

The Use of Choice Heuristics in Daily Activity Travel Behaviour: an Expert System

Els Hannes, Davy Janssens and Geert Wets

Transportation Research Institute

Hasselt University

Wetenschapspark 5/6, 3590 Diepenbeek

Belgium

Fax: +32(0)11 26 91 99

Tel: +32(0)11 26 -- -- {91 34; 91 28; 91 58}

E-mail: {els.hannes; davy.janssens; geert.wets}@uhasselt.be

Abstract

This research project aims at identifying the critical spatial factors in an individual's mental map which influence daily activity travel behaviour in order to improve the agent-based modelling of activity travel behaviour by means of a computational process model. A qualitative travel survey and in depth interviews are used to identify the spatial factors that appear in the destination and travel mode choice heuristics of experts when discussing their daily activity space. Recorded interviews are processed through ATLAS.ti. First, the representative IF-THEN heuristics used by the experts are identified and framed within the daily activity travel decision process and classified in a script network view. In addition the occurring spatial elements are indicated.

Keywords

activity-based modelling, spatial cognition, mental map, choice heuristics

1. Introduction

In essence travel is a representation of space-time behaviour. Not surprisingly, the relationship between travel characteristics (destination choice, mode choice, route choice) and attributes of space (regarding function and form) has proved to be a popular topic in geography, transportation planning and urban planning, both in practice and in research (see for instance Timmermans et al. (2003) and Stead & Marshall (2001) for reviews). From an agent based modelling point of view however, it is more important to grasp the interaction between the individual (agent), and space and travel. On an individual level, the relationship between travel decisions and spatial characteristics of the environment is established through the individual's perception and cognition of space. 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, since it reflects the individual knowledge and frame of mind concerning the environment and its transportation systems (spatial planning). While some research has contributed to this (Golledge & Gärling, 2003; Golledge & Timmermans, 1999), individual perception and cognition of space related to travel is less investigated than the measurable and objective representation of spatial and temporal patterns.

This research project therefore aims at identifying the critical spatial factors in an individual's mental map which influence daily activity travel behaviour in order to improve the agent-based modelling of activity travel behaviour by means of a

computational process model. While a wide variety of modelling approaches and techniques have already been tested and applied in the past, the activity-based travel demand modelling paradigm is one of the most comprehensive approaches that is able to produce reliable and policy responsive forecasts. Within activity-based transport modelling, disaggregate rule-based computational process models aim at establishing a true reproduction of behavioural processes underlying individual travel choices using simple IF-THEN heuristics. The prevalent paradigm of computational process models originates from descriptive decision theory: starting from the finding that people do not typically behave optimally, the assumptions of perfect information and rationality are relaxed. Instead, more simple sets of decision rules are focussed on, formalized as IF-THEN(-ELSE) heuristics.

One way to derive such decision heuristics is from data, e.g. by means of data-mining techniques, e.g. ALBATROSS (Arentze & Timmermans, 2000). Another and more direct method to gain insight in the 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 who want to know more about cognitive processes. It is also an important method for knowledge engineers whose goal is to build a knowledge-based computer system on the basis of human expertise (Van Someren et al., 1994). Since an application of the think aloud method in the strict sense is cumbersome, if not virtually impossible for the investigation of daily activity travel patterns established during a week – the expert would literally have to be followed everywhere by a researcher, continuously expressing his thoughts about his activity travel scheduling and execution –, this method is approximated to in this research project by conducting a structured pre- and post-interview with open ended questions about the activity travel scheduling and execution in a randomly chosen week.

A qualitative, explorative, descriptive and contextual research programme is utilised to conduct this research. The focus is to obtain a better understanding of the role of spatial cognitive factors within the general travel choice process, taking the context of daily activity patterns into account. The following research questions are at stake: are choice heuristics apparent in individual’s activity travel decision process, in particular with regard to the destination choice decision and the mode choice decision (1); which elements in general occur in this propositional reasoning, to be conditions, restrictions, justifications or otherwise (2) and which spatial elements or mental map components in specific can be identified within these heuristics (3).

Consistent with these research goals, this paper is structured as follows: first, the research methodology of the qualitative survey is explained in some detail. The following three sections present the results of the qualitative data analysis. First some general findings about the form and structure of the cognitive processes involved in activity travel decisions are explained. Next, the content of the decision process in general and the decision rules in specific are discussed. Within these sections special attention is paid to the spatial elements and mental map properties that appear in the decision process. To conclude, a general script network view presents an overview of the activity travel decision process, spatial determinants are indicated and future research plans are addressed.

2. Methodology

The research reported in this paper is part of a project conducted in the periphery of the FEATHERS framework (Hannes, 2006). In 2005, this research programme coordinated by IMOB was funded by IWT, Belgium. The goal of this program, in addition to exploring the

potential use of new technology on collecting travel data, is to develop a prototype, activity-based model of transport demand for the region of Flanders (Janssens & Wets, 2005). This prototype will be an agent-based micro-simulator that allows mimicking activity-travel scheduling, within day re-scheduling and learning processes in space and time (Arentze et al., 2006).

A one week activity travel survey and in depth interviews were used to identify the spatial factors that appear in the choice heuristics of experts when planning and evaluating daily activity travel behaviour. During one week, 20 respondents reported their activity travel behaviour in standard activity travel diaries and they used a GPS enabled palm computer to record travelled routes. Respondents were interviewed twice: the pre-interview took place before the start of the survey and consisted of an inquiry into the activity space and travel plans; and the post-interview or feedback interview occurred after finishing the survey and included a comparison of the executed activity travel programme to the former planning.

To reveal as much determinants as possible, a selected sample of respondents was contacted, taking some important characteristics into account that are known for causing variety in activity travel behaviour: age, sex, education, occupation, drivers licence, possession of car, marital status, household size, parenthood, residential location and mainly used transport mode. For each key characteristic in it's own right, 4 to 5 respondents were represented in the sample. This resulted in a total sample of 20 respondents, which is a typical sample size for qualitative research (Mehndiratta, 2003). 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 (FOD Economie - Algemene Directie Statistiek, 2007), respondents without a driving licence and households without a private car 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 activity travel planning and execution on the other hand.

