HOW TIME-PRESSURED INDIVIDUALS COPE WITH DISTURBING EVENTS AFFECTING EVERYDAY ACTIVITIES:

A LITERATURE REVIEW AND CONCEPTUAL ANALYSIS

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Inhoudsopgave

Samenvatting

Hoe drukbezette individuen omgaan met verstorende gebeurtenissen tijdens hun dagelijkse activiteiten: Literatuuroverzicht en conceptuele analyse

Bij het uitvoeren van hun dagelijkse activiteiten en verplaatsingen krijgen mensen te maken met allerlei omstandigheden die hun plannen verstoren. Vooral personen onder tijdsdruk kunnen hier nadelige gevolgen van ondervinden. In deze paper worden inzichten uit de literatuur over activiteiten- en verplaatsingsgedrag over hoe individuen met zulke verstorende gebeurtenissen omgaan, samengevat. Geconcludeerd kan worden dat er aanzienlijke vooruitgang is geboekt op dit terrein gedurende de laatste jaren. Desalniettemin bestaat er behoefte aan theoretische kaders en modellen die niet alleen rekening houden met cognitie-georiënteerde verklaringsmechanismen voor individueel gedrag in dergelijke omstandigheden, maar ook met het belang van sociale relaties voor de verklaring van zulk gedrag. In deze paper wordt daarom een theoretisch raamwerk gepresenteerd dat poogt cognitieve en sociale verklaringsmechanismen te integreren.

Summary

How time-pressured individuals cope with disturbing events affecting their everyday activities: Literature review and conceptual analysis

When conducting daily activities and the associated travel, individuals have to cope with all kinds of interfering events disturbing their plans. Especially time-pressured individuals may be sensitive to the impact of such events. This paper summarizes insights as to how individuals cope with interfering events obtained from the literature on activity and travel behavior. It argues that considerable progress has been made over the past years, although there is further room for improvement. In particular, there is a need for models and theoretical frameworks which not only consider cognition-oriented explanations for individuals' coping with disturbing events, but also the relevance of social relations for understanding such behavior. The paper therefore outlines a framework that seeks to bring both types of explanatory mechanisms to the fore.

1. Introduction

Time pressure is becoming a problem for an increasing number of individuals and households (Southerton, 2003). Rising levels of time pressure have been attributed to increases in work hours, the blurring of distinctions between work and family, and the progressive erosion of collectively maintained temporal rhythms like the Monday-to-Friday 9-to-5 workweek (Kaufman-Scarborough & Lindquist, 2003). Time pressure is, however, no one-dimensional concept; a distinction should at least be made between a more objective form of time pressure resulting from the organization of individuals' daily life, and a more subjective form associated with feelings about time use in a broad sense (ibid.). The intensity of both forms may vary by day, time-of-day and situation (Gärling et al., 1999).

One implication of objective and subjective time scarcity is that individuals' activity plans or schedules may exhibit less flexibility; time-pressured individuals are likely to have and perceive fewer opportunities to accommodate, or improvise when confronted with, disturbing or interfering events on a daily basis. The latter come in many forms and disguises. What unites them is their irregular rhythmic occurrence across time, which makes it difficult (if possible at all) for individuals to predict if, when and where they will happen. Examples from the transportation realm include non-recurrent road congestion, unreliable transit services, or vehicle breakdown. Interfering events can also affect the activities individuals conduct at stationary locations. Relevant cases are obligatory business meetings running late, a child falling suddenly ill, or another person not showing up at the scheduled time and place. Disturbing events are important, because they complicate the planning or scheduling activities and travel and pose dilemmas to individuals: to what extent should they be taken into account (if at all)? How realistic are they? How to respond to them? Can they be anticipated? In short, they are likely to create uncertainty on the part of the individual.

