Chapter 11
Concepts of Travel Behavior Research
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Abstract (max 100 words) please include

The paper proposes a conceptual framework for travel behaviour research through a definition of the scope of the research object, essentially human activity schedules, and a conceptualisation of the traveller as a network actor negotiating infrastructure and human networks and dealing with the social content of the activities undertaken. In the second part the paper sketches an operationalisation of this framework through the dynamic microsimulation of daily life nested within the microsimulation of longer term projects and choices.
Introduction

Travel behaviour research, now about sixty years old, draws for its concepts on a wide range of disciplines and on its own understandings, which are not necessarily consistent with each other, but often either overlay the same term with multiple, divergent meanings, or provide different terms for the same object or process. This is especially true, when one is talking about processes of change at the personal or system level. In addition, the field is tied to its professional forecasting and therefore modelling remit, which generally leads to confusion between the conceptual understandings in its research domain and the impoverished, truncated, simplified forms these find in the numerical models due to measurement problems, resource availabilities or computational limitations. This conflict will be visible in this discussion as well. The purpose of the paper is to propose a general conceptual framework for travel behaviour research. It is a proposal, a starting point for discussion, but hopefully also a kernel around which researchers can start building a common understanding of the dynamics of travel and communication patterns today.

The discussion will start by defining the scope and the objects of travel behaviour, which will be followed by an attempt to provide a framework of how travellers decide about the schedule of their day and by implication about their patterns of contacts. Two digressions look at two detailed issues: How to measure activity spaces? How do persons construct their choice sets? The final section turns to the elements of a modelling system translating these ideas into an operational system. An outlook highlights the open research questions.

Scope

Travel behaviour research studies the physical movement of persons outside their reference locations for any purpose. The movement of freight is only addressed in as far as the people transport freight for work, shopping or other private purposes. Logistic as the study of the production and distribution systems of goods and services will be excluded here. Urry’s scheme for the categorisation of “mobilities” (Urry, 2000, cited in Larsen et al., 2006) is (1) physical travel of people for work, leisure, family life, and migration; (2) physical movement of objects; (3) imaginative travel elsewhere through images and memories; (4) virtual travel
on the Internet, telephones, emails, etc. The categorisation highlights that a single-minded focus on the physical movement of persons might not serve the discipline well for much longer. The increasing quality of virtual environments, such as chat rooms, shared white-board systems, conference calls or the video conferences for substituted face-to-face meetings, and of (interactive) web-sites for service delivery, such as shopping, banking, inspecting goods, for instance, homes, holiday flats, etc., raises the question, if the scope should not in a first step be extended to the physical and virtual movement outside the reference location. In principle, one can and should see physical movement as one of many modes allowing communication and exchange between persons and persons and systems. Still, given that this would extend the scope vastly beyond the current range of the travel behaviour research literature, this step will not be taken. Nevertheless, even with a narrower extension to virtual movement, the problem of an appropriate generic term for such interactions arises. For the moment, I would suggest the term contact for any interaction between persons or persons and a system or location, independent of the physical co-presence of the persons or person and system/location. (The attributes of contacts will be discussed jointly with the attributes of activities below).

In the following the focus will be on physical movement outside the reference location of a person. The reference location is the place to which the person returns at the end of the day. This is generally the home, but might be the room in the student dormitory, the hotel room or some other short-term base for the person involved. The first object of study for travel behaviour research is therefore the share of persons leaving the reference location on any one day, or over any period of time (see Madre et al., 2006, for a review of the evidence from travel diary surveys). The second object is then the total time spent out-of-home\(^1\) on any one day (or period). Surprisingly, there is no travel behaviour literature to speak of about the time spent out of home.

The allocation of the time between the first departure of the day from home until the final return between movement and activities defines the outline of a person’s daily schedule. The other basic elements, which need to be fixed or chosen by the traveller, are:

- **Purpose** of the activity.

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\(^1\)Home is used here and later as a synonym for reference location since the private primary residence is the reference location in which most days end.
• **Timing** of the activity and by implication of the associated movements
• **Duration** of the activity
• **Location** of the activity, which is normally requested at a level of detail convenient for its recall by the respondents.²
• **Participants** of the activity, if any. Note that one should account for any animals, which influence behaviour, such as the dog, or more rarely a horse.
• **Expenditure** for the activity, i.e. costs incurred at the point of use.
• Structure of the associated movement, if any is required between two subsequent activities.

