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DESTINATION CHOICE IN DAILY ACTIVITY TRAVEL: THE MENTAL MAP'S REPERTOIRE

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ABSTRACT

In order to improve the behavioral realism of activity-based travel demand models, a deeper understanding of individual's travel decision process is needed. Therefore, this research project aims at revealing the variety of critical spatial factors in an individual's mental map which influence daily activity travel (AT) behavior. A qualitative travel survey and in-depth interviews are used to identify spatial factors that appear in respondents' destination choice decisions when discussing their daily activity space. Recorded interviews are processed with specialized software for qualitative data analysis (ATLAS.ti). First, representative IF-THEN(-ELSE)-heuristics used by respondents are identified and framed within the daily AT decision process and classified in a script network view. In addition, occurring spatial elements are indicated. To conclude, this article suggests a new "script" approach to grasp the behavioral mechanisms present in daily AT decisions and argues that further research along this line would contribute to the understanding of the impact of travel demand measures (TDM) and its assessment in activity-based travel demand models by means of an agent-based computational process model.

1 INTRODUCTION

In essence, travel is a representation of space-time behavior. Not surprisingly, relationships between travel characteristics (e.g. destination, mode and route) and various attributes of space (regarding function and form) have proved to be a popular topic in geography, transportation planning and urban planning. This interest is clearly shown in scientific research (see for instance Badoe & Miller (1), Boarnet & Crane (2), Ewing & Cervero (3), Stead & Marshall (4) and Timmermans et al. (5) for reviews) as well as in planning practice, witness the large attention paid to integrated land use-transportation planning strategies such as Transit Oriented Development (USA), Carfree Cities (worldwide) and the like, and the adoption of such strategies within general planning schemes aimed at sustainable development (6) (7) (8).

Research and practice mainly focus on relationships between travel characteristics and attributes of space on an aggregated level. On an individual level however, relationships between travel decisions and spatial characteristics are established through the individual's perception and cognition of space. This relationship is twofold (9): as an individual observes space, for instance through travel, the information is filed in the individual's mental map (spatial learning). Subsequently the mental map shapes – amongst others – the individual's travel decisions (travel planning), since it reflects individual knowledge and frame of mind concerning the environment and its transportation systems. While some research has contributed to this (10) (11) (12), individual perception and cognition of space related to travel is less investigated than measurable and objective representations of spatial and temporal patterns. Recently, some relevant research plans are addressed (13) (14) (15), but results remain preliminary so far.

Nevertheless, societal and scientific relevance of a better grasp of the subject is clear and ever growing; thorough understanding and reliable prediction of the impact of TDM such as integrated land use-transportation policies, require full comprehension of individual behavioral mechanisms involved in travel planning and execution, including spatial cognitive factors (16). Much of the advance in modeling methods and techniques to assess TDM is – partly due to the unprecedented increase in computational capacity – oriented towards a disaggregated, agent-based modeling of individual travel behavior or microsimulation (17) (18). As a consequence, data needs and modeling assumptions develop: from an agent based modeling point of view it is necessary to capture the interaction between the individual (agent), and space and travel.

Besides, the relevance of spatial cognitive factors or mental map properties is generally recognized in agent-based modeling literature. Discussions of theoretical frameworks of these models usually refer to such concepts, often related to issues of imperfect information and delimitation of choice sets. Arentze & Timmermans (19) for instance, mention spatial cognition when developing their rule based ALBATROSS model and Salvini & Miller (20) denote the mental map with regard to the “state representation” of the decision making unit in their ILUTE model. However, in actual practice, translation of mental map and spatial cognitive concepts remains poor due to problems with measurement and operation of the constructs (11). Few examples are known to us: a separate mental map model capable of learning the environment was suggested by Arentze & Timmermans (21), and Sivakumar & Bhat (22) integrated aspects of spatial cognition in an econometric model of spatial location choice for non-work activity participation.

Within travel demand modeling, unlike the trip-based approach, the activity-based paradigm considers travel to be a derived demand from entire activity agenda's: people travel to participate in activities that they need or wish to perform in space and time. Thus, activity-based

models describe detailed activity schedules and consequent travel, taking the personal, household and spatio-temporal constraints into account (23). In the variety of applied modeling techniques, two major strands run parallel to the present dichotomy in behavioral underpinning of the technical computation (24). On the one hand, in various statistical or econometric utility-based models it is assumed that decision makers, faced with a set of alternatives, choose to maximize utility. In these, ultimate choices are calculated as a function that maximizes the overall utility of a daily activity pattern within derived choice sets. On the other hand, disaggregate rule-based computational process models (CPM) aim at establishing true reproductions of behavioral processes underlying individual travel choices using simple IF-THEN-heuristics. The prevalent paradigm of CPM originates from descriptive decision theory: starting from the finding that people do not typically behave optimally, assumptions of perfect information and rationality are relaxed. Instead, more simple sets of decision rules are focused on, formalized as IF-THEN(-ELSE)-heuristics. In such systems, attractiveness of alternatives is evaluated in terms of a set of attribute values (e.g. trip duration, cost, reliability,...) using certain choice strategies related to dominance, satisfaction, lexicographic rules or utility (25). Here, the utility approach can be seen as a trivial case of the rule based approach (rule: sort by utility). Note that in both utility based and CPM models, AT decisions are modeled as the result of a (once) conscious decision process.