This uncertainty may be especially delicate to individuals with (severely) restricted time resources. Several consequences can be imagined. For instance, if a person has many tasks and activities to conduct, the occurrence of unforeseen events may reinforce or aggravate feelings of time pressure. Because time pressure is known to affect individuals' decision-making process – they tend to utilize information more selectively to arrive at a decision and more often employ simpler decision rules (e.g., Payne et al., 1993) – adjustments to their planned activity schedules may differ from revisions made under circumstances of less time pressure. Yet, owing to prior experience, time-pressured individuals may be well aware of the adverse impacts markers can have, and therefore, within the boundaries set by their plans, try to maximize opportunities to maneuver by interspersing their activity schedule with short

periods of relative rest (cf. Cullen & Godson, 1975). A comparable strategy is the planning of safety margins, periods of reserve time immediately prior to the required presence at a certain space-time location (e.g., Noland & Polak, 2002).

Although the last example may suggest that research about activity-travel behavior offers insights into the ways individuals cope with disturbing events in their everyday life, I will argue that it provides only a partial understanding of such behavior. This partiality stems in part from the overemphasis on individual responses related to commuting and road congestion in past work. Because non-work trips differ from commutes, it is not clear a priori whether insights obtained from research about commute trips can be transposed to other trips and non-work activities and to interfering events other than congestion.

An additional set of reasons lie in the underlying assumptions about how activity-travel patterns come into existence. While descriptive models of decision-making are becoming more popular, normative or prescriptive models continue to be employed frequently to explain how and which choices are made. These normative models focus on what *should be* the outcome in a certain situation, employing a set of assumptions about how individuals make decisions. Because these assumptions are frequently unrealistic in the light of individuals' limited cognitive abilities and bounded rationality (Simon, 1955; McFadden, 1999), normative theories can at best provide a limited understanding of what individuals *actually do* when dealing with uncertain conditions and unexpected events. Researchers therefore try to develop models mimicking the cognitive mechanisms of problem solving, although the derivation of the crucial elements of descriptive models – heuristics, or decision rules employed by individuals – from empirical data has so far turned out to be difficult. This is not only due to lack of appropriate data but also to the complexity of the (dynamics in the) decision-making process.

In the transportation field descriptive models accounting for individuals' cognitive limitations are rapidly becoming more popular. Yet, there are other assumptions of normative models that have so far been criticized only infrequently. These pertain to social mechanisms, about the ways in which individuals deal in relation to other individuals. In normative (and current descriptive models) individuals are seen as having more or less coherent characteristics and personality traits, and as the basic atoms animating and driving larger-scale systems. Yet, sociologists and geographers have argued frequently that behavior depends on the social and space-time relations in which individuals are embedded (e.g., De Certeau, 1984; Thrift, 1996). Their behavior is thus strongly context-dependent and may hence appear to be contradictory and incoherent when considered across situations. Consideration of notions of relationalism may enhance our understanding of how individuals cope with interfering events.

In sum, this paper has to two objectives. First, it seeks to summarize relevant insights about how individuals deal with disturbing events affecting daily activities and associated travel from the literature on activity-travel behavior. In particular, it attempts to enumerate a range of coping strategies employed by individuals. Second, it seeks to outline a framework for understanding how (time-pressured) individuals anticipate and/or react to disturbing events affecting their everyday activities and associated travel that gives prominence to both cognition-oriented and relational explanations for coping with interfering events.

2. Literature review

The body of literature most likely to yield insights about how individuals cope with such events stems from the transportation field and seeks to understand how and why people travel as they do. There are other bodies of literature in which disturbing events play a role like that on time perception and subjective time, but studies in those fields tend to look at more general patterns of behavior. To the best of my knowledge, they do not focus on individual activity and travel episodes and the linkages among them to the same extent as the transportation-based studies discussed here do. Yet, this level of detail is required for obtaining insights in relations between the spatiotemporal context and individuals coping with interfering events.
As will be detailed below, little is known about the impact of interfering events like vehicle breakdown or a child falling ill on individuals' planning and execution of daily activities and associated travel. Yet, the impacts of road congestion and unreliable transit services have been given considerable attention, albeit largely in the context of commute behavior. Related to this, recent years have witnessed a dramatic increase in interest in uncertainty and variability in transportation systems (Bonsall, 2004). This is clearly relevant for our understanding of individuals' coping with interfering events, although a note of caution is in order. Only studies focusing on uncertainty on the part of the traveler about the conditions of the transportation and activity system are relevant for our purposes. In short, two strands of literature are relevant to our understanding of individuals' coping with interfering events: studies about how travelers deal with congestion and associated travel time variability in the context of commuting; and studies belonging to the activity-based approach.

