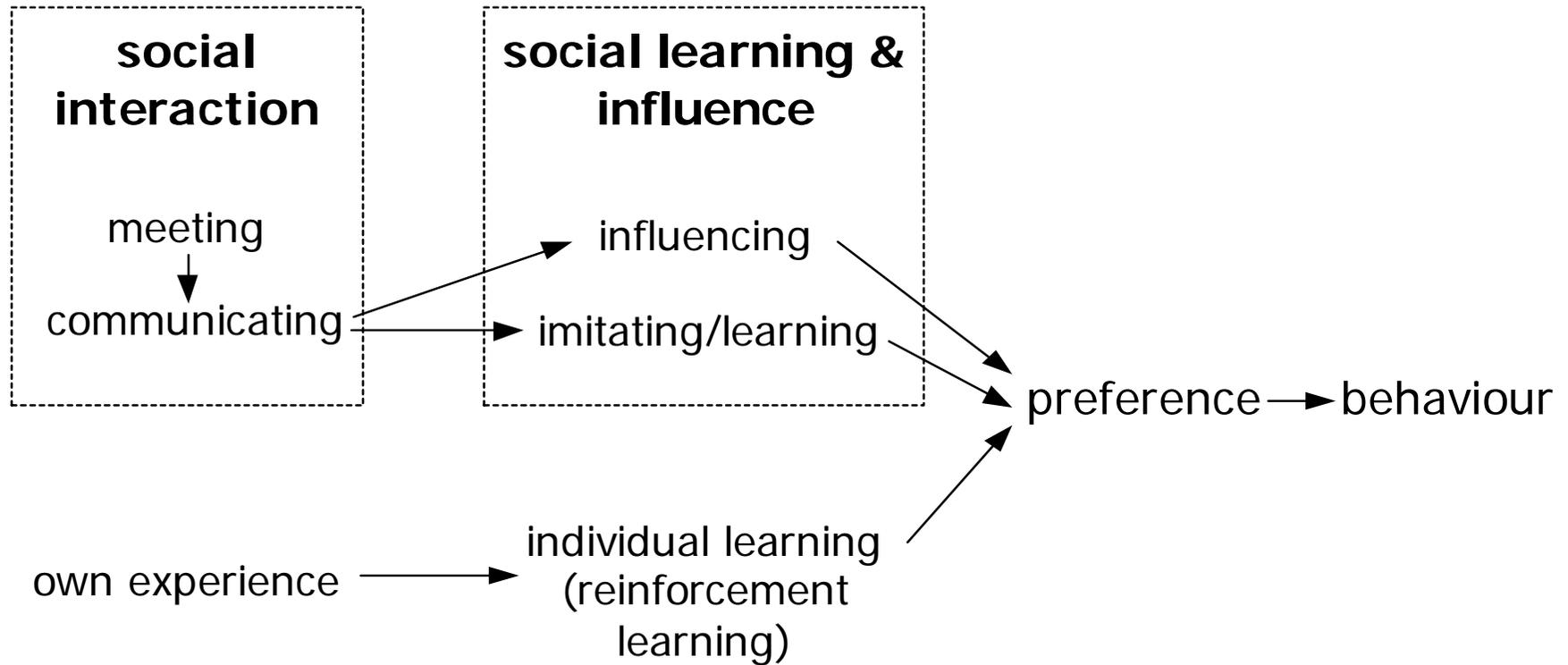
# Research hypotheses

- **Social aspects**, including social interaction, social learning/imitation and social influence, may influence travellers' decision making and behaviour
- **Repeated social interactions** between individuals:
  - generate high propensity for communicating
  - give more opportunity to induce compliance in the population
  - enable exchanges of information between individuals and provides a means of social learning/imitation
- **Minority influence**, a type of social influence, may have an important role in diffusion process

# Research objectives

- To obtain informed insights on the influence of social aspects in travellers' decision making to comply with a policy measure by utilizing agent-based approach
- To provide a better representation of social interaction with respect to travel decision making, which includes
  - consideration of various interaction domains: neighbourhood, workplaces, out-of-work social clubs
  - process of interaction: meeting & communicating
- To develop a model of social learning and social influence,
  - investigating role of minority influence in diffusion process

# Main concept of the study



# Social interaction

- Social interactions may occur within multi-dimensional relationships, based on similarities of 'social club' domains
  - Possibility of repeated interactions between individuals differs from one social club to another
  - Size of a social club can give different effects on behaviours of its members.
- Process of interaction
  - **Meeting**: two individuals meet each other without engaging in an activity involving an exchange of information
  - **Communicating**: may follow the meeting if there is a mutual agreement between them