These elements assume a definition of *activity* as a sequence of purposeful actions within the same spatial and social context, which is given by the set of persons interacting with each other. Where movement is the purpose of the activity, for instance, walking the dog, jogging, cycling, a drive with the car, it should be coded as an activity. The concept of the contact inherits these characteristics from the notion of activity. The two basic properties of the associated movement duration and distance covered and speed derived from them (see below for a more detailed discussion) apply therefore to the concept of contact via virtual movement as well. The speed of synchronous communication, via the phone or in chat-rooms, is for all intents and purposes infinity, although small delays are noticeable for certain technical modes of communication, such as voice-over-IP telephony, certain ship-to-shore services, or calls over very long distances. For asynchronous modes, such as letters or email, the speed can be calculated with the duration of the transmission starting with the posting of the message and ending with its reading by the addressee.

The elements of movement, defining its structure are (see also Axhausen, 2000, 2003):
• **Stage** (unlinked trip, segment) is the movement with one mode or means of transport, including waiting times during or after the stage. Walking is understood as a mode of transport. Means are the particular vehicles used. (Although strictly speaking an activity, it is useful to treat the time needed to get the vehicle ready to leave [pack it, seat all passengers, check the vehicle], or to obtain a ticket as a special stage.)

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²In surveys of daily travel, the respondents are normally asked to recall street addresses or places; in long-distance or tourism surveys the locations are aggregated to the level of municipality, region or even country.
(Linked) *trip* (leg) is a sequence of stages between two activities. A walk-only trip has one stage, while all trips involving a vehicle generally have at least three (walking to it, using it, walking away from it to the activity)

*Customer movement* is any aggregation of stages or trips, which supports operational, pricing or revenue allocation processes of public transport operators. For a trip, for example, consisting of two bus stages and a rail stage, the two operators involved would count two customer movements.

*Tour* is a sequence of trips away from and then back to the same location

*Journey* is a tour away from and then back to the reference location

*Move* is special journey from one reference location to the next, normally reserved for the movement between two main homes.

Each of these elements is defined by:

- *Timing* (of its begin)
- *Duration*
- The technical *means of transport* (stage only), which itself can be defined at various levels of detail depending on which characteristics of the vehicle or the service, in the case of *public transport*⁴, are of interest to the analyst.
- Main *mode* of transport, is identical to the mean of transport in the case of the stage, but otherwise needs be chosen from among those of the stages involved by an appropriate rule. The convention is to select the means, which binds the traveller most in terms of timing or covers the largest share of the total distance travelled. This means, that regular timetabled public transport means have priority in this ranking over private means, such as walking, cycling or the private car.
- The *start location* or origin
- The *end location* or destination. Note that for car stages this is the parking space and not the activity location, a difference that is normally neglected, but leads to an underestimate of walking as parking space and activity location are not necessarily close to one another.

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³*Public transport* is any service, where a third party transports a person against payment. The different forms of public transport are defined by the type of vehicle employed and the detailed characteristics of the service (frequency, sequence of access points, service period, rules of carriage, quality of accommodation within the vehicle).
• *Route*, that is, the exact sequence of links and nodes used, or more general the *connection*, that is, the physical route, the *access points* (parking place, stops, stations, port, airports) plus the (time tabled) vehicle (run).

• *Accompanying persons* during the movement. Note that one should account for any animals here as well.

• *Expenditure* for the movement and any associated parking, i.e. the out-of-pocket costs.

The main scope of travel behaviour research is the measurement, analysis, modelling and forecasting of the travellers’ schedules, that is, the volume, structure and characteristics of the activities and movements involved.

The reader will have noted that the word *mobility* has been avoided so far. The term has acquired so many meanings and connotation, that it is difficult to use without a definition every time it occurs. This is obviously cumbersome and invites misunderstanding. The term is used to mean travel undertaken by travellers. It refers to the capabilities of a person with regards to movement and travel independent of his or her actual travel. Finally the term is applied to movement in the social space, for example between classes, milieux, groups or roles, some but not all of which involve substantial amounts of travel. The extension of the term through subdivision, as in the example of Urry above, or through extension, such as for example Kaufmann’s (2002) *motility*, endangers its usefulness further. It will generally be avoided here.