The first interview part consisted of questions about the perception and the extent of the individual's activity space. During this part of the interview, two main sets of questions were posed. The first set refers to the destination choice and the 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 the respondent 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, motor(cycle) and car. It is important to note that in this interview section, no explicit questions were asked to reveal decision heuristics. Respondents often spontaneously referred to the circumstances and the reasons for certain destination and travel mode choices.

In contrast with this first activity space interview section, during the interview sections regarding the scheduling and evaluation of scheduled of activities, the reasons,

circumstances and choice options for the destination choice, the mode choice and the route choice were explicitly interrogated. With regard to the 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 used to choose that location frequently or considered other options as well. With regard to travel mode choice, 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 space was.

The interviews and other relevant survey information were all processed using ATLAS.ti, as this is a powerful software tool for the analysis of comprehensive qualitative data sets. The use of such specialized software packages for Computer Assisted Qualitative Data Analysis (CAQDAS) is considered to be a useful instrument to improve not only the pace and flexibility of data processing in specific, but also the consistency and internal reliability of qualitative research in general (Maso & Smaling, 1998; Seale, 1999). Thus, the initial reading, re-reading, indexing and subsequent systematic coding of the interviews and further classification of the codes results into the descriptive phase and the construction of theories. Starting from indexing the raw data and free coding the text, these theories *emerged* directly from the data according to the principles of “Grounded Theory” as defined by Glaser & Strauss (1967), while *theoretical sensitivity* is shown in the selection of the sample and classification of the assigned codes. In addition, the theories – the classified concepts and ideas that individuals associate with daily activity travel choices and the relation among them – are represented by the software’s graphic tool in “script network views”. Results from the interview data analysis of respondents’ discussion about their daily activity spaces are presented in the following section. Selected typical quotations from the interviews, translated as naturally as possible, are added for the sake of argumentation and illustration.

3. Results

3.1 General Form and Structure of Activity Travel Decisions

Two main observations dominate the analysis of the general form and structure of the cognitive process involved in daily activity travel decisions: the execution of daily activity schedules is principally automatic and seldom preceded by much deliberation (1) and the individual’s daily activity travel execution seems to start from a default setting, and is completed with additional heuristics (2).

A striking finding during the interview administration was the fact that, generally speaking, the different dimensions of the daily activity-travel planning and execution in general and the destination choice and the mode choice in specific does *not* appear to be sequential stages within the decision process. Although often modelled that way, the 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. Activity, destination and travel mode are set in fixed mental scripts that are cued by certain situations. It is highly automated routine behaviour, often performed mindlessly. This was not only spontaneously stated by one of the respondents:

- 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.

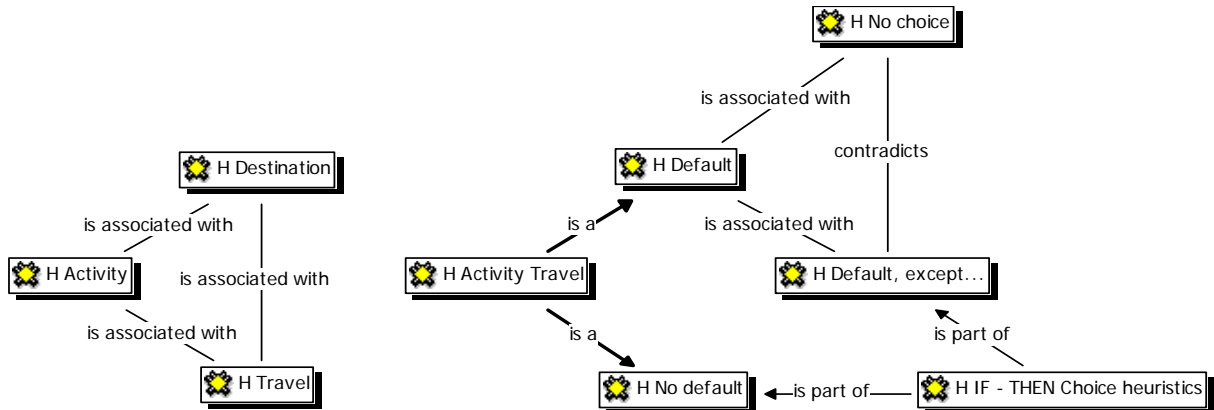


Figure 1. Script Network View: Activity Travel Decision Process in General

The script network view above which has been derived from the interview data, 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 everyday activity episodes. This default setting can be completed by some additional *exceptions*, expressed as IF-THEN heuristics. However, there are also some situations where either the destination or the transport mode or both attributes have *no default* setting and where two or more choice options are considered until the point of departure. In these cases, IF-THEN heuristics appear to explain the circumstances or reasons of considered choice options. The content of these default settings and these IF-THEN heuristics is discussed further in this paper.

