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Visualizing Practice Theory through a Simulation Model

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Abstract

Theories on human action are often either constructed in such a way that the emphasis is on the social or on the individual level. Especially within economics and consumer research, practice theory aims to build a bridge between these points of view. This report describes a simulation model that is a means to visualize some of the basic concepts of practice theory. Some of the aspects of the system may also be applicable in other domains.

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1 Introduction

There are many environments for modeling and experimenting with agent-based simulation such as Swarm[2] (Minar et al. 1996), MACE[3] (Multi-Agent Computing Environment) (Gasser et al. 1997), RePas (North et al. 2006), and SeSAm[4] (Shell for Simulated Agent Systems). In this report, we describe a related visualization tool that is meant to illustrate some basic concepts in practice theory (Pantzar and Shove 2008). The basic idea is that the activities and interactions between a number of agents are demonstrated. The simulation does not aim to be empirically grounded: there is no direct connection between the parameters or functioning of the system and some empirical evidence. Rather, the simulation illustrates the conceptual content of the theory and visualizes such dynamic features of the theory that would be otherwise difficult to grasp.

This report gives a brief introduction to practice theory and describes the simulation system in some detail. The software implementation is available at http://www.cis.hut.fi/research/cog/pracsim/.

2 Practice Theory

Weick (1969) suggested that interlocked behaviors are the basic elements that constitute any organization. In a cycle of interlocking behaviors the behavior of each individual is bound through reciprocation to the behavior of others within a collective structure. In general, interlocking and interdependent cycles constitute and characterize everyday life (Pantzar and Shove 2008). Weick's focus was in organizations, whereas the point of view of practice theory turns the attention to everyday life. Sociological theory of practices is an important theoretical background (Bordieu 1984, Reckwitz 2002).

In the following, the basic ideas of practice theory are outlined based mainly on articles by Pantzar and Shove (2005, 2008). Practical applications of practice theory have been presented, e.g., in (Korkman 2006). It is assumed that practices consist of three basic elements: material (materials, technologies and tangible,

[2]http://www.swarm.org/
[3]http://www.isrl.uiuc.edu/amag/mace/
[4]http://www.simsesam.de/

physical entities), image (domain of symbols and meanings), and skill (competence, know-how and techniques). Practices come into existence, persist and disappear when links between these foundational elements are made, sustained or broken: material, image and skill co-evolve. The disintegration of the links leads into fossilization (Shove and Pantzar 2006).

Practice theory can be applied in relation with many kinds of practices:

- *Traveling* is increasingly essential, e.g., for those who are to operate effectively as international business persons. Systems of mobility not only permit people to fulfil necessary practices, they have the further consequence of modifying what those practices are and how they are 'normally' configured and structured. If a trip is made in a car, practices include those of driving safely with related conventions (laws, regulations, rules of the road) and material systems and infrastructures (roads, cars, traffic lights etc.). (Shove 2002)

- An example from recent work on the origins and development of *Nordic Walking* (a form of speed walking using two specially designed sticks) shows how abstract propositions about integration can be operationalised and turned into empirical questions (Shove and Pantzar 2005). For example, in analysing this particular innovation one may ask how the ideas of the good life are integrated to produce a new way of walking. This integration links an image of fitness with specific skills and procedures. Walking sticks are integrated to produce a proper Nordic Walking technique (linking material objects with skills). Furthermore, images of safety, fitness and nature can be integrated into the sticks themselves (linking image and material object). (Shove and Pantzar 2005)

- Pantzar and Shove (2008) study the *normalization of the freezer* in UK and Finland in the recent history of these countries (see also Pantzar 2000). They consider how images of the freezer and ideas about it have developed. They also ask what new forms of competence were required for the freezer to count as 'normal' and what 'old' preservation technologies and associated skills were marginalised as a result?

3 Simulation Model

This section describes the software implementation of the simulation model. The motivation for the implementation is the possibility to visualize the basic concepts of the practice theory. A dynamic visualization enables illustration of such features of the theory that are difficult to consider in a static presentation.

3.1 Basic concepts

The simulation environment consists of a “world” in which a collection of items interact with each other. Following the practice theory, the items are either material, image and skill. Fig.1 shows the visualization of items. Material is visualized as a blue item, image as yellow and skill as red.

Practice is a structured arrangement, consisting of material, image and skill. These arrangements are illustrated in the visualization as triangular forms in which the items are connected with each other with links (see Fig.2) .

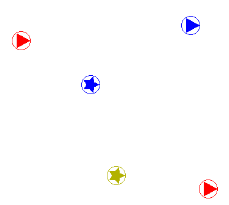

Figure 1: Visualization of items.

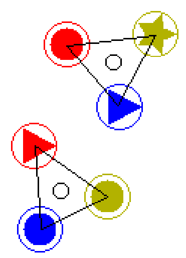

Figure 2: Visualization of two practices.

Practices can be linked together into systems of practices. These systems are visualized by links between the participating practices (see Fig.3).