Overall structures of activity-based models are quite similar, with a hierarchy of sub models and lower choices predicted conditional on higher level choices (26). After modeling geographical allocations of households and some long-term decisions (e.g. work, school and vehicle ownership), the model's scheduling engine generates daily activity programs. Subsequently, AT locations and travel modes are determined before final choices at the trip level are modeled. Spatial attributes such as measures of "accessibility", "attractivity" and other land use effects are most apparently taken into account in mode and destination choice sub models. At this stage, spatial cognitive factors should be dealt with pre-eminently. Besides delimiting choice sets, in econometric models this would influence perceived utility of considered choice options. In CPM, the mental map and its properties could influence the perception of attribute values as well as the choice strategy at stake.

This paper reports about the first stage in a research project that aims at identifying the critical spatial factors in an individual's mental map which influence daily travel behavior in order to improve the agent-based modeling of travel demand in general and destination and mode choice sub models in particular. An activity-based CPM approach is chosen because a similar prototype activity-based micro-simulator of travel demand for the region of Flanders is currently being developed (27).

One way to derive necessary decision heuristics for a CPM is from data, for instance by means of data-mining techniques, e.g. ALBATROSS (19). Another, more direct method to gain insight in knowledge and methods of human decision making is to use domain knowledge, for instance elicited by means of the "think aloud protocol". This method is frequently used by psychologists and social scientists to reveal cognitive processes. It is also an important method for knowledge engineers whose goal is to build knowledge-based computer systems based on human expertise (28). A clear example of such an application is the cognitive model of planning developed by Hayes-Roth and Hayes-Roth (29). But an application of this protocol strictu sensu is cumbersome – if not virtually impossible – for investigating daily AT patterns during a week; experts would literally have to be followed everywhere, continuously expressing their thoughts about their AT scheduling and execution. Therefore, this method is approximated to by

conducting a structured pre- and post-interview with open ended questions about the AT behavior in a randomly chosen week.

A qualitative, explorative, descriptive and contextual research program is utilized to conduct this research. The focus is to obtain better understanding of the role of spatial cognitive factors within general travel choice processes, taking the *context* of daily activity patterns into account. Prime objective is to *explore* this framework and to make some preliminary observations and distinctions related to spatial cognition and travel behavior based on the variation that is found in the data. A limited sample size and mainly *qualitative* methods are used. Results are *descriptive* and suggest an analytical perspective, useful for further research. In essence, following research questions are at stake: are choice heuristics apparent in individual's AT decision processes, in particular with regard to destination and mode choice decisions (i); which elements in general occur in this propositional reasoning, to be conditions, restrictions, justifications or otherwise (ii) and which spatial elements or mental map components in specific can be identified within these heuristics (iii).

The paper's structure is consistent with these research goals: first, research methodology of the survey is explained in detail. The following three sections present results of the qualitative data analysis. Some general findings about form and structure of cognitive processes involved in AT decisions are explained to start with. Next, content of the decision process in general and the decision rules in specific is discussed. Within these sections special attention is paid to spatial elements and mental map properties that appear in decision processes. Based on the findings of this qualitative research, a new "script" approach is suggested for future quantitative testing and some particular research plans are addressed. This paper mainly describes results related to destination decisions at length. Related travel mode decisions are dealt with in another paper (30).

2 METHODOLOGY

The need to more fully understand underlying behavioral mechanisms of travel decisions is well recognized in literature (16) (31) (32). As a consequence, new data collection techniques are required to observe decision processes in addition to well established methods to gather data describing decision outcomes. This results in a growing need to explore qualitative methods of data collection (23). Likewise, this research project takes both approaches into account: a one week AT survey traditionally used to gather revealed data in quantitative research was used in combination with qualitative in-depth interviews to identify the variety of spatial factors that appear in choice heuristics of experts when planning and evaluating daily AT behavior. Survey length was extended to a week because of the focus on variety in decision patterns on both a general and individual level, and to reveal and question a typical sample of an individual's daily activity space.

During one week, 20 respondents reported their AT behavior in standard AT diaries. Besides, they used a GPS enabled hand held computer to record routes, enabling a comparison between stated, perceived route information (e.g. distance estimates, route descriptions), and their revealed counterparts. Respondents were interviewed twice: a 1 hour pre-interview took place before the start of the survey. This consisted of an inquiry into the activity space and travel plans. A 45 minutes post-interview or feedback interview occurred after finishing the survey and included a comparison of executed AT to the former planning.