3.2 Content of Default Settings in Daily Activity Spaces

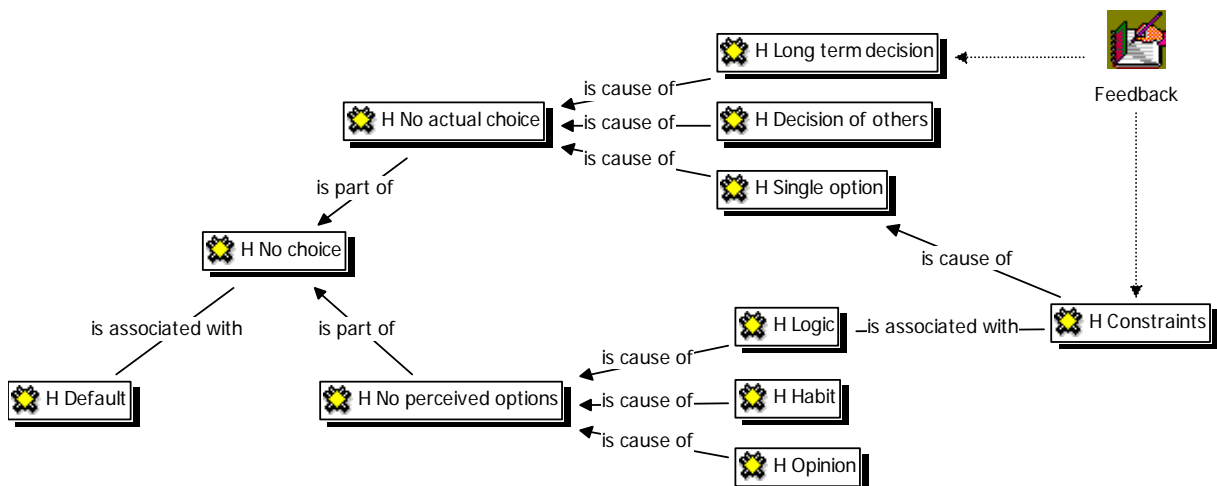


Figure 2. Script Network View: Default Settings in Daily Activity Spaces

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 first situation 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 constraints, coupling constraints 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 the solution (again, within given constraints), the fact that it is a *habit* or they expose some *opinion*, which relates to attitudes and beliefs.

3.2.1 Destination Choice Default Settings

In daily activity travel patterns, destinations are fixed for a lot of activities. There is no actual choice at the time of the everyday activity travel 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 the destination of leisure travel in everyday life and, as a result, such activities become less flexible in activity schedules. Therefore it can be stated that 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], now I'm giving it some thought, yes”

Besides that, for all sorts of discretionary activities where others are involved the activity location decisions can be made by other respondents as well. In the majority of cases, these other agents are members of the household, but destination decisions made 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 the choice set is defined by the specificity of the wanted product or specialization of the needed service, 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. the post office in the neighbouring area), 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 activity travel destination choice where there are *no perceived choice options*. Daily grocery shopping, shopping for non-daily goods, consulting services and real discretionary leisure activities are all activities having multiple destination possibilities. Nevertheless, even when there is no official commitment to certain destinations and there are a number of possible activity locations, “logic”, “habit” and “opinions” seem the driving force in the establishment and maintenance of default destination settings. As explained before, this categorization is derived directly from the interview data. Respondents make references to “logic”, “habit” and “opinions” when explaining their default settings.

“*Logical arguments*” refer to the position of the actual activity location in the entire activity schedule and the various applicable constraints. Some solutions are just the most “logic” thing to do under the given circumstances. 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.*”
- I: “*Yes. Do you still do your grocery shopping there? Yes?*” 19: “*I’m working in Turnhout city, that’s why*”. I: “*O, yes, just on your working tour, you go*”. 19: “*yes, and the Cash [supermarket, red.] is closed during noon and that shop is a lot more expensive*”

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 habitual destination choice. Besides, it is considered rather unusual to change certain activity locations once a choice is made and the result proved to be satisfying, even under changing circumstances.

- 14: “*Our doctor he lives in Hove actually and there when we lived in Boechout [neighbouring town, red.] we have chosen him. But, yes, today that is in fact a remainder of that time.*”
- 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 of “*habit*” in this theory differs from the usual meaning of habitual travel choice behaviour in transportation literature. Indeed, the term “*habit*” is often used to indicate all travel choice behaviour without explicit intention and no or little deliberation (Gärling & Axhausen, 2003).

Finally, “*opinions*” about destination choices and opinions about attributes of theoretically optional activity locations can shape the default destination settings. The first mentioned type is related to general problem-solving strategies and attitudes.

- 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*”.
- 12: “*I do have problems however, for example, or what bothers me is, when our daughter says that she’s going to the movies to the Kinopolis in Antwerp in the evening... that bothers me*” ... “*because there is one here in the neighbourhood, and eum... I mean, I’m a bit of an environmentalist so, that bothers me a bit... I ask myself again and again how long will the environment bear the huge amount of traffic on the road...*”
- 08: “*And in Leuven I always, say, I always walk to cover distances, so in principle I could leave the bus in Leuven at the station and change to another bus which stops right in front of my office doors, but that is not what I do*”... “*Of principle, that is again a matter of principle because it gives me some exercise. (Laughter) Because I do have a sedentary job, so I think it’s important.*”

The latter example shows that the distance minimization strategy is sometimes relaxed when a certain benefit from travel is experienced and time constraints are flexible enough,

for instance when travel is used as a means of passing the time or as physical exercise. This results into apparently less “logical” decisions.

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 distance.

- 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].”
- 12: “It will never cross my mind to drive to a butcher in Herentals just because he has nice sausages... so, but there are people like that, you know”

A last remark that can be made about the default destination settings in daily activity travel patterns is the fact that 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 the concept of “districts” as Lynch proposed in 1970.

3.2.2 Travel Mode Choice Default Settings

The impacting factors for the default settings of mode choices are similar to those of destination choices. First of all, *long term decisions* with regard to the possession of vehicles (purchase of a bike, motor or private car) and the ability to drive them (learning how to drive a bike, passing one’s driving test for motorized vehicles) is an important predictor for the use of individual modes of travel, as is the acquisition of public transport season tickets and reduced fare passes for the use of bus or train. Moreover, people seem to organize their lives from the perspective of the available modes of transport as well: they buy a car to get somewhere but the fact that they have a car, makes them chose destinations that they would not have considered if they would not have owned a car.

