Computational Social Simulation

Studies of Creativity & Innovation in Complex Social Systems

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Outline

- Design and Social Change
- Cellular Automata (CA)
- Social Networks
- Multi-agent Based Simulation (MABS)
- Discussion of this Approach
- Long-term Vision

Designers and Social Change

- Designers shape the built environment
- They may trigger innovation and be regarded as creative practitioners
  - i.e., they may be ascribed a creative value by different stakeholders
  - Computer simulation enables the study of design as an element of change in complex social systems

CA

- To explore urban segregation, demand-supply economic systems, social influence, and innovation diffusion…
- Output: emergent patterns of coordination in decentralised systems
  - Ergodicity: a tendency of recurrent random walks in one and two-dimensional spaces
- Do these simplistic models capture anything relevant about social systems?
- Bottom-up emergent patterns are used to proclaim a novel kind of scientific inquiry
  - Used to explain general processes of chemical, physical, and biological phenomena

Criticisms of CA

- Representation limited to a two-dimensional rectangular or hexagonal grid of equal height and width.
  - Small variations in the shape, size, density, and arrangement of these units can have significant effects on the emergent patterns
- Useful to replicate reactive group behaviour determined by environmental cues
  - Social agents can be assumed to build models of the social state
  - Bottom-up linear emergence may be insufficient to represent social phenomena
  - Lateral and circular emergence between individuals and groups is necessary
- CA models are of limited use to explain social systems

Insights from CA

- A combination of group imitative behaviour and occasional minority dissent facilitates the spread of new ideas

MINORITY	MAJORITY	COLLECTIVE RESULT
Imitates	Imitates	Convergent lock-in
Dissents	Imitates	Recursive innovation
Dissents	Dissents	Noise

- Group structure: ‘degree of separation’ determines the diffusion of ideas.
  - Diversity is likely to emerge and be maintained in groups where neighbours-of-neighbours are not mutual.
  - Societies where members are part of various contact networks are more likely to support the emergence of new values

Insights from CA (cont.)

- Interaction between groups promotes diversity
  - Whilst spatial structures (social) remain unchanged over long periods, value organisation (culture) can evolve periodically

- The composition or structure of artefacts can determine the speed and scope of diffusion
  - An artefact with high compatibility and low complexity is likely to speed rapidly and reach a large segment of a population

Social Networks

- Small-group research shows that individuals are more creative than groups
  - A higher number of original ideas are generated when people work separately than when they work in teams
- Ideational Productivity
  - A social net model of idea generation enables computational brainstorming experimentation
- Production blocking
  - Nominal groups generate around 50% more distinct solutions, and up to 70% more explorative behaviour than real groups
- New techniques to manipulate the sharing of conceptual structures in brainstorming