2.1 Congestion and commuting

Many studies have attempted to identify travelers' responses to changes in travel conditions. As argued before, previous research has emphasized how individuals respond to congestion and the associated uncertainty. Stern (1999) makes a useful distinction between *preventive*

responses, which are taken prior to departure usually on the basis of pre-trip information, and *reactive* responses, taken when confronted directly with a congestion situation.

According to Stern (1999), *reactive responses* pertain to route choice and driving behavior. The latter falls apart in passive behavior (delay acceptance) and active behavior (the adoption of more determined driving styles and illegal "rat runs"). Bonsall (2004) adds to these strategies: (*i*) changing route or mode; (*ii*) alerting people at the destination to the likelihood of delayed arrival, for instance through the use of mobile communications; (*iii*) multi-tasking to make up for lost time, for instance via mobile communication and productive use of travel time; and/or (*iv*) abandoning a journey. According to Bonsall (2004), reactive responses are severely under-researched, and few theoretical frameworks have been developed for understanding such reactions. An exception is the work by Stern (1999) who uses Decision Field Theory developed in psychology to understand the dynamics and variability in human preferences and choices in congestion situations. Utilizing experimental data on lane switching when driving an auto, he verifies that individuals make increasingly use of non-compensatory decisions rules and less information as the level of time pressure increases.

Preventive response can be classified using the work of Mokhtarian and co-workers. Although focusing on how individuals cope with congestion in general, they provide a detailed overview of possible strategies which are categorized on the based of generalized costs (monetary costs as well as implications for daily life) and the adoption time frame in three classes (Clay & Mokhtarian, 2004): (*i*) low cost, short-term travel-maintaining/ increasing strategies: the purchase of a car stereo system, a mobile phone, a better car, a more fuel efficient car, change of the work-trip departure time, hire someone to do house or yard work, adopt flex-time, and a change from another means of getting to work to driving alone; (*ii*) more costly, medium-term, travel-reducing strategies: e.g., telecommuting and adopting a compressed workweek; and (*iii*) long-time, major lifestyle changes like working part-time and job and residence relocation. Empirical analysis indicated that short-term strategies are adopted most frequently; however, adoption patterns over time are quite complicated, with people shifting from higher to lower-order strategies and vice versa during their life-course (Raney et al., 2000).

Other work provides further insights into preventive strategies employed by travelers. Numerous studies have indicated that travel time variability, which is closely associated with irregularly occurring events, affects individuals' route and mode choices, as well as departure time decisions for commutes (Bonsall, 2004). Departure time studies are concerned with the planning of on-time arrivals at the workplace, and are usually rooted in expected utility theory and based on the following premises: commuters face a probabilistic distribution of travel

times and choose a departure time by minimizing a cost function whose specification varies across studies (Noland & Polak, 2002). Usually the cost function entails a tradeoff among the desire to minimize time spent in congested traffic, inconvenient schedules and a lateness penalty. Schedule inconvenience refers to the amount of time a person arrives earlier or later than the preferred arrival time. The outcome of the tradeoff is a *safety margin* – the difference between the planned and expected travel time (Polak, 1987).