- 08: “But in in Antwerp or in eum Ghent, and and that is that might be good to mention, I actually own a bus season ticket for the entire regional bus network from de Lijn and that also partly constitutes plays an argument to catch the bus or the tram more easily in Antwerp or in Ghent or the like because I, yes, I have a public transport season ticket, so...”
- 15: [bike] “not much actually, I think, eum. I have, eum, I have only fixed it last week... so I didn’t have a bike before”. I: “so you still need to get used to it?” 15: “Yes... So, I don’t know yet which things I will be using it for”
- 20: “the same reason, so we intended not to buy a car... and we thought that, if we want to do that, we will have to be located near the village centre... otherwise that is not feasible.”

In certain circumstances the default setting of travel mode experienced as a no choice situation in the daily activity travel pattern is a mere consequence of *the decision of others* in favour of a certain mode of transport.

- 06: [Car] “Eum, yes, going to the shop. But, hey, I don’t drive in that case but I go along with my parents”
- 14: [Moped] “every Friday I drive along with a colleague... (Laughter).” I: “really? Is that really true? With the motorcycle, or? Yes, o, great!” 14: “Yes, that is from one

school to the other school, you see. Yes. But he has like, like a Vespa, you see, and then both of us a helmet on...

A third “no actual choice” situation occurs when the modal choice set is limited to *only one choice option*. This is obviously the case for activities such as “walking the dog”, “run around the block” or “making a bicycle trip”. Besides that, this situation also arises when there is a limited individual modal choice set to start with (no car, no bike, inability to walk due to a physical problem), when public transport supply does not fit the spatial or temporal demand or when destinations are chosen that can only be reached one way within a reasonable period of time.

- 05: *“If I, sometimes, eum, on a Saturday or so, go to visit friends in Hamont, then I take the bus. But at night, there are no busses and then they bring me back to Hasselt that way, so. For the rest, I don’t drive along with a car. But it is the case when I have no alternative.”*
- 11: *“Now, suppose I miss the bus to Geel, so, then I still have another option, then I can take the train to the main station, to the station of Geel, and then the shuttle bus service... So if I miss that bus, I still have a chance to arrive at school on time,... that is not the case with Vorselaar, that is only one connection.”*

In addition to “no actual choice” situations, *no perceived choice situations* happen to occur in default mode settings. The first type of arguments for the existence of certain default mode settings appears to be *logic* within situational constraints. Because different modes of transport have different properties (speed, flexibility, cost, needed physical effort, availability, loading capacity...), they all have a different perceived logical use.

- 07: [Car] *“If you walk out the hairdresser’s door, your hairdo is fine, and then I think, if it rains then or the like or in the winter, I think in fact, I think it’s a shame, so.”*
- 11: *“Friends, very close friends live in Brussels.” I: “Is that far?” 11: “to my opinion that is far, yes... we usually take the train when we go there...”*
- 12: *“now, for instance driving to my horse... eum, so, because that is to far, and because I take the dog with me, and so that is by car... eum, and when I go on a business trip to eum, courses, to Brussels, then it is done by car, because then we are with 2, or with 3 or with 4.”*

As mentioned before, activity, location and mode are intimately tied in everyday activity travel scripts. Because a lot of destinations in the activity space are fixed or appear to have a strong default setting, the resulting distances that have to be travelled are fixed as well. Certain distances and destinations are automatically associated with certain suitable transport modes. Choosing the fastest mode out of the options is a common *logical* choice strategy serving the benefit of time minimization, unless there is some benefit experienced from travel with a slower mode.

- 08: *“Time, sure, that surely plays an important part for me... because I with regard to my job, eum, I experience it as loss of time... but I do carry on... because I, just because I take the bus and on the bus I can do something else then when I’m behind the wheel myself eum and can do nothing else but eum minding the traffic.”*
- I: *“Yes. And does that only have to do with distance? Or as well, does it have another reason as well? Why you would never take the car to go there?” 13: “For parking as well. Sometimes you’re a lot quicker by foot than by bike or by car.”*

As for destination choice default settings, *habit* is of strong influence in the establishment and maintenance of default travel mode settings. Moreover, a (chosen or forced) habit to use a certain transport mode to reach certain activity locations can be so strong that it becomes a general default travel mode setting for nearly all activity travel in everyday life. In that case, activity scheduling follows the functional logic of the travel mode at stake.

- I: “Yes. And how do you go to the station?” O7: “by car... (Laughter) everything by car”. ... I: “and what is in fact too short as distance for you, to travel by car?” O7: “yes, what, what actually... the village centre... but I still do that anyway” ... “regularly eum during the summer eum we try to make it a habit to to go to SACHICO [sports centre, red.] for instance by bike.”
- 17: “no, in fact, yes, I am used to walk to the locations you mention... then we keep it that way.”

Finally *opinions* about transport modes and the properties of the environment in which they are of use influence the fact that certain modes are not perceived or considered as a choice option in everyday life. General attitudes, beliefs, bad experiences, lack of knowledge or a sufficient degree of satisfaction achieved with other transport modes feed this category.

- 13: “but like the Alma [supermarket, red.], things like that. The Aldi [discount supermarket, red.] I would walk to if it wasn’t such a busy road, but it is far too busy so... I think it’s even dangerous by bike.”
- 16: “But that is just because we have no alternative in that case, that is to say, just because we consciously avoid the car but then there is the bus and I think it’s too long, but hey, that’s something like OK, so be it.”
- 17: “Eum in fact I used to travel by train to Tongeren and back ... and now, because this girlfriend has a car, we often drive by car... since I like it better”. I: “Yes (laughter). Don’t you like to travel by train?” 17: “I do. Until, well, until you’re no longer allowed to smoke now... I don’t know. That is to say, I have, eum, I’ve done that for 3 years and, and, well, it gets tedious indeed. It’s, it’s one hour and a quarter on the train and you always see the same things and... pfff... then you know”. I: “Yes. And the bus? You like that?” 17: “I prefer it to the train, because you... well, you travel through a centre now and again and then there is a bit on the main road and then you pass through a village. Well, it’s more, I don’t know, it’s livelier, in my opinion.”

