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Cognitive stances in urban mobility: a simulation experiment

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Abstract   This paper reports about a model application which is being carried out at Ires for getting a better understanding of mobility in urban contexts. It aims to dig into some aspects underlying agents' spatial choices and related decision making process. An effort is made to extend the cognitive abilities conventionally attributed to urban agents in describing their mobility behaviour.

In most mobility models, cognitive abilities are based on the unquestioned assumption that agents' reasoning possesses an unlimited capacity. Reasoning plays a major role in discrete choice models, which since the mid 1970s have become the dominant modelling approach in transportation analysis. In these models, the agent is supposed to be able to evaluate all possible choice alternatives and choose the one which maximizes his utility. The hypothesis is quite unrealistic: if the agent has to choose among n destinations, p modes and q departure times for a single trip, he must evaluate n x p x q alternatives. Even if one had to consider the sequence order of activities in activity schedules, for a list of 10 activities there are almost 10 million possible solutions.

A recurrent finding supporting the principle of bounded rationality is that people use heuristic decision rules that circumvent their limits on information-processing capacity and simplify the decision task. Individuals therefore can be viewed as agents whose decision process is structured according to a hierarchy of if-then rules, akin to those performed by classifier systems in Complex Adaptive Systems.

In the mobility model we are developing, it is supposed that agents are endowed with a set of so-called cognitive
stances which can be differentially applied in their mobility choices. The cognitive stances are identified by articulating a knowledge and a reflexivity dimension, and defined as:

• habitual behaviour. The agent chooses in his agenda the route he has run through more often in the past. In this case, the choice is made without reflection and explicit deliberation;

• learning by instruction. The agent chooses a route that another agent, living in his house or working in his workplace, suggested to him;

• reasoning. The agent chooses among the routes in his agenda the most convenient one;

• visioning. The agent explores a new route, never run through before, by selecting nodes and arches of the street network at random or by combining two routes from his agenda.

The adoption of a cognitive stance depends on agent's personality, i.e. habitual vs. deliberative behaviour, exploration vs. exploitation.

It is argued further, that cognitive stances are related to both the syntactic and semantic components of agent's mental worlds. A same cognitive stance can be applied in different choice context, i.e. reasoning can be used in route choice for minimizing personal monetary disutility, or maximizing time savings, or minimizing safety risks etc.

The semantic component of the mental worlds accounts for the set of values referred to by agents in interpreting the world and give a sense to the resulting mental representations: monetary utility, sustainability, aesthetics, time saving, safety etc. These values can belong to both the agent's internal world, being driven by his/her beliefs and desires, and external world, being entrenched in the norms, rules, social obligations constituting the individual's cultural world. Semantic values may influence the adoption of certain cognitive

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stances. In addition, they can be modified as a consequence of transport policies (i.e. campaigns promoting safety or the use of public transport, and so on) or of interaction with other agents having different values.

The paper is articulated into two main parts. The first describes the conceptual underpinning of the model. The second presents some simulation results in which different populations of agents are considered according to differences in personality, semantic values and inclination to modify the latter.