To reveal as much determinants as possible and enable theory building, a selected sample of respondents was contacted. Consistent with Trost's (33) recommendations for strategic nonrepresentative sampling aimed at exposing variety, most important explanatory characteristics for variety in AT behavior were taken into account: age, sex, education, occupation, driver's license, possession of car, marital status, household size, parenthood, residential location and mainly used transport mode. For each key characteristic in its own right, at least 4 to 5 respondents were represented, while avoiding clusters of characteristics as much as possible (e.g. both man and women are present in the group of respondents without a driver's license). This resulted in a total sample of 20 respondents, a typical sample size for qualitative research in this field (34), e.g. (35) (36) (37). Respondents were firstly selected from the wide circle of acquaintances of the researcher and then, according to the 'snowball method', attracted from the circle of acquaintances of acquaintances. Since the degree of motorization in Flanders (Belgium) is rather high with 481 private cars per 1,000 inhabitants and 1.17 private cars per household (38), respondents without a driver's license and households without private cars were selected to start with. Income proved to be the most difficult variable to account for. All respondents can be situated in the lower or upper middle class, leaving decision strategies for very low and very high income groups a subject of further research.

Two major parts of the interviews could elicit IF-THEN destination and travel mode choice heuristics: the description of the activity space on the one hand and the explanation of the AT planning and execution on the other hand. The first interview part consisted of questions about perception and extent of the individual's activity space. During this part of the interview, two main sets of open ended questions were posed. The first set refers to destination choices and perception of distances in the activity-space: "Where do you perform [activity type]? Is that far away? How far is it? In distance? In time?" Activity types taken into consideration are: work, school, social visit, daily shopping, non-daily shopping and services. The second set of questions regarding the activity space concerns the activity-related reach of respondents using different transport modes: "Which activities do you execute by [transport mode]? Regularly? Occasionally? How far is that? In distance? In time?" Transport modes mentioned, are: foot, bike, bus, train, motorcycle and car. Note that in this interview section, no explicit questions were asked to reveal decision heuristics. Respondents often referred to circumstances and reasons for certain destination and travel mode choices spontaneously.

In contrast with this first activity space interview section, during the interview parts regarding the scheduling and evaluation of scheduled activities, reasons, circumstances and choice options for destination, mode choice and route choice were explicitly interrogated. With regard to activity locations away from home, respondents were asked to specify where the activity took place, what the distance to the activity location was both in qualitative and in quantitative terms, why they had chosen that location, whether they had been there before and whether they were used to choose that location frequently or considered other options as well. With regard to travel mode choices, respondents were asked why they had chosen that particular mode of transport, whether they used that mode of transport frequently to reach that destination, whether they could and would consider other transport modes and what their general appreciation of the accessibility of that activity location was.

Interviews were taped, transcribed verbatim and processed with ATLAS.ti. The use of such a specialized CAQDAS (Computer Assisted Qualitative Data Analysis) software package is considered to be a useful instrument to improve not only pace and flexibility of textual data management in specific, but also consistency and internal reliability of qualitative research in

general (39) (40), at least as long as basic prerequisites of qualitative theory building are taken into account (41). A cross-case analysis was undertaken for the activity space interview parts. Initial reading and re-reading was followed by indexing and free coding the text, which involves assigning conceptual labels to topics and refining them through repeated inspection. Bearing the research questions in mind, all mentioned travel decisions were indexed manually in ATLAS.ti according to their activity, mode and destination type. References to the choice process and IF-THEN-heuristics were indicated and coded. For every new instance, similarity with previous cases was considered according to the constant comparative method (42). ATLAS.ti facilitated the selection, retrieval and display of coded quotations to a great extent. If no proper existing label could be assigned, a new code was created and previous interview passages were checked anew for missed cases. While coding progressed, ideas about different perspectives and relationships between codes and overarching categories developed and these were provisionally conceptualized in memos, codes and code families. Secondary coding involved the elaboration of these preliminary ideas, further code classification and the examination of relationships between labels and categories. Final inspection and selective coding of the data lead to an understanding of interrelationship between categories and their properties and the integration into central categories with regard to the AT decision process. Finally, this data-driven analysis resulted into the descriptive phase and the construction of theories. Thus, theory emerged directly from the data according to the principles of “Grounded Theory” (43), while theoretical sensitivity was shown in the initial selection of the respondents (cf. supra) and in the classification of the assigned codes. In addition, these theories – classified concepts and ideas that individuals associate with daily AT choices and their relationship – were represented in “script network views” using the software’s graphic tool. Results from the interview data analysis of respondents’ discussion about their daily activity spaces are presented in the following section. Besides the use of causal networks to display data (43) selected typical verbatim quotations, translated as naturally as possible, are added for the sake of argumentation and illustration – a common practice in qualitative social research (44). In these quotations, redactor’s additions to clarify the context of the statement are indicated with: ‘red.’