A final remark about the observed appearance of “logic” for the development and maintenance of default destinations and travel mode 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 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 of the activity travel scheduling and evaluation part of the interviews will illustrate this.

Within the destination and travel mode default settings, the influence of space and spatial cognitive factors is at most apparent in the perception of distances and the subsequent distance minimizing strategies. Besides that, the generalisation of possible activity

destinations into functional areas is significant. A third element of spatial factors influencing destination and travel mode decisions is the appreciation of the suitability and accessibility of environments with certain travel modes. For slow modes this can involve the presence of suitable infrastructure and motorized traffic. For car driving, respondents refer to congestion levels and parking facilities.

3.3 Content of IF – THEN Heuristics in Daily Activity Spaces

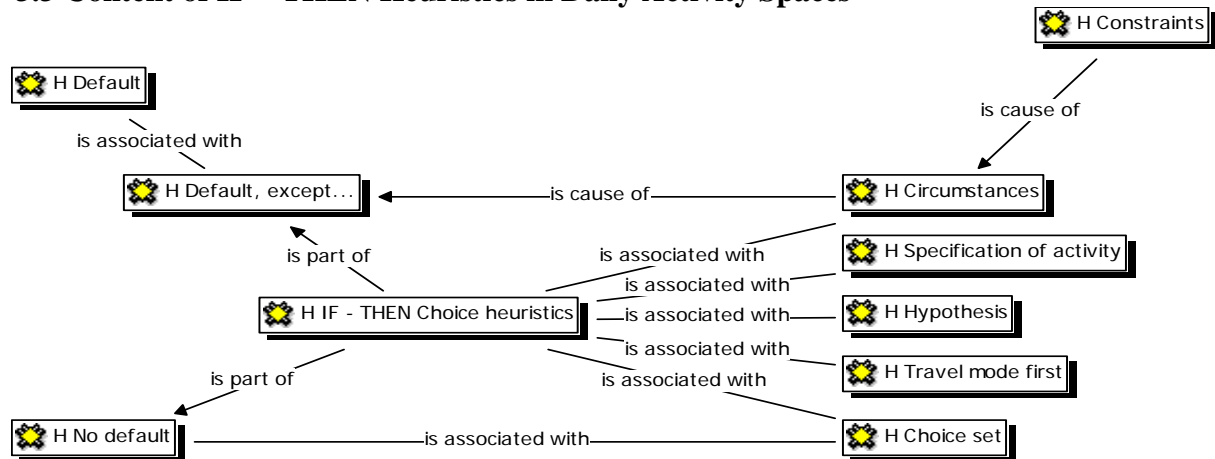


Figure 3. Script Network View: IF – THEN Choice Heuristics

3.3.1 IF – THEN Destination Choice Heuristics

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, the 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.

A first set of heuristics was used to explain the 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 the destination default setting. Quite remarkable is the fact that these exceptional problems and subsequent solutions as they are, seem to be part of fixed scripts. This reasoning shows the existence of a “destinations repertoire” or mental map which comprises a set of standard alternative solutions for rather exceptional situations in everyday life.

- 17: “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”
- 12: [groceries] “that’s not my duty really... and if I do go, if I do go, then it really is in the vicinity... to the Vewo [supermarket, red.] or to the Cash [supermarket, red.]... or to the butcher for instance... so it is”
- 13: “So if it is really urgent, and the kids are really ill, then I do go to Dr. de Praeter, and that is not so bad then”

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 category is an aggregation based on presumed similarities in behaviour 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). Whenever a certain activity subcategory only occurs infrequently (e.g. shop for furniture), possible destinations are not fixed and are 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 and occasional leisure trips (e.g. cycling at summertime or go to the sea) 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: *“Eum. Well. Eum. What the usual grocery shopping is concerned, eum, so eum, what has to be done every week, that is eum, we go, we always go to the Colruyt [supermarket, red.] because they have got everything, eum, Antwerpseweg, that is, gee,... about five minutes, or not even so... because that is most often, because that is a busy road, you know, you are sometimes a bit, in comparison a bit longer on the road... eum, in the city Centre of Geel we do little what that is concerned. I mean for food and stuff, and eum... For the rest it is actually the case that 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”... “And what is actually playing a part in that is that what I can find here, I don’t have to drive any further for, or the like.” Although that we did once, for instance, for furniture or something like that it could be... furniture that is something we do more easily drive a bit further away for, that way, we have been to Antwerp once or so... That is not something you buy every day, so, but for a single occasion, it could occur.”*
- 05: *“yes I think that we for instance if we go to the seashore, that this is 2 to 3 hours and then we do that but then it is with some reservations already, then it really has to, it really has to be something interesting. I can’t sit in the train the whole day just to sit in the train.”*

Apart from the specifications of the activity categories, the above quotations also illustrate some of the relevance of distance in the destination choice within different activity travel categories. However, the travelled distance seems more related with the frequency of the activity performance and the attractiveness of the destination 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 in the interview conversation. Since these heuristics do not reflect actual performed travel behaviour of the past but only reflect suspicions about possible future behaviour, they are not discussed further.

- 03: *“I think it’s not logic to buy your weekly groceries in another village. But that’s just the reality because we in our...” I: “So you would like to do your grocery shopping closer in the vicinity in fact?” 03: “yes,... if tomorrow a new department*

store opens in the neighbourhood, 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 destination choice. 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 the possibilities of the single available travel mode.

- 09: *[daily travel by bike] “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.”*
- 10: *[to the sea] “if we go by train, then we try to take the shortest span, which means Blankenberge in that case. And by car it doesn’t, eum, it doesn’t really matter.”*

Finally, in the no default choice situation the destination choice set in everyday life’s activity travel comprises several considered opportunities. In these cases, destinations are valued equally and the actual established choice appears to depend on scheduling logic, situational circumstances and coincidence. Further analysis of the activity travel scheduling and evaluation of the established choices at the end of the recording week is needed to gain more insight into this process.