Departure time choice studies in this tradition can be criticized on several grounds. They pay little attention to the fact that many individuals link non-work activities to commute trips, and ignore non-work travel in general. Mahmassani (1990) questions the formal utility maximization approach posited in the above studies, and adopts Simon's (1955) notion of bounded rationality. Commuters are believed to be satisficers rather than optimizers, and search for acceptable outcomes. This framework is operationalized via the notion of the indifference band of schedule delay: as long as the arrival time falls within the specified margins, the individual will not adapt her departure time the next she makes the trip. Empirical analysis shows that the width of the indifference band varies across persons and situations (Mahmassani & Jou, 1998). Senbil and Kitamura (2004) extend this work, arguing that past studies have paid little attention to the properties of utility functions employed and have not thoroughly examined the properties of departure time choice as a choice under uncertainty. To that end, they apply prospect theory (explained below). Although the authors note that their approach can be generalized to departure time choices for other activity types, their empirical work concentrates on morning commutes. Avineri and Prashker (2003) also employed prospect theory, only to explain route choice in situations of uncertain travel times.

2.2 Activity patterns

Insights about responses to changing conditions can also be obtained from research belonging to the activity-based travel demand paradigm, which concentrates on the linkages between activity and travel episodes and on complete activity patterns rather than on isolated trips (e.g., Arentze & Timmermans, 2000). There is no straightforward distinction between preventive and reactive strategies in the literature about activity patterns. This is because many studies, supported by empirical evidence, posit that activity planning continues during the execution of plans; individuals are continually planning, revising and adapting plans. The following short-term coping strategies can nevertheless be identified: (*i*) deleting one or more activity episode for the schedule, which may canceled completely or postponed to another day; (*ii*) transferring one or more activity episode to other household members; (*iii*) changing the sequence of activity episodes to be conducted; (*iv*) changing the start time of one or more

activity episodes; (*v*) changing the duration of one or more activity episodes; and/or (*vi*) changing the location(s) where activity episodes will be conducted, i.e., changing travel time, transportation mode and route, and/or the formation of more complex/simple trip-chains.

Activity-based studies stress that behavior is not completely volitional; the choice of a given behavioral strategy depends on externally imposed constraints and internally generated priorities. Increasingly sophisticated simulation models are employed to understand which and how elements of activity-travel patterns are modified in response to changing travel conditions (Arentze & Timmermans, 2000). Yet, these models typically focus on how individuals and households respond to changes in space-time circumstances due to the implementation of policy measures aimed at reducing or regulating travel behavior, and not so much on the impact of uncertain travel conditions and interfering events on the planning, modification and execution of activity-travel patterns.

Interest in activity scheduling and rescheduling mechanisms is, however, rapidly increasing. Gärling et al. (1999) were among the first to consider how individuals adjust planned activity-travel schedules when facing time pressure. They suggested that individuals first try to reduce the duration of activity or reorder the sequence of activities. If this is not sufficient, individuals will eliminate activities one by one (a reflection of bounded rationality). Elimination can be random or planned. In the latter instance individuals are assumed to select activities for deletion on the basis of the total duration of all activities in the schedule and a threshold indicating an acceptable level of time pressure, and on the basis of the priority accorded to a given activity. Eliminated activities may be postponed until later or deleted altogether from the list of activities to be conducted in the future. In total sixteen procrastination strategies for coping with time pressure were developed.

Joh (2004) elaborates Gärling et al. (1999) by extending the theoretical underpinnings of the model and examining rescheduling decisions in greater detail. The result is a model named *AURORA* (Agent for Utility-driven Rescheduling of Routinized Activities). Joh formalizes the problem of rescheduling under time pressure as a maximization of the utility of scheduling and rescheduling decisions, subject to a set of constraints. A specific *s*-shaped utility function for activity duration is developed for this problem, in which impacts of all other activity choice facets are captured via the maximum level of utility attainable. Via the parameters of the utility function allowance is made for differences among rational, conservative op opportunistic decision styles. *AURORA* assumes that individuals have incomplete information at their disposal and display imperfect choice behavior. Cognitive constraints result in a recursive and iterative heuristic search strategy for schedule adaptation. The following steps are repeated until no further improvement is possible with the help of a search tree: problem

identification; enumeration of alternative courses of actions for revising the schedule, including changing duration, re-sequencing, and re-location; evaluation of these actions one by one; and choose the action maximizing the total utility of rescheduling. Empirical estimation of the parameters of the utility function has provided encouraging results, but implementation of the decision tree awaits future research. In analytical terms, the *AURORA* model has recently been generalized to a model for dynamic activity-travel choice under conditions of uncertainty and learning (Arentze & Timmermans, 2004).