In the following, we describe in some detail the implementation of the simulation software.

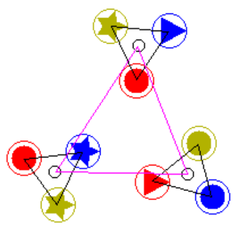

Figure 3: Visualization of system of practices consisting of three member practices.

3.2 Software implementation

The software is implemented in Java and requires Java VM 1.5 to run. The simulation application can be run as standalone workstation program or as Java Applet via web browser. The latter is especially suitable for interactive demonstration program. Fig.4 shows a screenshot of the software running the simulation.

3.2.1 Class structure

The software is divided in four packages: `ui`, `simulation`, `graphics` and `util`. The `ui` package implements the user interface of the software by creating and positioning the Java components such as frames, panels and buttons. The `simulation` package contains the logic and data structures for the actual simulation. The `graphics` package consists of classes for drawing shapes on the screen and `util` package has geometry related utility functionality.

The packages are in a layered structure, where each package is allowed to depend on and access only the packages in lower levels. The `graphics` and `util` packages form the bottom layer. The `simulation` package and `ui` packages form the middle and top layers by themselves. Fig.5 shows the layer structure and dependencies between packages.

The `ui` package consists of classes `MainFrame` and `Pracsim`. The former creates application window for the program and is needed only when running in standalone mode. The latter is extension of `JApplet` and is embedded on a web page or in the frame created by `MainFrame`. `Pracsim` contains a panel for simulation

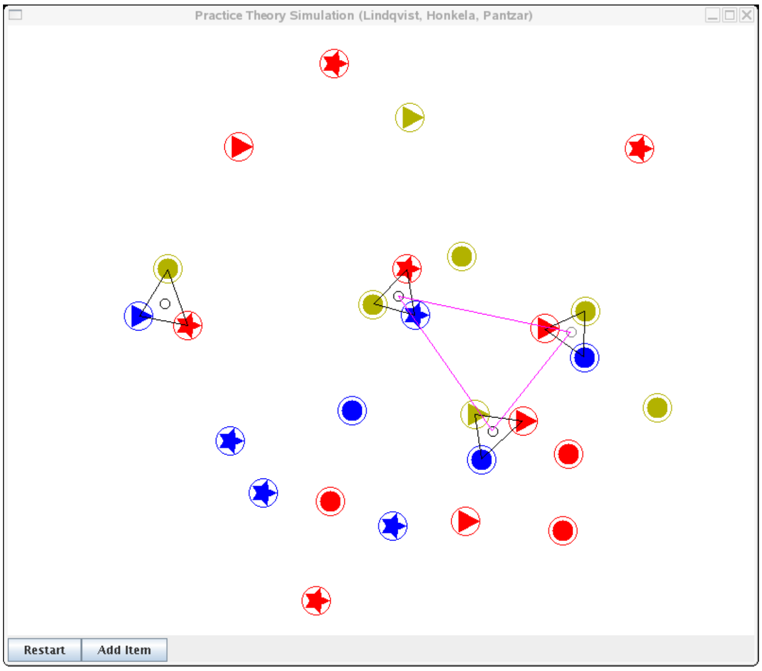

Figure 4: Screenshot of the software.

and user interface components such as buttons.

The `simulation` package contains the simulation logic and has a number of classes derived from the basic `SimulationObject` class (see Fig.6). `Item` class represent the items is practice theory. `Group` class groups several `SimulationObjects` into a single entity. Practices are represented by a group of `Item` objects. Systems of practices are represented by a group of practices which is implemented with `MetaGroup` class. `SimPanel` contains all the simulation objects and runs the main simulation loop which requests `SimulationObjects` to update themselves, creates new practices and systems of practices and draws all drawable objects on its drawing surface.

3.2.2 Dynamics

The items in the simulation interact with each other through forces. The simulation includes two kinds of forces: those that are derived from practice theory and

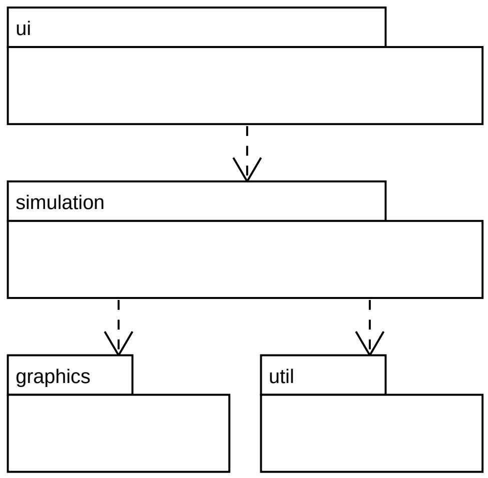

Figure 5: Package diagram of Pracsim

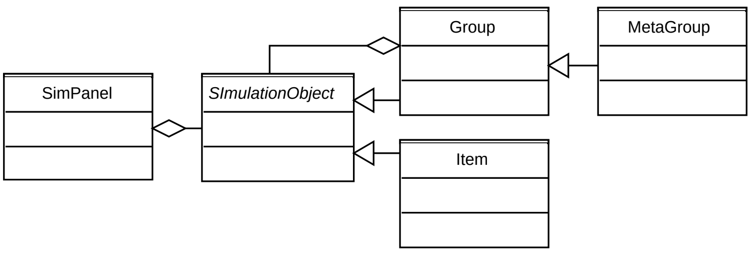

Figure 6: Class relationships in `simulation` package.

those that are there for achieving smooth rolling and easy to follow simulation.