# Social interaction

- Various 'social club' domains
  - Neighbourhood
  - Workplace (or course of study – for students)
  - Out-of work social club (or out-of-study social club)
- Structure of network has an important role to determine a successful diffusion of influence.
  - Neighbourhood: lattice structured network
  - Workplace & other social clubs: complete mixing (random)
- A distinguished agent ('star') has the power of manipulating the direction of social learning and it does not face a choice problem and stochastic shock
- 'Stars' may represent a group of minority with high influencing power

# Social learning & influence

- Social learning/imitation and social influence may occur during process of social interaction
- Social learning/imitation: change of judgments/opinions is a result of active search for information by the individual
  - **Imitation**: carry out the action that they observe from others without thinking much about the consequences
  - **Learning**: consideration of the consequences of learned behaviour. Individuals may learn from the mistakes made by others
- Social influence: the change is a result of being exposed to those of other individuals
  - **Majority influence**: efforts to produce conformity on minority
  - **Minority influence**: efforts to convert majority to its way of thinking

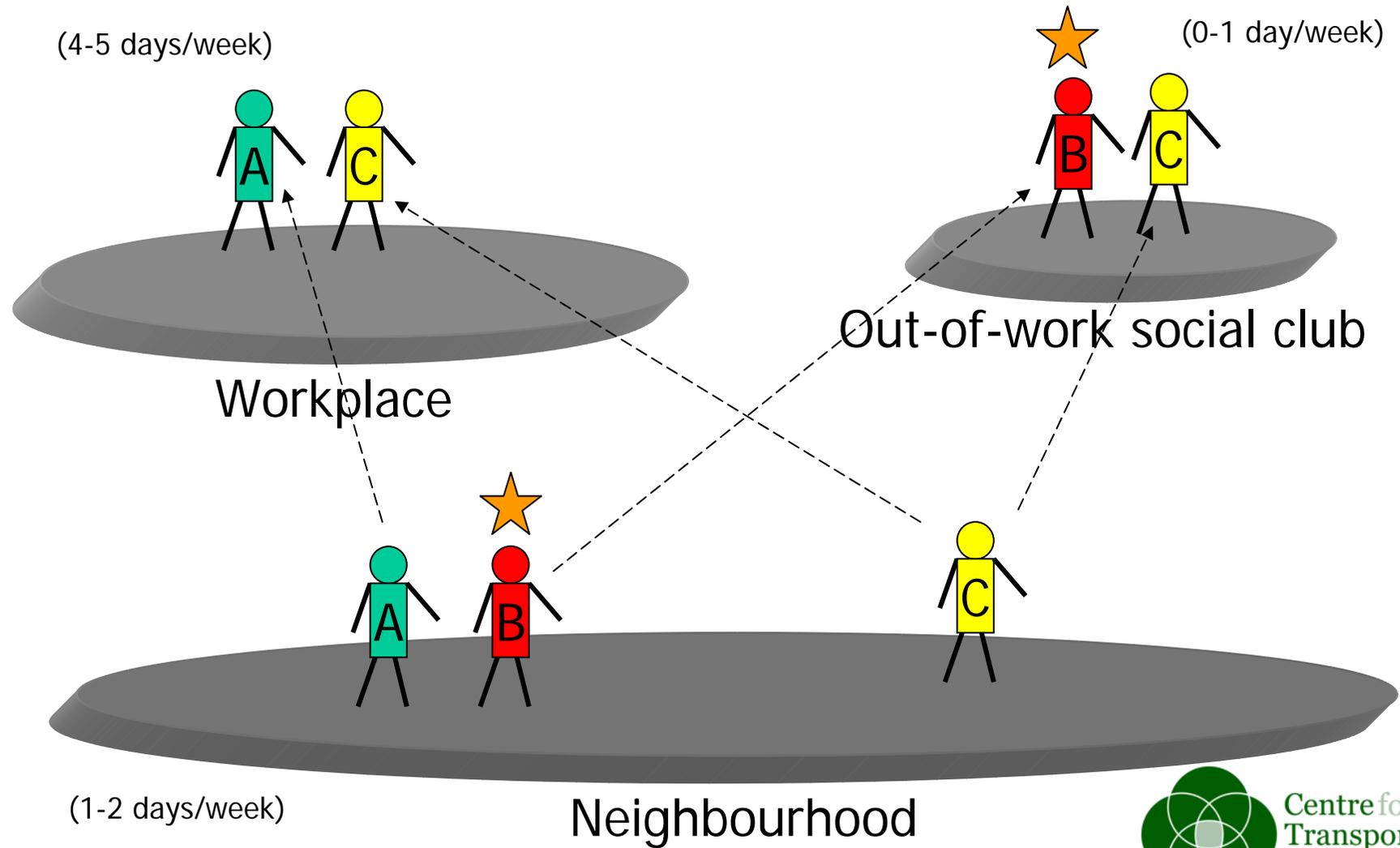
# Minority influence

- Few influential agents (independently or in group) have more **power to influence others** whom they communicate with
- Strength of their influence is derived from the **reputation** built from their consistency of choice
- 1<sup>st</sup> Theory of Social Impact - Principle of Social Forces:

$$\begin{array}{ccc} \mathbf{Strength} & \times & \mathbf{Immediacy} & \times & \mathbf{Size} \\ \text{(power, expertise)} & & \text{(proximity in} & & \text{(number of influence} \\ & & \text{space/time)} & & \text{sources)} \end{array}$$

- The minority influence may have smaller number of influence sources than majority, but it may rely on **strength** (influence power from reputation) and **immediacy** (closeness of relationships between people)

# The model: Multi-domain interactions

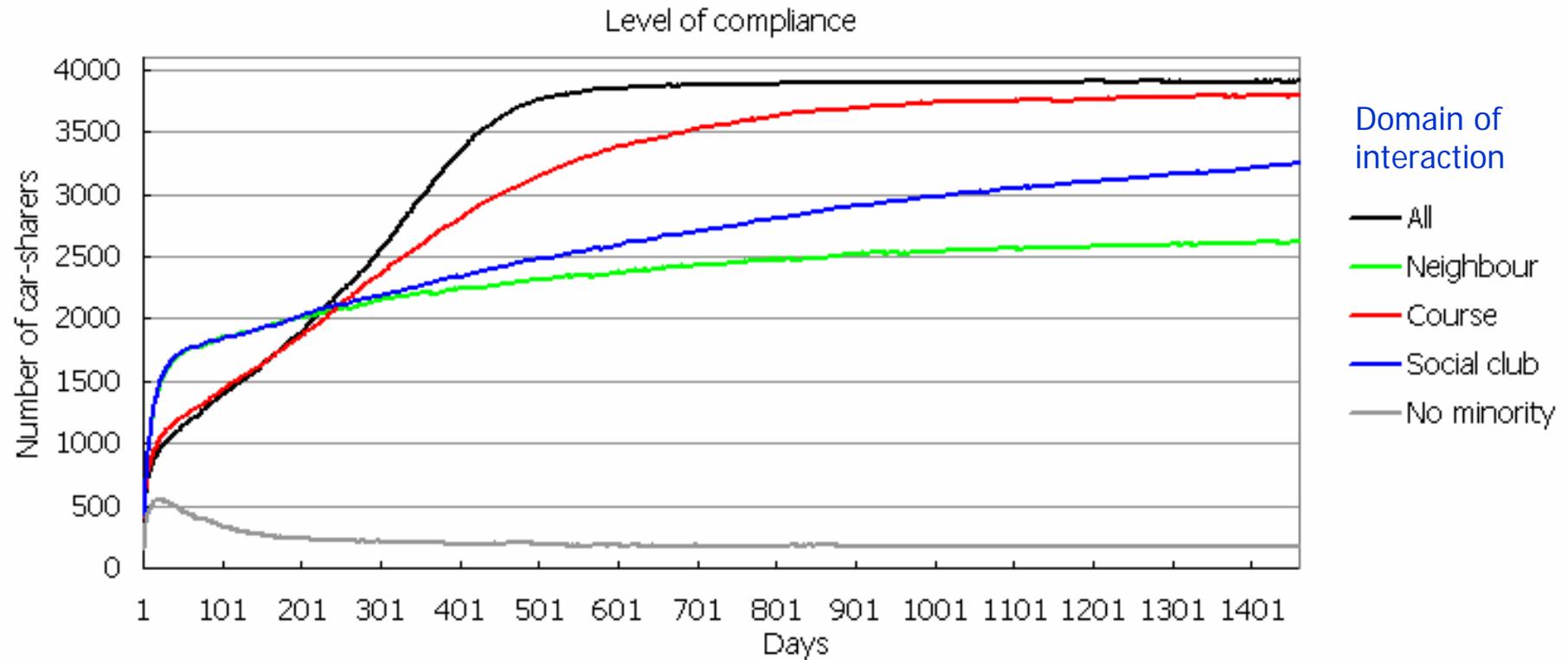




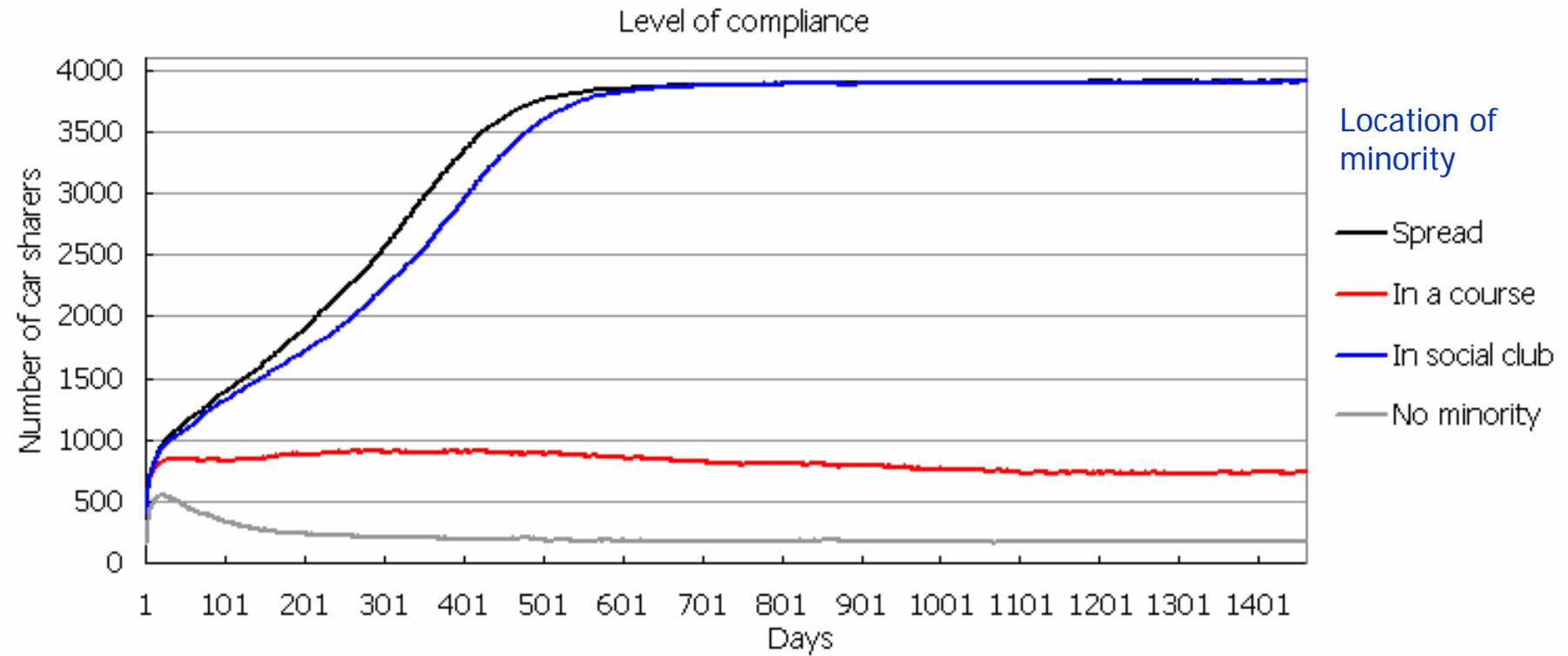
# Parameters & initial variables

- Behavioural survey on university students
- University setting:
  - Workplace → course of study
  - Out-of-work social club → out-of-study social club
- Policy measure: car-sharing
- Parameters: threshold for communicating, reputation, weight of others' influence, reinforcement factor, decaying factor, size of minority
- Initial variables: preference, deg. of relationship, timing of making decision, decision, level of compliance
- 178 types of individual (survey) → 4096 agents (model)

# Interim results



# Interim results



# Pre-conclusions

- Model is able to provide some informed insights about diffusion of compliance with a policy measure through various kinds of interaction domain
- Role of minority influence on eliciting compliance has been demonstrated in the experiments
  - A small number of influential individuals are able to diffuse their choice to others
  - A group that consists of members with high preference to comply is able to diffuse their compliance to other individuals from different groups.
  - Several small-sized groups are more productive in inducing compliance rather than a single big-sized group, since wider scope of interaction can be covered when more groups involved

# Pre-conclusions

- A group domain with a high opportunity of repeated interactions between its members, like course of study, has an important role on the spread of compliance
- Neighbourhood may have a smaller role since the interactions between neighbours are mostly incidental and not as frequent as in the workplace
- These findings show that repeated interactions between individuals generate higher propensity for communicating which later give more opportunity to induce compliance in the population

Thank you !