- 18: *“yes yes. But hé, I never have to make a long detour here. Really, I run into at least four bakeries.”*
- 16: *[non daily goods] “Eum no first in Lier in the city centre, by foot. So that is 500 meters at the most.” I: “Is that close?” 16: “yes that is close yes, sure... eum or else I go eum shopping in Antwerp and then I go by train.”*

3.3.2 IF – THEN Travel Mode Choice Heuristics

In contrast with the IF – THEN destination choice heuristics, mode choice heuristics were far more numerous in the interviews. This might be due partly to the interview questions, but it also indicates that people perceive more choice options with regard to mode choice than with regard to destination choice and that variety in mode choice occurs more frequently than variety in destination choice. Within these heuristics, the classes of occurrence (“circumstances”, “specifications”, “mode first” and “choice set”) defined in figure 3, can be recognized for each travel mode.

WALKING – First of all, walking as a travel mode is a choice in exceptional situations when circumstances are optimal and general space-time constraints are relaxed: nice weather and a lot of time are typically mentioned as being favourable conditions. Relatively short distance to the activity location proved to be a prerequisite. In exceptional situations with constraining circumstances, however, walking can also be a (perceived) single remaining option. Examples of this are weather (snow), incidents, kids, cargo... Moreover such conditions can result into different destination choices.

- 04: *“and to the church I’ve been by foot sometimes in the summer. But then I walk, well... at least a quarter of an hour, let’s say.”*
- 06: *“eum, sometimes to the bakery, if it has snowed or something like that, then I do go by foot to the bakery or.”*
- 05: *“So if we go on holiday for instance, eum, then we can hardly take our suitcases on our bike to Hasselt station, so then we walk to Kiewit station [nearer but smaller, red].”*

As for destination choice heuristics, IF – THEN mode choice heuristics for daily walking occasions are used in the interviews to specify mode choice options within certain activity categories clustered by location type or activity type. Again, distance is an important factor, together with prism constraints such as the company of children and the transportation of purchases.

- 05: *“Services, yes. Shopping as well if I take the shop across the road, then I often walk.”*
- 18: *“yes, you know, if I eum, take for instance, go to buy drinks. Bottles, but that is by foot as well. And I think that is not as handy by bike... yes that is in fact, those are practical concerns... and such a crate with bottles. Yes, that is not so convenient by bike.”*

Walking in itself can be chosen previous to the destination choice because of the benefit of it, as pastime or in combination with the leisure activity. These cases are less distance sensitive.

- 19: *“yes, what happens is that we walk to den Bruun [village pub, red.] on a Sunday afternoon, drink something and walk back.” I: “but that is if you have a lot of time then?” 19: “yes.”*
- 08: *“and eum, take a walk with the kids after school or something like that, through the city centre sometimes or if we walk to the playground with the kids or something like that”*

Walking and cycling are sometimes considered as equal alternatives for short distances. Revealed decisive factors are time constraints and practical concerns; the bike is faster, but reliable storage is desired.

- 08: *“Eum, well, it could be the trip to the station, because I’d rather not leave my bike over there, and it could be just”... “It depends on the time, eum, so at the beginning I did it far more easily by foot as well, but eum, now it is very often because of the kids and the lot that eum, let’s say the fuss in the morning and so on that I am sometimes obliged to take the bike to get to the train on time, so eum...”*

A final remark about walking is the fact that more than one third of the respondents indicated to hardly ever walk to any activity location. Besides the noted reasons of time saving and health reasons the main explanatory factor is the fact that they tend to live in low density sprawl dwelling area’s where distances are obviously larger and walking accommodation is poor; walking is simply not a perceived option in these area’s.

CYCLING – As is the case for walking weather conditions and time are often mentioned as favourable (pre)conditions. However, more often than walking, cycling is used to replace car travel for short to medium distances because of its speed and reach.

- 02: *“It’s just, now, at, at summertime we do ride the bike.”*
- 08: *“in time, by car it is about a quarter of an hour... But that is something I do sometimes, if the weather is nice, I do it by bike and then it is about half an hour.”*
- 16: *“So that’s about eight kilometres. So if we have time at weekends or on a day off, but of course not like that... if you have time, or then, you know...”*
- 12: *“to go to the bank eum,... to the bakery, eum, yes... things if the weather is nice and I’ve got some time, then I use my bike.”*

IF – THEN bike heuristics also appeared in the interviews. In this case the breakdown does not only occur on the level of the activity but also on the level of location type, travel time and travel distance, illustrating the close coherence of activity – destination and travel mode choice.

- 08: *“Services, yes, yes, of course if I have to go to the post office for instance I won’t take the car, there I always go by bike. Yes. That’s the same radius of action, in fact, because that is all grouped in the centre, you know, eum. Regularly travel further away, yes, it depends on where exactly I have to be, eum. If it, if it is Geel, then it is by bike, you know, so and then it is possibly a bit further away, you know, because, eum, It’s like I say, if I have to go to Bel, Yes, then I go by bike, you know, or to Zammel or whatever...”*

For some daily activity routines, people have a standard mode choice set. Respondents answered the question: “How do you go to [activity]” with at least two possible travel modes. Again, revealed decisive factors are time constraints and practical concerns.

- I: *“yes. Regularly to work [by bike], yes”. O1: “Yes, every day”. I: “Every day? No matter what? O.” O1: “mm... unless it rains if I leave”... “and if health permits it, you see.”*
- O2: *“Well, it’s just a matter of, like the weather, yes, then I will take eum the bike, but if I go shopping, yes, then I usually take the, eum, the car you see. You’ve got a lot of stuff with you in that case, you see... Like to the butcher or something like that. Yes, every time I can I go by bike, you see.” I: “Yes, if you don’t have to bring too much.” O2: “To park over there, where I go to the butcher, well, there is no parking place and then I’d rather go by bike.”*

Quite remarkable is the fact that a quarter of the respondents did not possess a bike at the time of the interview. The majority lives in built up area’s near public transport services and has no direct access to private cars or no drivers licence. However, income levels show that this is not a matter of poverty. Those respondents simply live close enough to various facilities to fulfil their daily needs by foot or public transport.