**Explaining behaviour**

The travel behaviour literature generally documents the increasing refinement of the conceptual frameworks and models for the behaviours and choices of travellers on individual days. Taste differences, lifestyles, attitudes and socio-demographics have been added to the description of choice situations, which are driven by the relative *generalized costs* of the activities and their associated travel. What is mostly missing is integration between the short-
term and long-term dynamics of travellers’ behaviour. While the industrialized world will never again see a similar dramatic shrinking of its time-space system as it did during the last fifty years (see Figure 11.1 for the Swiss example), other major changes should force travel behaviour analysis to adopt fully dynamic frameworks, of which charging at the point of use is the most likely candidate next to improved real-time information. The recent difficulties and costs involved in expanding infrastructure capacity have led to increasing reliance on demand management approaches to balance the network loads. Transport telematics, on-line traffic control, road pricing, revenue management of the airlines, but also employer-based green travel come to mind. All of these work because travellers have some flexibility with regard to their timings, above and beyond other possible changes to their schedule such as route, mode or destination. These changed timings are likely to affect more days than just the current one and therefore suggest models that are able to address sequences of days.

Additionally, the limitations of the current set of variables to explain behaviour have become clear. While the models often have good fits, there remains an unease, especially about trip generation\(^5\), the stability of behaviour over time, the joint choices of groups and households, the formation of choice sets and finally the selection and formation of choice rules by travellers. Against a dynamic perspective, and also again visible in an analysis of omitted variables, two issues (and variable groups) seem obvious: the information assembled by travellers via their biographies and the information and abilities inherent in their social networks.

Figure 11.2 summarizes a view of the traveller in a dynamic social context. The personal world of the traveller is perhaps better known as his or her mental map. However, this term emphasizes the geography of the activity space at the expense of other important elements of knowledge: types of activities known, when and with whom to undertake them, and the opening hours of facilities. An alternative term for this knowledge would be activity

\(^5\)In the most common approach to the schedule generation (see, e.g., Ortuzar and Willumsen, 2003) it is partially reconstructed through a sequence of partial analyses addressing the number and type of activities (trip generation), origins and destinations (trip distribution), modes (mode choice) and equilibrium allocation of routes and connections (assignment).
repertoire, which in turn is partial because it does not refer to the geography of activity participation. Drawing on the knowledge accumulated over the course of a lifetime, the traveller selects projects against the background of his or her current commitments. Longer-term choices, such as household locations (including workplaces, regularly used shops and other facilities), social networks as well as available mobility tools (such as licences, motorized vehicles, public transport season tickets and bicycles, which reduce the variable costs of travel in exchange for some upfront – capital - payment) are included in Figure 11.2. The members of the social network and their personal worlds are both resources and constraints. Thus, their knowledge, their abilities and their material resources can be drawn on within the limits of convention and proportional to the strength of the personal relationship, which gives the individual extra leverage in his or her daily life. Their locations, abilities and resources are also limiting, as they have to be considered in decision making. Consider the trivial case of the joint choice of a restaurant, if one of the members of the group has particularly strong dislikes, such as an aversion to a cuisine, or is allergic to, say, seafood.

Insert Figure 11.2 about here

Still, the social capital of a person is embedded in their social network. At the microscopic level of human interaction in daily life it needs to be given a specific definition to enable its measurement and operational use in conceptual, econometric and simulation models. Axhausen (2005, 2006) proposes that it is the joint skilful ability of the members of a network to perform, act and enjoy each other as the result of their joint history, commitments, references and understandings. In daily life, it encompasses both productive and hedonic aspects of joint human action. This capital is built up through joint activity and therefore travel, but also through technology mediated contacts such as letter writing, texting via SMS, emailing, chat room talk, instant messaging, phoning employing any number of technologies (land line, mobile, voice-over-IP, etc.). These tools, and the ability to use them, form together with the mobility tools, mentioned above, the networking tools of a traveller.