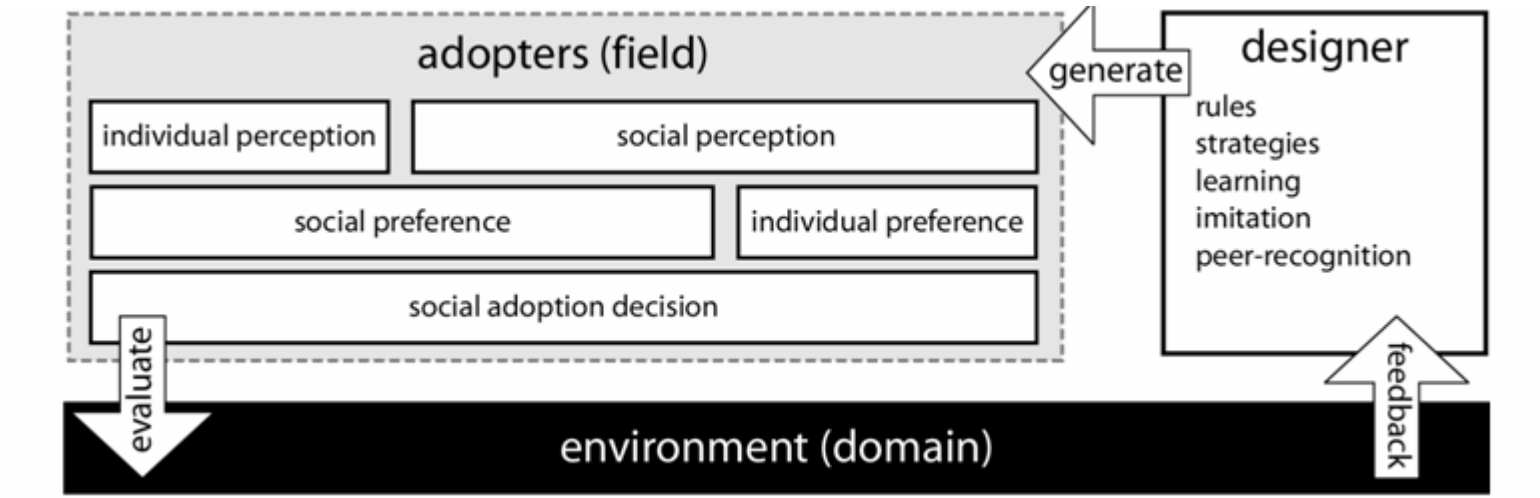
Multi-agent based simulation

- In MABS, the unit of behaviour exhibits more complex behaviours (social agent)
- A framework is used to study systems that include a competing designer agents, a social group of clients or adopter agents, and a cumulative repository or domain of design solutions or artefacts

- A schema is used to represent design processes where:
  - Designing is the transformation of function (F) into the description of an artefact capable of producing that function
  - Artefact attributes and their relationships are its structure (S)
  - Behaviour of structure (Bs) is directly derivable from structure
  - Expected behaviour (Be) provides the (socially) agreed means by which function can be achieved independent from structure and knowledge

DIFI

- Domain – Individual – Field Interaction



MABS

- Experimentation with the types of interactions between system components
  - Transmission from domain to individual, variation from individual to field, and selection from field to domain
- Social agents adapt their behaviour to continuous changes triggered by the generation of new solutions and by an iterative process of social influence
- This generative-evaluative coupling is explored by manipulating the characteristics of social interaction and observing consistent effects on design behaviour and domain configurations

Insights: Designers

- The role of individual differences in triggering group changes may be less significant than often assumed
- Of similar or higher importance can be situational factors such as:
  - Environmental conditions that support individual behaviour
  - Conditions that determine the group impact of such behaviour
- An increase of individual traits need not be proportional to the effect of individual behaviour.

Insights: Field

- Type and rate of contact in an evaluating group determine structures of influence
  - The size of a domain can vary significantly as well as the patterns of adoption and competition
- Influential critics promote the prominence of a few designers. The stability or variety of such decisions affect who becomes creative
- A design generator can be regarded as creative within one social setting but not within others
  - Macro conditions may provide the bases for particular generative processes, or they may facilitate particular effects on evaluative processes

Insights: Domain

- In domains of short design cycles, more knowledge is produced collectively by competing designers than in domains where design rate is slow
- However, in systems where design cycles are longer, more domain artefacts are selected by critics than in those of frequent design updates

Discussion

- New questions, a wider perspective
  - Creativity as a combination of individual / social / epistemic factors
- ‘Creative Situations’
  - Circumstances conducive to creativity
  - The confluence of individual and external conditions within which creative (generative-evaluative) behaviour is determined

Ongoing Work

- Group Brainstorming
- Alternative adoption schemas
- Combined experimental conditions
- Design space exploration
- Case modelling
- Extend social agency

Future Work

- To develop a model of design situations (micro-meso-macro)
- Match field / lab / computer studies

IN VIVO	IN VITRO	IN SILICO
Biographic and Historiometric case studies	Cognitive and social experiments	Simulation and forecasting applications
Mostly for innovation	Mostly for creativity	Apt for the link between both

- Veridicality
- A view of creativity-innovation as a gradual system process