Doherty and Miller (2000) developed *CHASE* (Computerized Household Activity Scheduling Elicitor) to track the planning decisions made during the actual execution of a schedule, among others due to unexpected events. Using *CHASE* in a survey among 270 Toronto households, Roorda and Miller (2004) found that activity conflicts were resolved mostly through reordering of activities on the same day (68%), followed by deletion altogether (20%), and postponement of an activity to another day (12%). Because not all those conflicts resulted from disturbing events, a subset of the Toronto respondents were re-approached for a stated adaptation exercise in which they were asked how they would deal with hypothetical disturbing events affecting randomly selected activities in their activity pattern. In-depth questions were asked about scheduling responses to an unexpected one-hour delay in getting to an activity; unavailability of the mode chosen to access an activity; an unexpected change in the duration of an activity; and an expected problem with childcare arrangements. Analysis of the findings is currently underway.

2.3 Discussion

The literature review has made clear that a plethora of coping strategies is available to individuals coping with interfering events, ranging from doing nothing/accommodating the event to abandoning complete (sets of) activities and associated travel. However, strategies not only vary according to their impact, but also in the extent to which they are preventive or reactive.

With regard to the choice among strategies, there is some evidence that people first select lower-impact strategies and proceed to more costly strategies when earlier choices are not sufficient. Yet, with the exception of the work by Roorda and Miller (2004), there is as yet no study that has investigated in detail how the nature of disturbing events may affect the adoption of a given strategy. It is more common to take the effect of disturbing events – uncertainty in the mind of the individual about the conditions of the activity-travel system – as the starting point of analysis. However, as will be explained below, the nature of the event is likely to influence the adoption of a certain strategy or set of strategies.

Finally, while descriptive approaches to human decision-making focusing on decision rules individuals employ in real-life situations are being adopted more frequently to understand how individuals cope with uncertainty, these focus on cognition-related objections to the assumptions of utility maximization models. Social relations are not given much emphasis. Relations that are considered are within-household interactions and activities that are conducted together with others (e.g., Arentze & Timmermans, 2000), but these are seen as constraining factors, restricting the activity scheduling opportunities of individuals. Thus, our understanding of how individuals deal with disturbing events may be improved by investigation of cognitive as well as social mechanisms explaining behavior.

3. An alternative framework

Having identified several directions in which the analysis of individuals' strategies for coping with interfering events and uncertainty can be improved, I will outline an alternative theoretical framework in the remainder of this paper.

3.1 Time-geography

The basis of the theoretical framework is Torsten Hägerstrand's time-geography, which aimed to provide a contextual approach to man-environment relations. Hägerstrand conceptualized human and non-human entities as following a trajectory or path through space and time. The course of these paths depends on the projects in which entities are involved and various space-time constraints (e.g., Pred, 1978): (*i*) capability constraints, including physiological restrictions for humans (e.g., minimum time required for sleeping), and characteristics of transportation systems (e.g., maximum attainable travel speed); (*ii*) coupling constraints, including the need to meet with other individuals at particular times (e.g., one's family), or to employ specific equipment or instruments for activity participation (e.g., a means of transportation for destinations beyond walking distance); and (*iii*) authority constraints which have to do with access to and mode of conduct in domains (space-time entities under the control of a specific individual or group of individual), and include rules, laws and norms. Examples are store hours, entrance fees, and transit fares.

Hägerstrand and co-workers have noted that space-time constraints can compensate, reinforce and mould one another's impact on the activity scheduling process. However, individuals are also subject to various non-amenable basic constraints or time-geographic realities (Pred, 1978), which apply to all corporeal interaction of humans and non-human entities. These include the indivisibility of human beings and other (non-)living entities, the limited ability of

time-space to accommodate things and events, and the fact that movement between any two points in space consumes time (Hägerstrand, 1975).