A person belongs to multiple social networks. A social network is defined as a set of persons who are linked pairwise, so that each person can reach any other through an active tie. The nature of the tie varies by the type of network, but always entails a certain minimum flow of resources and commitments between the two persons: being related to one another,
working for the same group or firm, having studied with the same teacher, belonging to the
same sport clubs, attending the same games, being a regular at the same bar, driving the same
antique car model, having grown up in the same place (at the same time), etc. As the possible
number of overlays of different strength is nearly endless, it seems pointless to speak just of
strong and weak ties. Each tie entails certain rights and duties. The differences in these rights
and duties also segment the in principle universal net encompassing all human beings into a
set of many smaller networks, which have different levels of awareness of their respective
existence\(^6\). Nevertheless, their presence is felt through the general level of trusting and trust in
a particular environment (see Seligmann, 2000, or Offer, 2006)

Given their limited understanding of the world and the time pressure of daily life,
travellers have to schedule their day. Pre-commitments to work or regular activities, such a
gym, joint sport, family dinner, reduce the complexity of the choice problem by providing
constraints, as well as tested routines (see Schlich, 2004 for a detailed analysis). Still, there
are degrees of freedom even with these pre-commitments and there is free time. It seems
reasonable to assume that the travellers construct alternative solutions from which they select
that advances their interest best. (Offer, 2006, on the problem of how well persons can and do
choose between longer-term commitments and pleasure now). For the outside observer and
modeller, the time horizon of this choice, the set of alternatives constructed and considered
and the complete frame of reference remain unknowable.

The utility of the choice is the weighted sum of the hedonic pleasure derived from the
schedule (activities, contacts), any money earned, any contribution to a larger project, the
activity expenditures and the generalised costs of the necessary movements. It is important to
note that projects in the sense of a coherent set of activities undertaken to attain a goal provide
additional structure over longer-time periods. They range from the trivial, such as preparing a
dinner, to the profound, such as working towards a professional degree. The boundary to firm
commitments, which one could see as open-ended or projects without a specific goal, is fluid.

The concept of generalised cost was advanced in the thinking about travel behaviour
from the start, as all analysts recognised that travel costs are not reducible to just one variable.

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\(^6\)Some networks and their members are public knowledge, such as parliaments, the boards of listed firms,
professors of a university. Other networks are known to exists, but their full membership is not generally known:
social clubs, such as the Masons, Lions or Rotary, sports clubs, political parties, churches, families, etc.; finally
some networks can be assumed to exist, but their memberships are unknown: friendship groups, alumni groups,
etc.
Travellers trade off different attributes of a movement, foremost, expenditure against travel time. It is also obvious that the acceptable trade-off will vary depending on the exact choice situation of the traveller defined by the time pressure of the choice, the time pressure of the movement, the physical strength of the traveller, the mobility tools at hand, the weather, and the purpose and social content of the activity at the destination of the movement. The generalised cost can be thought of as the taste-weighted sum of the perceived risk-adjusted expenditure and the comfort-adjusted and risk-adjusted travel time of the movement (see Xiang and Polak, 2005, for a similar reasoning). The risk-adjustment is necessary, as the traveller cannot know with certainty how large the expenditure will be, or how long the movement will last. The route taken and the means of transport offer different levels of comfort and enjoyment. The elements of quality include further safety from accident and violence, quality of information provided, smoothness of the ride, and interiors of the vehicle, etc.

The perceived expenditures or costs will vary by person and the time horizon of the choices at hand. Generally, fixed costs, such as purchase prices of cars or season tickets will be ignored in day-to-day decision making; even fuel, as bought irregularly might be ignored by car drivers. This discounting explains the disproportionate weights given to single fares, tolls and parking fees, which are a regular feature of any analysis of the impacts of these very visible out-of-pocket expenditures.

Given the field’s focus on movement, travel behaviour research has learned relatively little about the utility derived from the activities for which the movement is undertaken. In principle, Becker’s (1976) leisure time allocation model and its derivatives dominate the field (see, e.g., de Sepra, 1971; Jara-Diaz & Guevara, 2003). There are however few attempts to estimate the underlying utility functions and even fewer that experiment with alternative functional forms beyond the logarithm of duration. A decreasing marginal utility of any activity with regards to its duration stands to reason, or the common experience of satiation or boredom. Still, it is unclear, whether the marginal utility become negative, and if so, when and why. On the other hand, the argument made above about social capital as the product of joint learning would suggest that any social activity should produce some positive utility as long as it increase the joint skill level.