3 RESULTS

3.1 General Form and Structure of Activity Travel Decisions

Looking at the pieces of the cognitive process involved in mode choice revealed when discussing the daily activity space, two main observations dominate the analysis of general form and structure of this decision process: the execution of daily activity schedules is principally automatic and seldom preceded by much deliberation (i) and the individual’s daily AT execution seems to start from a default setting, and is completed with additional heuristics (ii).

A clear finding during the interview administration was the fact that, generally speaking, different dimensions of daily activity-travel planning and execution in general and destination and mode choices in specific do not appear to be sequential stages within the decision process. Although often modeled that way (45), travel related decisions in an everyday activity schedule are in fact perceived of and handled as being part of an integrated problem where certain interconnected solutions are triggered simultaneously without much consideration, not to mention the systematic weighing of different alternatives by its attributes which is assumed in most classic utility based choice models (16). Activity, destination and travel mode are set in fixed mental scripts that are cued by certain situations. It is highly automated routine behavior, often performed mindlessly. This was not only stated spontaneously by a respondent:

17: “Now I’m giving it some thought. That is not what one normally does.”

This hypothesis is also shown by the fact that respondents very often stated travel times to certain activity locations without even mentioning the travel mode or having referred to it before in the interview.

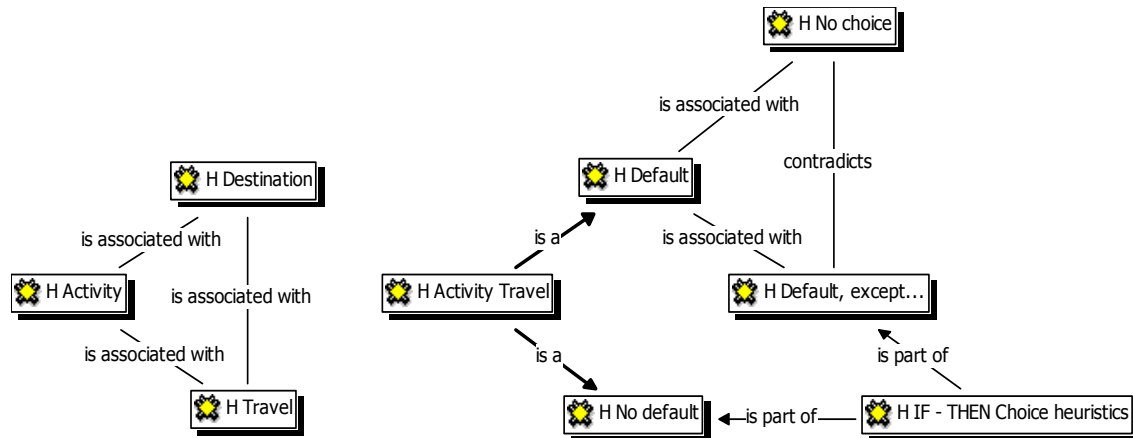


FIGURE 1 ATLAS.ti Script Network View of the Activity Travel Decision Process in General.

The script network view above which has been constructed based on the interviews, shows that within these activity-destination-mode scripts, both destination and travel mode appear to have some sort of standard norm or default setting for most of the activity episodes. This default setting can be completed by some additional exceptions, expressed as IF-THEN-ELSE-heuristics. However, there are some situations where either destination or transport mode or both attributes have no default setting and where two or more choice options are considered until departure. In these cases, IF-THEN-heuristics appear to explain circumstances or reasons for the consideration of choice options. With regard to destination choices, content of these default settings on the one hand and appearance of these IF-THEN-heuristics on the other hand are discussed further in this paper.

3.2 Content of Default Settings in Daily Activity Spaces

In case of a default setting, it is often referred to as a no choice situation in two ways: either there is no actual choice within the daily activity context or there are no perceived choice options. The former can be caused by the fact that the choice at stake was part of a long-term decision, by the fact that others made the decision or by the fact that there was actually only one single choice option (within existing and accepted constraints such as space-time-, coupling- or institutional constraints). Besides the occurrence of no actual choice, there can be no perceived choice options as well. Respondents' explanations in this situation refer to the logic of solutions (again, within given constraints), the fact that it is a habit or they expose some opinion which relates to attitudes and beliefs. Finally, a feedback effect can be identified between constraints in daily life and long-term decisions.