In practice theory the items can be thought to be moving in an abstract space and come closer to the other items in one time and go away from in other times. To simulate this kind of moving, the items do random walk in the simulation plane. The random walk is implemented as follows. Each item has a target position in the plane. A constant force is generated that drags an item towards its target. Once the item reaches a position close enough its target a new target is draw from random number generator.

The items have a repelling force away from each other which tries to keep some empty space around the items and avoid collisions. The magnitude of the repelling force is determined by the following equation:

$$F_{repel}(d,c,\sigma) = ce^{-\frac{1}{\sigma^2}d^2}, \tag{1}$$

where d is the distance between items, c and σ are parameters affecting the scale and shape of the function. The items have also friction force against the direction of their velocity. The magnitude of the friction is proportional to the magnitude of item's velocity and thus behaves somewhat similarly as air resistance:

$$F_{friction}(v) = cv_{mag}, \tag{2}$$

where c is a scaling coefficient and v_{mag} is the magnitude of item's current velocity.

Once items of three different kind (colors) come into proximity of each other they can join up and create a practice. Practice creates links between the members which generate an attracting force between their ends. The practices have a fitness attribute that tells how good the practice is from the point of view of the simulation. The fitness can be calculated, for instance, from the side lengths of the triangle. The smaller the triangle the healthier it is. The practices can come apart if the their fitness drops below certain threshold. This can occur, for example, when the random walking targets of the member items are in opposite regions of simulation space. Practices can also break down because of a new item that comes close by and offers a more fit combination.

The attracting force between members of a practice is proportional to group's fitness according to following equation:

$$F_{attract}(h,c) = ch, \tag{3}$$

where c is a scaling coefficient and h group's fitness.

In addition to items, practices also walk randomly in the space generating new targets when reaching the old one. A force towards practice's target is added up to the member items. The attracting force towards the target is constant. Different practices have a repelling force away from each other according to the Eq.1 but with different parameter values than in repelling force between items.

The practices can form a system of practices when two or more practices are close to each other in the simulation space. When a system of practices is in place, it generates attractive force between its participating practices according to Eq.3 and also do random walk with constant force towards its random target.

3.3 Future extensions

Further development of the software is planned to further increase the utility of the tool. One direction is to increase the complexity of the simulation model to enable more detailed ideas of the practice theory to be demonstrated with the software. Another way is to enhance the interactivity of the simulation to help the demonstration of particular structures of interest and gain information about different simulation objects.

The simulation could be enhanced to take into account the lifetime of the items. New items could be born into the simulation via external source, practices or systems of practices. Also old items could die out or retire to some part of simulation space thus becoming inactive. Some retired items could also be reactivated by influence of new items and form new practices. In this setting the rapidity of the movements of the items could be proportional to their activeness.

The interactivity of the simulation could be enhanced by adding functionality to the user interface. For example, clicking object could give information about item's type and condition. Also moving object by dragging with mouse would give user greater flexibility to make interesting structures and demonstrate ideas more precisely through them.

4 Conclusions and discussion

We have reported the background for and an implementation of a simulation system that illustrates the basic concepts of the so called practice theory. There are many kinds of potential extensions, some discussed already in the previous section.

From the practice theory point of view, interesting extensions include the possibility to consider varieties of spatial contexts. For instance, different areas of the visualization space could have different meanings, such as a particular area being a “museum” for abandoned technologies. Another important issue is the relationship between microlevel and macrolevel phenomena. It would be possible to explore the model in different levels of abstraction. One could, for instance, “zoom” from a general level to details in order how microlevel phenomena give rise to the emergence of macrolevel phenomena.

The earlier research in our laboratory has focused mainly on modeling complex phenomena. Very widely spread modeling methodologies within the general field of neural networks or statistical machine learning have been developed (Kohonen 2001) or important developments have been reached (Hyvärinen et al. 2001). The methods such as Self-Organizing Map (SOM) or Independent Component Analysis can be used to model some specific functional aspects of an individual intelligence agent. We have made earlier some attempts to create communities of agents, each of which is adaptive. For instance, based on some preliminary ideas of SOM-based cognitive agency (Honkela 1993), Honkela and Winter (2003) presented a general framework for simulating language learning within an agent community. Lindh-Knuutila et al. (2006) have taken the research further to simulate meaning negotiations in a language game setting. One possibility is to bring together various aspects of these two lines of research. Some of the basic theoretical elements in this direction are presented in (Honkela et al. 2007).

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