While studies about the activity performance (main and any interwoven secondary activities) are rare in travel behaviour (see Hensher, 1977, for example of research on value of
travel time savings of business travellers, or Lyons, Jain and Holley, 2006 for all journeys), work on the social content is essentially non-existent. Social content is the social implication of any activity above and beyond any actions performed. Axhausen (2005) proposes to capture the social content of an activity through the following items:

- A more detailed coding of the actions involved, perhaps at the level of detail typical for time-use studies
- A description of the social purpose of the activity and of the obligations fulfilled with it
- The beneficiaries of the activity
- Composition of the party travelling together to the activity
- Composition of the party participating in the event and having meaningful interactions with the traveller
- The locations of the fellow travellers and participants prior to the trip or activity, to assess their costs to be involved in the activity or the movement
- Distribution of the travel and activity costs among the participants and beneficiaries.
- The planning horizon of the activity
- Number of previous visits to that location, in particular, if it was the first visit ever.
- The secondary activities undertaken during the trip and the activity, if any.

These items would give an indication of both the how and why of the activity, but also of the value attached to it. They would position it in the larger context of the persons daily life through the planning horizon and the information about the beneficiary.

Individual items of this list have been tested in recent diary surveys (see Löchl et al., 2005; Axhausen et al., 2006; Schlich et al., 2003; Axhausen et al., 2002), but their joint potential to illuminate the social content of activities and travel is still unexplored.

Just as the social content has not been given much attention in travel behaviour research, the search for *behavioural innovation*, or its cousin *variety seeking*, which does not, strictly speaking, require new experiences, has been equally neglected. The term innovation, an invention transformed into an object or service in daily use, is actually difficult to apply to travel behaviour research, which is not primarily concerned with new objects and services, but
with the patterns of behaviour resulting from the interaction of these with the traveller. We could define behavioural innovation as any in its (detailed) elements never before observed pattern of activity and movement. The analyst has to limit the number of the elements and of their categorisations to be able to operationalize novelty (Schlich, 2004; Schlich et al., 2004). The recent availability of long duration diaries and of even longer GPS-based observational data of travel behaviour, makes it is now possible to analyse the level of innovation in daily behaviour (see Figure 11.3 for an example).

This pattern of an on-going search for new locations is consistent across a range of six long duration data sets, which have been analysed by Schönfelder and Axhausen (2003a, 2003b, 2004) and later Schönfelder et al. (2006). It would be interesting to know whether this search for the new is equally pronounced among the other dimension of travel behaviour: activity type, routes or participants in the activities undertaken.

**Digression: Activity space and innovation**

The observed constant rates of innovation with regards to visited locations raises the question of how much space, or how many activity locations have to be within reach for a traveller to satisfy her or his need for the new and different. The traveller’s mental map is likely to be substantially larger, as it includes second-hand information. One possibility is to restrict the measurement to the observed locations and search for a measure which at least approximates the likely underlying mental map. Any systematic measure based on these locations observed could be called *activity space*. Schönfelder and Axhausen (2003a, 2003b) propose a number of approaches for this purpose, partially derived from the ecological research on animal home ranges. The most satisfying are the simple to calculate and robust size of the 95% confidence ellipse (see Figure 11.4a) and the shortest path network (Figure 11.4b), which requires substantially more background data in the form of coded road and public transport networks and more computation. It is defined as the length of the set of links,
which are part of the shortest paths between the locations visited by a person, in the sequence observed\textsuperscript{7}.

The 95% confidence ellipse rests on strong parametric assumptions and imposes a particular geometric form. It also generalises and covers parts of the city or urbanised landscape, which the traveller is very unlikely to know. It is therefore not fully suitable as a proxy measure of the underlying mental map. The shortest path network requires fewer parametric assumptions and only considers observed locations. The shortest path network should also be a better approximation, as it only includes parts of the city, of which the traveller has first hand experience; assuming that we observe the traveller long enough, we can hope that he or she starts to exhaust the locations which form part of the mental map. Any innovation is then likely to add only marginal amounts to its size.