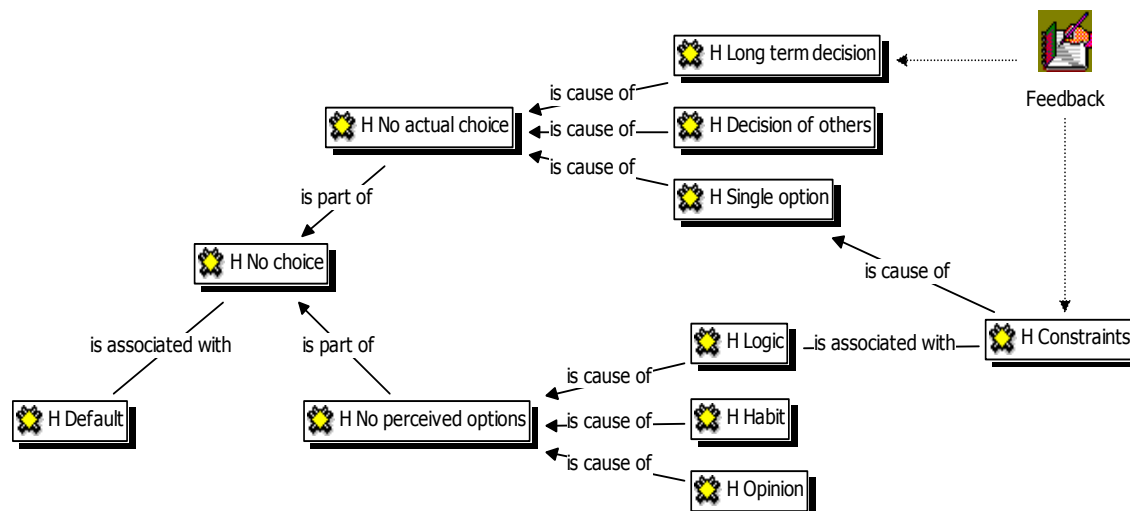


FIGURE 2 ATLAS.ti Script Network View of the Default Settings in Daily Activity Spaces.

Categories indicated in Figure 2 are illustrated below for destination choices. In daily AT patterns, destinations are fixed for a lot of activities. There is no actual choice at the time of the everyday AT planning and execution. Long-term decisions such as where to live, where to work and where to go to school determine travel destinations of mandatory activities such as work and education. Leisure activities such as sports or other hobbies are generally considered to be discretionary activities. The long-term decision to join a club however, can fix destinations of leisure travel in everyday life. As a result, such activities become much less flexible in activity schedules. Thus, long-term decisions add to the constraints of daily life.

The daily destination choice of travel to execute social activities (family and friends) is obviously determined by a (long-term) location decision of others.

11: "And going to friends, well, it is in fact indeed ... a lot of people did actually move outside [respondent's hometown, red.], now I'm giving it some thought, yes"

Besides that, for all sorts of discretionary activities where others are involved, activity location decisions can be made by others as well. These others usually are members of the household, but destination decisions by others outside the household also occur, for example when going out with friends. A special case of this situation consists of bring/get activities.

Finally, destination choices can be determined by the fact that there is actually only one choice option. When there is only one post office in the area for instance, you'll be obliged to buy your parcel-post package over there. Remarkable in these cases is not only the fact that the amount of destinations available in choice sets are defined by the specificity of wanted products or specialization of needed services, but also by the fact that there is a commonly accepted spatial assumption present in the statement: "in the area". Theoretically speaking more options can be available (e.g. post offices in the neighboring areas), but in case of a large difference in (actual and perceived) distance between two equally valued alternatives, proximity within the space-time settings of the daily activity schedule can restrict the actual choice set.

Of course, the latter example is also related to the default settings in daily AT destination choice where there are no perceived choice options. Daily grocery shopping, shopping for non-daily goods, consulting services and real discretionary leisure activities all have multiple destination possibilities. Nevertheless, even when there is no official commitment to certain destinations and there are a number of possible activity locations from an objective point of

view, explanations that can be categorized as “logic”, “habit” and “opinions” are mentioned in the interviews as the driving forces in the establishment and maintenance of default destination settings.

Logical arguments refer to the position of the actual destination in the entire activity schedule and various applicable constraints. This finding is clearly related to literature that addresses the ratio between stay time and travel time for different types of activity places, such as the travel time ratio (46) or travel time price (47). Such constructs could be considered as “norms” that help people reach acceptable solutions without much deliberation. Given circumstances, some places are just the most logic place to go. Time and distance minimization in specific and cost minimization in general are important driving forces.

07: *“She [daughter, red.] also does everything there, so, eum, her hobby’s are there too, so eum. And currently I go to the gym, the Horizon, to use the Power Plate but that is currently also when driving back from eum, from school. Generally. I try to.”*

A final remark about the observed appearance of “logic” for the development and maintenance of default destination settings regards the fact that this “logic” in itself could be translated into logical decision rules or IF-THEN-heuristics. It might be clear that in the above mentioned quotations, such rules were often implicitly present. To make them more explicit, stated data from a thorough questioning of destination and mode choice in default settings could elicit such logical decision rules. At least, as far as people are aware (which is often not the case for default settings, as is shown above) and as far as they are able to articulate the complex relationships between influencing factors. In addition, logic does not have to be a synonym for rationality in human reasoning. Further analysis will illustrate this.