Projects have been defined as series of tasks that are necessary for the completion of any intention-inspired or goal-oriented behavior (Pred, 1981). These tasks are usually ordered sequentially via an internal logic and normally require the presence of multiple human and non-entities. They thus entail synchronization and synchorization, or temporal and spatial coordination of space-time paths of all entities involved, and thereby automatically create coupling constraints. The project concept is very flexible; its defining characteristic is goal orientation. It can therefore be applied to activities by individuals, firms, communities, or states. Projects are nested within each other "like Chinese boxes" (Hägerstrand, 1982: 336).

Projects compete with one another for realization; they struggle with one another for limited space-time resources. Moreover, "… projects are susceptible to many sorts of accidents. They become held up by each other, get crippled, die out completely before a full program is finished, or have to see the programs redefined." (Hägerstrand, 1973: 81). The time-geographic realities regarding indivisibility, and mobility dictate which space-time paths can be brought together to form bundles of space-time paths and which projects will be realized or not. Distances in space-time among the entities involved in the project are important: the closer project entities are (or the easier they can be brought together), the stronger the odds of success. This implies that the juxtaposition of entities in the landscape or *diorama* – the grand situation including everything material as well as immaterial (memories, feelings, norms, laws, etc.) – is crucial for project realization (Hägerstrand, 1995). In short, the situation or space-time context plays a very important role in time-geographic thinking.

Following this line of reasoning, a state of objective time pressure is the result of the interaction of several time-geographic realities and project participation. The physical indivisibility of a human being together with her limited time resources imply that she can accommodate only a finite number of activities and events. If she needs or prefers to participate in many projects, each of which create their own coupling constraints, she may run out of time.

A question arising from this discussion is which projects a person will give prominence, modify and/or drop when facing disturbing events. Cullen and Godson (1975) argued that activity scheduling depends on the level of flexibility of tasks and activities associated with a given project; the more inflexible activities are, the stronger they "act as pegs around which the ordering of other activities is arranged and shuffled" (Cullen & Godson, 1975, page 9). The most flexible projects are thus likely to be dropped or modified first in situations of time pressure. According to Cullen and Godson (1975), flexibility is a function of the degree of

commitment to an activity or task and its space-time fixity, where the latter is in turn determined by external constraints and internal priorities. Subsequent work has related priorities to hierarchies of needs (e.g., Gärling et al., 1999). This implies that projects associated with paid labor, personal care and household maintenance may receive the highest priorities in situations of time pressure.

Hägerstrand (1973, 1982) considered the competition among projects a central problem of analysis, and believed that this process had to do primarily with power relations. One way to investigate the relations between power and such competition is by extending the project concept and taking a relationalist perspective.

3.2 Extension of the project concept

While time-geography's focus on the individual and the integration of time and space were novel at the time of its articulation, it also embodies numerous notions and concepts of traditional geographic approaches, such as a strong emphasis on (physical) proximity and linear Newtonian time. Such classic or Euclidean geographies have been challenged recently by relational geographies in which the existence of a single, linear time has been replaced by a multitude of linear and circular time scales (e.g., May & Thrift, 2001), and physical proximity "may occur 'at a distance' as well as nearby" (Healey, 2004: 47).

This relational geography is among others inspired by the body of work known as actor-network theory (ANT).[1] In essence ANT is a relational approach dealing with question as to how power is constructed. According to actor-network theorists, power is the result of the formation of networks; a person (or another entity) tries to create a network consisting of other entities to achieve some goal. These entities may be other human beings but also non-humans like material objects. ANT stresses the crucial role instruments fulfil in enabling humans to act; associations of human and non-human entities are indispensable for reaching a purpose. Yet, ANT also makes clear that networks of human and non-human entities are never stable. Relations within networks have to be negotiated and (re)constituted over and over again. Whereas early ANT studies treated human and non-human entities as equals, more recent studies have argued that humans should be considered as intentional beings possessing reflexive capacity rather than as merely networks of elements themselves. Intentions may be the mobilizing forces leading individuals to construct networks in the first place, while reflexivity may imply that they (seek to) resist the roles they are given in networks by other entities (Murdoch, 1998).