BUS – Busses are often used by daily cyclists to replace the bike in exceptional situations, such as bad weather conditions. Busses can also replace certain train trips, especially late at night when accessibility by train in certain area’s drops. Busses are far less likely to be an alternative for car travel because of their association with longer travel times and their (equal) sensitivity to traffic chaos. Only if time constraints permit and if no other option is available or another benefit is experienced from travelling by bus, people will opt for the bus instead of the car.

- I: *“yes. And to Turnhout. You do that sometimes by bike, and sometimes by bus as well. When...” 20: “Mostly by bike and sometimes by bus”. I: “and when by bus? Can you”. 20: “if we don’t feel like...” I: “(laughter) yes?” 20: “after a night out it could happen or if it’s bad weather it could occur as well.”*
- 16: *“No, that is, the train till 10 at night or till 10:30, yes, and there is another train at 20 past, but yes, then you have to go to the station and busses, in Antwerp most busses stop more central, like, on central places, so then we choose to bus. And the time: 40 past midnight, so up to 30 past midnight is an advantage then, you know.”*
- 11: *“yes... now and again even, I have a friend living, who lives in Noorderwijk, then I can take the bus from Leuven, I’ve done that before some times... and other friends of*

ours moved near to a bus stop somewhere, so it could occur that I will do that... but mostly I go there together with my partner by car at weekends... but it could occur once during holidays... I do think it out then carefully, you know... ”

Some specifications of the situations in which busses are used in terms of activity type and distance or area also appear as IF-THEN mode choice heuristics.

- 08: *“Eum... Not easy, or at least... Now I really have to think carefully. I, eum, what happens now and again is, for instance if I eum have to be in Ghent because of business, then it could that I take a bus over there... And that is...” I: “Over there?”*
08: *“Over there. Yes.”*

For some trips busses are part of the standard choice set. High transportation supplies with frequent busses to various destinations at low cost are favourable conditions for the occurrence of this choice situation.

- 15 [*chess club*]: *“sometimes walking, sometimes by bike and sometimes by bus” I: “o, yes, by bus. That’s easy from here”. 15: “Yes, because there are busses, I think, every 10 minutes”. I: “And, when when would you go by bike and when by bus? And when would you walk? It depends on what?” 15: “Hm... How I eum... by eum... my bike was not fixed yet that time, you know”... “Otherwise I have to walk then, but you have to be there at a certain time, if not, you loose anyhow”... “But my wife has to work then, so I have to take care that she arrives and that I can leave immediately then, and if that just not works out, well, then I have to catch the bus, because in that case it is quicker than walking”.*
- 16: *“Eum and then as well, take sometimes I take the bus home from the station. Because the bus in Lier is free, it stops, stops here in the city centre”... “And if I have a lot of groceries with me or if I don’t, if I don’t have the bike with me at the station, then eum... then we do take the train... eum de bus home”... I: “That’s afterwards, that is?” 16: “Yes, it is afterwards from the station” I: “And that’s because you have groceries with you,” 16: “Yes” I: “As well as to gain some time then, or?” 16: “Yes, sometimes to save some time. If I am not by bike and then I think, hey, there’s a bus, OK, I get on the bus and then I am two or three minutes faster than...”*
- 18: *“to Hoogstraten it’s on the marketplace, I guess, or at the Watertoren, I’m not sure. Or at the Warande or on the marketplace... yes, that is... That is a little bit further. To Herentals that was here at the corner, you know”... “here, at the Herentalsstraat that is. That’s why the temptation was a bit higher perhaps, not?” I: “If the bus stop is nearer or?” 18: “yes yes.”*

TRAIN – Only one typical “IF [activity] – THEN default [other mode], EXCEPT [circumstances] THEN Train”- heuristic could be recognized in the interviews. The train is not often used as a travel mode to replace default travel modes in exceptional situations in daily activity travel. It is however a vehicle that is highly associated with typical exceptional activities to certain typical destinations at medium to far distances like occasional leisure trips to the seashore or to city centres and occasional work trips to the Central Business District of large cities

- I: *“Now and again by train?”* 02: *“Just once a year ... To the seashore, with my sister sometimes. Once a year.”*
- 03: *“O, eum... if I have to go to Brussels, for instance”... “on a workshop or eum...”*

- 04: *“to Antwerp, that is”. I: “regularly or?” 04: “No! Now and then. If there is a, you know, a musical.”*
- 07: *“to grandpa and grandma to, at least to Bruges when grandpa and grandma give a party in Bruges. (Laughter) Because, because we don’t have to mind the alcohol then.”*
- 08: *“Well, regularly no, but it is an alternative with regard to my job when I have to go somewhere else on a meeting or congress or whatever”... “a conference or whatever, you know, yes, if I can do that by train, that is, that is occasionally...”*

Sometimes, principally for leisure trips, the choice of the travel mode train occurs before the destination choice. In the interviews, the train was never mentioned to be part of a travel choice set in a no-default mode choice situation. Moreover, for more than half of the respondents both bus or train are simply never considered in daily activity travel.

CAR – As said before, cars are typically used for all distances. In exceptional cases, they are believed to replace rather short trips that can be executed by feet or by bike whenever weather conditions are considered too bad. Furthermore cars are used to replace another default travel mode when time constraints are high or when public transport is not longer available, for instance during the night.