Besides logic, “habit” can be a strong driving force as well, even overruling the logic of distance minimization. Built-up personal relations over time or semi-official commitments for services such as a bank or the family doctor enhance such habitual choices. Besides, it is considered rather unusual to change certain activity locations once a choice is made and results proved to be satisfying, even under changing circumstances.

18: *“The hairdresser is in Vosselaar still” ... “yes yes yes so, that is those 5 kilometres again” ... “that’s an old habit, I shall say.”*

Due to the interpretation of habitual forces by respondents, the concept and use of habit in this theoretical framework differs from the usual meaning of habitual travel choice behavior in transportation literature. In that, the term “habit” is often used to indicate all travel choice behavior without explicit intention and no or little deliberation (48). Here, habit is but one force mentioned as cause for the maintenance of certain default settings within a set of daily AT scripts that can be performed mindlessly.

Finally, opinions about destination choices in general and about attributes of theoretically optional activity locations can shape the default settings. The first mentioned type is related to general problem-solving strategies and attitudes. The second sort of opinions about attributes of theoretically optional activity locations is related to preferences, often shaped after unsatisfactory experiences. There is a default setting because (all) other options are perceived as being insufficient. The benefit of the outcome can overrule the logic of minimizing distance.

09: *“But say, we buy everything here in the vicinity... if something is broken, we can go back there immediately.” ... “And the service is good as well, so it is stupid wanting to buy it somewhere else if it’s a little bit cheaper”.*

14: *“You have got a small supermarket over here, but we don’t like to shop there. Most of the times, we go to the Delhaize [supermarket, red.]”*

Within destination default settings, influence of space and spatial cognitive factors is at most apparent in perception of distances and subsequent distance minimizing strategies. Besides that, generalization of possible activity destinations into functional areas is significant; e.g. for shopping activities (small groceries, clothing and the like), the default setting often is a general area which still holds a few possibilities instead of one specific activity location. From a mental map's point of view, this spatial generalization of the destination choice set into functional area's is related to Kevin Lynch's concept of "districts" (49).

3.3 Content of IF-THEN-Heuristics in Daily Activity Spaces

Besides clear default settings, IF-THEN choice heuristics occurred in the interviews in two ways: they were either used as an expression of existing exceptions to default settings, usually linked with specific constraining circumstances, or they were used to express choice options and considerations when an AT default setting was lacking. Quite remarkable is the fact that these exceptional situations and perceived choice sets plus their subsequent outcomes as they are, seem to be part of fixed scripts. This reasoning shows the existence of an "AT repertoire" or mental map which comprises a set of standard alternative solutions for everyday life.

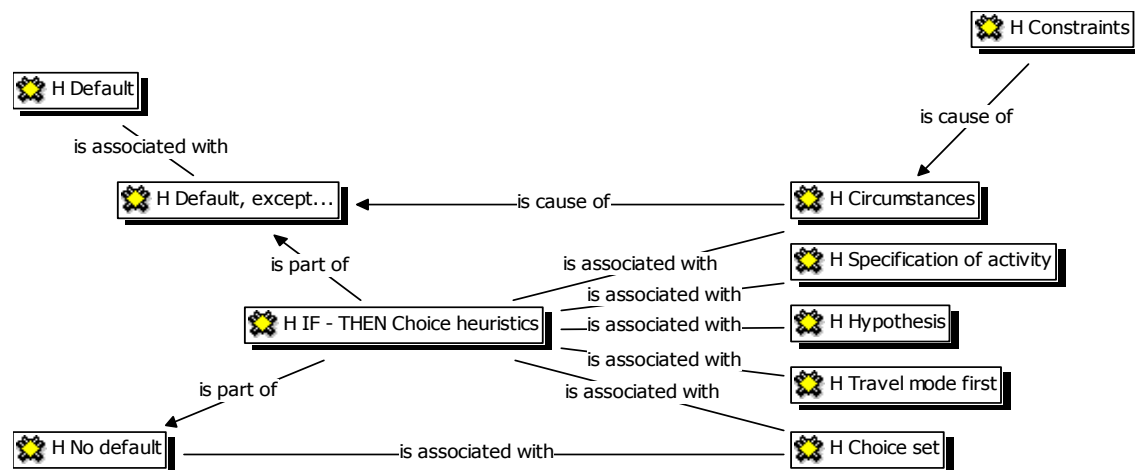


FIGURE 3 ATLAS.ti Script Network View of the IF-THEN Choice Heuristics.