[1] Murdoch (1997) and Law and Hassard (1999) for more detailed discussions.

Notions from ANT may be used to extend time-geography's *project* concept. Projects may be seen as networks of relations among a diversity of entities, including humans and the instruments individuals use for project realization: automobiles, bicycles, household appliances, (cellular) phones, PCs, etc. It is these instruments that give humans the ability to act and achieve a goal. This integration offers several advantages. As the above already illustrates, the actor-network perspective highlights the role of instruments, which have become indispensable in coping with time pressure: they save time (thereby freeing up time for other activities), and enable individuals to cope with coupling constraints through alternative, more flexible forms of synchorization and synchronization. Rather than being physically co-present with other humans in space-time, modern communication devices allow individuals to interact with one another via video-conferencing, e-commerce, etc. (e.g., Urry, 2004).

The adoption of an ANT-inspired perspective on projects is also instrumental for obtaining a better understanding of the nature of interfering events. A distinction can be made between disturbing events which are internal to projects and those stemming from the displacement of projects. Internal interfering events can be further divided in those that pertain to non-human entities enrolled in the project, and those occurring when persons enrolled in a project(network) do not perform as expected. The former type is exemplified by vehicle breakdowns or mobile phones loosing connection, the latter by persons not showing up on time or canceling a meeting or not performing a task whish needs to be done for the project to be successful. These simple examples make clear that individuals enrolled in a project can always find ways to resist and evade the requirements and space-time constraints imposed by a given project (De Certeau, 1984; Murdoch, 1998).

Disturbing events also occur when project come together in a diorama and displace each other. Such displacements are often the result of limitations on the packing capacity of a bounded area in the diorama. Too many projects need to pass through a bottleneck in a diorama, resulting in delays in the duration of specific tasks and queuing effects. Note that the packing capacity of a specific part of the diorama may vary temporally, and that this variation may cause the interfering event. For instance, the capacity of roads may be seriously reduced in bad weather conditions, to the effect that travelers using it on those occasions may experience delays they would not face in more regular circumstances.

3.3 Human behavior

Because time-geography's conceptualization of the individual has been questioned repeatedly, a more detailed discussion of human behavior is in order. There have been many attempts to

complement time-geography with approaches seeking to understand how individuals make choices. In the 1970s, for instance, attempts were made to integrate time-geography with notions from humanistic geography, some of which provide insights relevant four our purposes. Buttimer (1976) proposed that a humanistic time-geography be focused on the space-time rhythms of phenomena in individuals' life-world. More specifically, she argued that the mismatch across rhythms was important, because of the stress it causes for individuals (including subjective time pressure), which may feed back into their behavior.

In addition to the links between feeling and behavior, there are also reciprocal links between behavior and knowledge. The latter is largely pragmatic and acquired in "achieving mastery over recurrent situation in the life-world" (Ley, 1977: 506). Yet, this also means that the individual's knowledge base is partial, ambivalent, inconsistent and uncertain. Many of these ideas about reciprocal links among behavior, knowledge, feelings and personality can also be found in Thrift (1996) and Pred (1990). Another insight from humanistic geography is the importance of routines individuals develop in their daily life. Individuals are believed to create "standard procedures or recipes to deal with repetitive and routine matters" (Ley, 1977). Yet, when confronted with major changes in contexts, time pressure and/or interfering events, these recipes may not work, and more conscious planning or scheduling is required (cf. Gärling et al., 1999).

Such planning or scheduling behavior will most likely not follow the assumptions of utility maximization approaches, for several reasons. First, as argued before, behavior is to a large degree dependent on the (social) relation(s) in which it is cast. For instance, when a person is the initiator of a project, she may behave differently than in situations where other persons or institutions have enrolled her in the project. In the latter situation, she may use other behavioral rules focused on improvisation and manipulation, which De Certeau (1984) calls *tactics*: the numerous informal ways through which individuals are able to resist the demands and strategies of more formal and/or institutionalized forms of power. Particularly relevant in the current context is *la perruque*, the use of time for purposes other than what it should be used for according to other (more powerful) parties. An example is shopping for groceries or consumer goods via e-commerce during work time, as a means of coping with time pressure.