The analysis in the papers cited above shows that the activity spaces follow a left skewed distribution, that the size is not strongly tied to the travellers’ socio-demographics, but that it is dependent on the total number of trips observed. This weak link between the socio-demographics and the patterns of trip making was also found by Schlich (2004) who also worked with long duration diaries. The activity level and variety-seeking seem to be independent of the usual explanatory variables. An interesting question is then to what extent travellers self-select as residents into locations allowing them to satisfy this need with lower generalised cost for high(er) quality activities.

**Digression: Construction of the choice sets**

Travel behaviour research divides decision making into two parts: construction of the choice set and the choice itself. The bulk of the research during the last three decades has gone into modelling the second part with continuously more complex structures, mostly of the general extreme value type (see, e.g., Ben-Akiva & Lerman, 1985; Bhat, 2006; Daly & Bierlaire, 2006; Train, 2003). The problem of the choice set formation has been

\textsuperscript{7} If GPS records are available, the computed shortest paths may be replaced by the observed routes.
acknowledged, but essentially ignored in practise, as it tied up with the unobservable traveller’s *personal world* and the equally difficult to observe choice situation of the specific case. Generally, it is not known when the details of a particular activity and movement are decided upon, under what time pressure and with whom, if anybody, the choice was negotiated. The work of Doherty and collaborators (e.g., Doherty & Miller, 2000) has shed light on the lead times of the choices, but not yet on the other aspects. The large share of observed choices labelled impulsive, spontaneous or last-minute in his surveys, is noticeable through-out, and indicates that travellers have often little time or take little time to decide.

Figure 11.5 proposes a structure for the choice process. It highlights, that the choice among the alternatives constructed by the traveller is only the last of a series of choices. The first is the metadecision that a decision is required. The person must have detected, that his or her situation has changed and that the current behaviour might produce an unsatisfactory outcome. Examples in the travel context would be the onset of congestion on a planned route, the unproductive meeting or activity, the realisation that on-street parking is not readily available or the rapid technical deterioration of the personal car. The time available for that choice must be defined. Again, in the transport context, this might be the driving time until the next junction or exit, or the time until the end of the leasing period for the current car. The traveller needs to assess whether he or she has enough alternatives to choose from or to establish or construct new ones. Hägerstrand (1970) identified the physical, social and legal constraints that will limit the alternatives to those compatible with time-space regime of the environment, the prior commitments to others and the locations reachable with available mobility tools. Depending on the time pressure, there might be time for an extensive search for information, say in the case of a new work location or a new residence, or just enough time to recall earlier trips and their routes that involve the upcoming exit ramp. The end of the extensive search has also to be decided upon (see Varian, 1999, for the economics of search). Only now can the traveller decide. Sometimes no alternative is found, so no change in behaviour is possible, in other cases the number of alternatives is large, as for example in the case of holiday destinations or after searching various airline websites for the routings of a multi-destination round-the-world journey.

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8The partial relaxation of the social constraints through the general availability of mobile phones was thirty years in the future when Hägerstrand’s (1970) seminal paper was published. He could also not foresee the attendant tolerance for the announced delay and real-time rescheduling.
A possible modelling framework

The view formulated above sketches the traveller as a network actor in a double sense. It sketches a person, who has to negotiate both the physical space of locations and infrastructure networks and the social space of his or her social networks, ranging from work, school, clubs, church, neighbourhood to friendship and family. Through investment in his or her mobility and networking tools the traveller reduces the variable generalised costs of travel, either through faster speeds or higher comfort or lower variable expenditures. Positioning himself or herself in an environment which matches the desired profile for the rate of innovation the person can pursue the projects envisaged and the commitments accepted. This is a profoundly dynamic understanding of the travellers, as just about all elements are subject to on-going change: the person learns and thereby updates his or her personal world, mental map and activity repertoire. The social networks grow and change through the actions of other members of the networks, which in turn will change the joint activity space, as new locations are added by new network members. Finally, one would expect that the traveller will generally seek to improve his or her situation, or at least to stabilize it. Offer (2006) discusses the problem of the choice of time horizon for this improvement.