Within these heuristics, classes of occurrence (circumstances, specifications, hypothesis, mode first and choice set) of Figure 3 can be recognized. Below, IF-THEN-heuristics in each class are discussed for activity location choices.

Destination choice appears to be fixed for most daily travel activity decisions. Some few explicit IF-THEN-heuristics occurred in the activity space related interview part. As explained above, activity categories "work", "school" and "social visits" are fixed due to long-term decisions or decisions of others. Activity categories "services" and "leisure" usually comprise some fixed locations due to certain commitments. For other destinations related to "services" and "leisure" and for destinations related to "grocery shopping" and "shopping for non-daily goods", few if any options are perceived or considered in everyday life.

Figure 3 shows that a first set of heuristics was used to explain specific circumstances or situations in which other than usual choices appear. Certain situational constraints, such as exceptions due to institutional constraints, household task allocation and space-time constraints, can cause deviations from destination default settings.

17: *"If possibly the department store here nearby is not open, and and then we go somewhere else sometimes to the GB or to, what is it called? the Delhaize [supermarket, red.] or so."*

A second appearance of explicit heuristics has to do with the categorization of activities. Apart from work and attending school which usually comprises only one destination, each activity category is an aggregation based on presumed similarities in behavior within the activity category. However, most respondents spontaneously mentioned meaningful specifications and typical subcategories, expressed as: "IF[activity subcategory]-THEN[destination and/or mode choice]". Conditional on the subcategories of daily and non-daily shopping, destinations are either defined in terms of generalized activity location areas (e.g. small daily groceries) or exact locations (e.g. comprehensive weekly groceries). When a certain activity subcategory only occurs infrequently (e.g. shopping for furniture), possible destinations are not fixed and referred to in general terms. Within the quite diverse activity category leisure a distinction between daily and weekly routines with principally fixed and near destinations on the one hand, and seasonal activities (e.g. cycling at summertime or a trip to the sea) and occasional leisure trips on the other hand, seems possible. The occurrence of "leisure shopping trips" also shows that a mere functional categorization of activities has its limitations.

08: *"... for what shopping is concerned, if I need clothing or something like that, then I always try to buy that in Geel, eum, in the city centre of Geel, eum, so I go, I travel very little distances for shopping elsewhere."*

Apart from specifications of activity categories, some of the relevance of the perception of distance in destinations choice within different AT categories was also illustrated. However, traveled distance seems more related with frequency of activity performance and attractiveness of destinations than with the actual activity related purpose of the trip.

Besides actual occurring choices in daily activity space, respondents mentioned hypothetical choice situations as well. These heuristics do not reflect actual performed travel behavior of the past, but they reflect suspicions and intentions related to possible future behavior.

03: *"yes,... If tomorrow a new department store opens in the neighborhood, then I will shop in the vicinity because that bothers me"*

A fourth sort of heuristics illustrates the fact that mode choice can precede the choice of the activity location. Apart from that, all travel modes are associated with a certain reach. In a no travel mode choice situation, destinations are obviously also chosen within possibilities of the single available travel mode.

09: *[Daily travel by bike, red.] "Eum, if it is within half an hour, let's say, within an hour then..." I: "Then it is feasible, yes?" 09: "Let's say, for me, yes."*

Finally, in the no default choice situation, destination choice sets in everyday life's AT comprises several considered opportunities. In these cases, destinations are valued equally and actual established choices appear to depend on scheduling logic, situational circumstances and coincidence.

18: *"Yes yes. But hé, I never have to make a long detour here. Really, I run into at least four bakeries."*

With regard to spatial characteristics and spatial cognitive factors influencing destination choice in daily AT IF-THEN-heuristics, no other elements than already mentioned in the default reasoning section have to be addressed. Here too, the importance of perceived distances and the cognitive representation of destination choice sets in generalized areas of opportunities is significant.

3.4 Long-term Decisions and Daily Constraints: The Feedback Effect

A final point of attention in the analysis of individual activity spaces is the feedback effect related to long-term decisions and daily constraints which influence both default settings and IF-THEN choice heuristics in daily AT. Such a feedback effect has been recognized in literature before, both regarding long-term events and choices in general, e.g. (50) and with respect to the residential location choice in specific, e.g. (51). In this study, this effect is indicated schematically in figure 2 and it is further explained in this last section of results.

With regard to the IF-THEN-heuristics, it is shown that the weather clearly is a variable environmental factor that is able to trigger the execution of different scripts in people's mental maps. For people who are used to cycle to certain destinations, bad weather conditions are typically mentioned as an exceptional situation. In these cases, they usually take the bus. However, for people who are used to travel by car, bad weather is often used as an excuse for not choosing bike and nice weather is typically seen as an exceptional situation; perhaps cyclists are born optimists, unlike car drivers?