- 02: *“Yes I say in this weather I will take the bike more easily, but if it’s cold or if it rains, yes, and then I usually take the car.”*
- I: *“Or to your sister [nearby]? Would you take the car to go there?” 03: “Nyes, but exceptionally. Very exceptionally”... “It must be raining sh... shit then.”*
- 08: *“Normally, normally I take the bus, if I so, if I, if I can be flexible with my working hours, that is to say, if I haven’t got in the morning, let’s say about nine or something like that, if I haven’t got a meeting or don’t have to teach or the like, eum, then I just take the bus, if I, if I can’t afford it to, let’s say, arrive at work at 9:30... In other cases if I have to start earlier or if I stop eum later, if I have something to do in the evening that overruns it’s time, and then I take the car. But mostly I take eum the bus.”*

Distinctive specified activities that are most likely to be undertaken by car are activity travel tours and weekly or monthly grocery shopping. Even most respondents who didn’t own a car or had no drivers licence indicated to execute grocery shopping that way. They either borrow a car for these occasions or drive along with members of the household, relatives or friends. Only respondents from very small households stated not to need a car; they simply increase the frequency of their grocery shopping.

- I: *“Do you drive to your parents by car once in a while for instance?” 03: “No, no, that is just around the corner, you know. I mean...” ... “No, then we have to pick them up and go somewhere or...”*
- 12: *“yes, that that, drive to the paddock is a short distance, so, but... for the rest I dare to drive to the bakery store of course, you know... or a combination of all different things... When I have some time of, write down a list so I have to do that and that, I have to do that, and then I drive so”... “then I drive a tour by car, you see... but that is all within Geel in fact, so... Once in a blue moon... yes, bring my lawnmower to maintenance, but that is in Olen, so but... those are just little exceptions you know.”*
- 11: *“... eum, now and again, eum, to go to the shop, if we have to do a lot of groceries... the Colruyt is very near, but then we do take the car... to buy drinks and stuff.”*

- 20: *“we go, eum, once every 6 weeks to 2 months we do big grocery shopping” ... “and then we can borrow the car from my mother, usually from my mother, or else from my father in law.”*

Finally, with regard to spatial characteristics and spatial cognitive factors influencing destination choice and mode choice in daily activity travel IF – THEN heuristics, no other elements than already mentioned in the default reasoning section have to be addressed. Weather conditions are 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 cycling a lot, weather is 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 excuse for not choosing the 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. On one hand, car drivers have (unconsciously) chosen daily activity destinations in a habitual activity travel schedule from the car’s perspective: daily activity travel 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. Spatial determinants are thus more important in the occurrence of travel poverty than vehicle ownership.

On the other hand, individuals without a driver’s licence 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...”*

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 and thus being less dependent on this travel mode. Others can only be forced to make other travel mode choices if habitual daily activity travel schedules become untenable (e.g. due to external conditions such as congestion).

4. Conclusion and future research

Default settings and IF – THEN heuristics are apparent in individual’s daily activity travel decision process, in particular with regard to the destination and the travel mode choice decisions. 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 particular in time and space plays an important role. The mental map comprises a repertoire of possible

References

- Arentze, T.A. & H.J.P. Timmermans, H.J.P. (2000) *Albatross: A learning-Based Transportation Oriented Simulation System*. European Institute of Retailing and Services Studies, Eindhoven, The Netherlands.
- Arentze, T.A., Timmermans, H.J.P., Janssens, D. & Wets, G. (2006) Modelling Short-Term Dynamics in Activity-Travel Patterns: from AURORA to FEATHERS. *Proceedings of the Innovations in Travel Modelling Conference*, Austin, Texas, 21-23, May 2006.
- FOD Economie - Algemene Directie Statistiek (2007) http://statbel.fgov.be/figures/d37_nl.asp
- Gärling, T. & K. Axhausen (2003) Habitual travel choice. *Transportation* 30, 1-11.
- Glaser, B.G. & A.L. Strauss (1967) *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Aldine, Chicago.
- Golledge, R.G. & Gärling, T. (2003) Spatial Behaviour in Transportation Modelling and Planning. In K. Goulias (ed.), *Transportation systems planning: methods and applications*. CRC Press, New York.
- Golledge, G. & H. Timmermans (1990) Applications of behavioural research on spatial problems I: cognition. *Progress in Human Geography*, 42:3, 57-99.
- Hannes, E., Janssens, D. & Wets, G. (2006) Proximity is a State of Mind. Exploring Mental Maps in Daily Travel Behaviour. *IATBR Proceedings of the 11th International Conference on Travel Behaviour Research*, Kyoto, Japan, 16-20, August 2006.
- Janssens, D. & Wets, G. (2005) The presentation of an activity-based approach for surveying and modelling travel behaviour. *Proceedings of the 32nd Colloquium Vervoersplanologisch Speurwerk*, Antwerp, Belgium, 24-25, November 2005.
- Lynch, K. (1960) *The Image of the City*. M.A. MIT Press, Cambridge.
- Maso, I. & Smaling, A (1998) *Kwalitatief onderzoek: praktijk en theorie*. Boom, Amsterdam.
- Mehndiratta, S.R., Picado, R. & Venter, C. (2003) A Qualitative Survey Technique to Explore Decision Making Behaviour in New Contexts. In P. Stopher & P. Jones (eds.), *Transport Survey Quality and Innovation*. Pergamon, Elsevier, Oxford.
- Seale, C., (1999) *The Quality of Qualitative Research*. Sage Publications, London.
- Stead, D. & Marshall, S. (2001) The Relationship between Urban Form and Travel Patterns. An international Review and Evaluation, *European Journal of Transport and Infrastructure Research* 1, No. 2, 113-141.
- Timmermans, H., van der Waerden, P., Alves, M., Polak, J., Ellis, S., Harvey, A.S., Kurose, S. & Zandee, R. (2003) Spatial context and the complexity of daily travel patterns: an international comparison. *Journal of Transport Geography* 11, 37-46.
- Van Someren, M.W., Barnard, Y.F. & Sandberg, J.A.C. (1994) *The think aloud method. A Practical guide to model cognitive processes*. Academic Press, London.