Such a dynamic view of the individual requires a division of the modelled processes into short-term and long(er)-term ones. The perspective changes from the descriptive one taken so far to an operational one. The task of travel behaviour research is to predict changes due to policy intervention or exogenous changes, such as immigration, population growth or decline, changing prices, etc. One possibility for such a division is suggested in Figures 11.6 and 11.7. The understanding referred to here does not require an equilibrium\(^9\), but assumes a willingness on the part of the traveller to improve his or her situation incrementally. While

\(^9\)Equilibria in the travel behaviour context are defined as a situation, in which the expected generalised costs on which choices are based are equal to those encountered by the modelled agents during the execution of these choices. There are no inconsistencies left.
behaviourally appealing, such an approach might still need equilibrating mechanisms to produce consistent results in application contexts.

Insert Figures 11.6 & 11.7 about here

The central process for the short term (Figure 11.6) is the formulation of schedules as the complete description of a day (number, type and sequence of activities, their durations and locations, modes and routes, finally group size and composition for travel and activities). It is assumed here that the scheduler draws from an activity calendar that lists the activities or, more generally, activity types that the traveller has to accomplish due to project engagements, commitments, physiological needs or desires. This list reflects the person’s activity repertoire which can be expanded through interaction with others and the environment. As people generally aim to improve and possibly even optimize their schedules, they will draw on their mental maps to reduce the effort and uncertainties of the day. We know that travellers, as a rule, do not fully book their days, but leave slots for the unexpected and the unplanned. In a simulation framework it might be necessary for the sake of computational convenience to impose the assumption that the current day has been fully allocated by some arbitrary point of time in the previous night.

The execution of the schedule requires interacting with others in the infrastructure networks and in activity locations, such as shops, cinemas or other persons’ homes. In some cases the resulting congestion or the failure of an activity opportunity to deliver the expected service or good forces travellers to adjust and to reschedule. At the end of the day, travellers will have updated their knowledge about the elements in their activity repertoires and mental maps. They may have developed new solutions to the fulfilment of their needs by innovating, here trying new routes, modes or locations, by drawing on new information, by expanding their expectation space or by accepting solutions proposed by others on the basis of their knowledge. The expectation space is a third view of the personal world. It is the set of simple rules or heuristics that people develop about the environment, and their generalizations about the organization of space. Examples are the heuristics of how to detect the onset of congestion, how to find a gasoline station in an otherwise unknown part of town or expectations about the store composition of any local shopping mall.
Longer-term processes (see Figure 11.7), which structure the shorter-term ones, revolve around the projects which a traveller formulates to translate his or her life goals and his or her understanding of himself or herself into reality (Nuttin, 1984). In any one period these projects need to be sequenced to provide a reasonable load and prioritization. This planning requires negotiation with others, as many projects will depend on synchronization with, input of, presence of or permission of others. Again, the interaction with still others in the markets and networks during execution will require adjustments and changes, including the abandonment of certain projects or project elements. The experience will update and expand the individual’s personal world but also shape the set of life goals pursued in the next time interval.

The impact on travel behaviour modelling of such a reframing of the task would be profound. It would move the centre of attention away from the idea of equilibrium and towards concepts such as innovation, solution generation, life goals and commitments to people and ideas. These concepts are not unknown to activity-based travel behaviour analysis, but they would need to be moved centre-stage.

**Outlook**

This chapter has tried to provide concepts enabling a discussion of the dynamics of travel behaviour. At the same time it has argued for a view of travellers as network actors constantly aiming to stabilize or improve their situation. The model system sketched in the last section seems feasible to apply with today’s computers and software tools. Between feasible and operational is a large gap however, which needs to be bridged by appropriate research. The major topics of such research would need to be the description of social networks and their impact on travel decisions, the modelling of the mental maps and activity repertoires of travellers, the identification of the solution strategies applied by individuals when they schedule their day and with it the days of the persons they interact with and contact. Last but not least, all results of the research need to be translated into computational models, which can support the decision making of firms and governments.
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References


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Figure 11.1. Road travel time-scaled mapping of Switzerland (same scale)

Source: Axhausen and Hurni (2005)
Figure 11.2. The individual in a dynamic social context.
Figure 11.3. Share of never before observed and never before visited leisure locations over a 12 week period.

Data: Schlich, Simma and Axhausen, 2003
a) 95% confidence ellipse

b) Shortest path network

Source: Schönfelder, 2006

Figure 11.4. Examples of activity space measures.
Figure 11.5. Simplified model of the choice process.
Figure 11.6. Modelling the individual’s day-to-day dynamics
Figure 11.7. Modelling the individual’s longer-term dynamics