The explanation of such difference lies within the long-term organization of the individual's daily life based on the availability and accessibility of travel modes and in the feedback mechanisms between long-term decisions and daily activity constraints. On the one hand, car drivers have (unconsciously) chosen daily activity destinations in an habitual AT schedule from the car's perspective: daily AT schedules are space extensive and time intensive. As a consequence only few destinations can actually be reached by other modes, unless their habitual daily activity schedule is thoroughly reconsidered. They have developed a car dependent lifestyle. Their mental map, full of automated car related scripts, is uni-modal and biased.

On the other hand, individuals without a driver's license or private car have probably organized their lives in short-term and long-term decisions bearing a necessary spatial proximity and temporal deceleration in mind. Their reflected repertoire of daily activity scripts typically shows a great variety of travel modes. Although the radius of action might be more limited in distance, such individuals surely show more flexibility regarding travel mode choices. In a prevailing car-oriented society, these respondents also proved to be very aware of their somewhat unusual way of life.

09: "For us nothing is far away. But for those who have cars, everything is far away. That is in fact really strange, no?" I: "yes, you will have to explain that a bit, because..." 09: "We are used to the fact that it always takes a long time before we get anywhere, for us it is not far away..."

Spatial determinants (density and functional mix) are thus more important in the occurrence of travel poverty than vehicle ownership; people who are living in mono-functional areas or far away from potential activity destination typically have no choice but to use the car. Those who have a mix of activity opportunities within a small distance range, usually have more suited travel mode options available.

Of course, the above painted pictures of car drivers versus non-car drivers are quite extreme. In reality, several mixed situations occur. Driven by attitudes and opinions, some people deliberately choose to use the car more consciously. This way, they are less dependent on this travel mode. Others can only be forced to make other travel mode choices if habitual daily AT schedules become untenable (e.g. due to external conditions such as congestion).

4 CONCLUSION AND DISCUSSION

The research reported in this article aimed at revealing the individual's daily AT decision process in general and the spatial factors influencing the destination choice in specific. The ultimate goal is to improve the behavioral realism of an agent-based computational process model to assess the likely impact of TDM by integrating the mental map concept. A qualitative, explorative, descriptive and contextual research approach has led to the formulation of the "script approach" of individual travel choice behavior, a new analytical perspective that will be used for further research.

Summarized, specific findings from this research with regard to travel decisions show that in daily AT, activity, destination choice and travel mode choice are mainly fixed, interconnected decisions, triggered simultaneously without much deliberation. Within these fixed scripts, strong default settings for mode choice and destination choice are apparent for most of the daily activity travel routines. In addition to this, IF-THEN choice heuristics cover a whole range of specific or exceptional situations in which both travel mode and destination are fixed as well.

Actual and perceived choice sets are very limited and choices are typically restricted and justified by long-term decisions, decisions of others, logical reasoning, habits and opinions. The driving force behind the logical reasoning are various conditional constraints experienced in everyday life. Within these heuristics, reasoning concerning accessibility in general and distances in time and space in particular plays an important role. Thus, the individual's mental map comprises a repertoire of possible AT scripts including travel modes and activity destinations. Elements in this opportunity set are connected to an – often imperfect – perception of accessibility with various transport modes which influences the daily AT decision making process.

While long-term choices such as the residential location choice or vehicle ownership largely determine the conditional constraints experienced in everyday life, a clear feedback effect is shown as well. Using (and getting used to) certain modes of transport enhances the organization of daily activity patterns from the travel mode's perspective. For instance, typical car drivers develop a space extensive and/or time intensive lifestyle, leaving no or little choice options to organize their daily AT.

Some more research in this area is needed to refine the way daily AT scripts are formed, how they are preserved and how they can be changed. Formation and adoption of scripts could be a matter of conscious reasoning, but other learning strategies such as experimentation or imitation could occur as well. To understand the preservation of scripts, it could be useful to assess their strength in terms of establishment (e.g. result of a choice or no choice situation) and additional forces such as habituation, opinions etc. Moreover, the circumstances in which particular parts of people's repertoire are applied and the conditions causing variety in AT behavior deserves future attention, as well as the circumstances and conditions which can force sustainable changes in scripted AT behavior.

As such, no concrete mathematical model is derived from the results of this research. However, this qualitative research is an important way to improve expert's domain knowledge. The descriptive or semantic model developed in this paper informs quantitative, mathematical modelers with regard to several modeling assumptions, such as the model's structure (e.g. different decisions are triggered simultaneously), the activity categories used (e.g. small daily

grocery shopping versus weekly groceries), the parameters involved (e.g. the existence of default settings), etc. In general, the descriptive results of this research can help to develop empirically grounded modeling hypotheses that – without any doubt – need further quantitative testing and validation. Future research plans follow this line of thought. For instance, we have developed a formal model recently which conceives the mental repertoire of fixed scripts as a Bayesian Inference Network. Initial tests with this model show promising results.

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