Second, individuals only have partial and ambivalent information and knowledge, which depend strongly on their own prior experience. In addition, as numerous psychological experiments have indicated, cognitive capability constraints also imply that the presentation of information affects the way individuals process it (cf. McFadden, 1999). The most well-known of such effects is *framing*: lotteries which are equivalent from the perspective of economic theory are judged differently depending on whether they are formulated as a gain or

as a loss (a glass is half-full versus half-empty). The differential treatment of gains and loss stems from the use of reference points, or base positions against which situations are evaluated. Kahneman and Tversky (1979) found that individuals tend to be risk aversive with respect to gains: they give sure outcomes more weight than uncertain ones. Yet, if they are to loose in comparison to a reference point, individuals become risk seeking and tend to favor the uncertain over the certain outcome. The work by Kahneman and Tversky is based on how persons deal with lotteries; however, framing and preference reversal effects have also been observed in many other situations and fields of research (Kühberger, 1998).

Kahneman and Tversky (1979) developed prospect theory, a choice-oriented theory that accommodated the impact of cognitive constraints as later generalized into cumulative prospect theory (CPT) (Tversky & Kahneman, 1992). CPT assumes two phases in the choice process: an early phase of editing in which information and options is organized, reformulated and simplified; and a subsequent phase of evaluation in which the edited alternative with the most favorable outcome is chosen. During the editing phase received information is interpreted relative to one or more reference points, and coded as a gain or loss. In the evaluation phase the value of the edited alternative is multiplied by a decision weight, which takes into account how individuals perceive and understand chances, and the most attractive alternative is chosen.

Insights from CPT may be meaningfully integrated with the framework described so far. Its appeal for the current study lies in the combination of formalization it offers via the methods and computational procedures simulating the evaluation phase of the decision-making process, and flexibility regarding the editing phase. However, the operations hypothesized to be employed by individuals in the editing process need to be broadened to include sociology-based explanations for behavior. Thus, not only individuals' routines or habits regarding the timing of certain tasks and activities, which have been developed via repetitive participation in a project, may act as reference points, but this holds also true of rules laid down in environmental timetables and scheduled meeting times. Examples of the former type are a person's routines to walk the dog every night at 11 PM or to start work on telecommute days at home at the same time as a workday in the office. Store hours and the joint family dinner from 6 to 7 PM exemplify the latter.

In all these examples there is a certain opportunity for improvisation or maneuver with start times, which makes that interfering events can to some extent be accommodated. The size of this opportunity or band of indifference varies across situations, however, and depends on factors like the type of project and constituent elements and the time-space context. Assuming that walking the dog is done alone, a person may also engage in this project at 10.45, 11.10 or

11.30 PM (unless the dog makes clear he needs to go outside). The band of indifference is thus quite large. Yet, the opposite is true for the store hours example. If a shop closes at 6 PM, a person may get in when she arrives a few minutes late (probably after negotiating with the personnel), but not when it she arrives at 6.15 PM. The dinner example is least straightforward. If a child gets home by 6.05 PM he may be disciplined, depending on whether or not he can provide a good explanation for his behavior. A disturbing event associated with a prior activity which is not his fault may be a good example (e.g., a bus running late). However, if the child is to blame for coming late in his parents' opinion, he is likely to be disciplined. On the other hand, if it is the father who is coming home at 6.05 or even later, he may not be disciplined at all, simply because he is the project initiator and power holder.

Two observations can be made from these examples. First, coupling constraints associated with projects – whether among humans or combinations of human and non-human entities – cannot always be pinned down to an exact clock time; there is a certain band of indifference associated with them. Second, if multiple humans are involved, expectations, norms, even formal rules are likely to come into play. Coupling constraints are then thus embedded within authority constraints. In short, with respect to timing decisions, it may be more appropriate to speak of reference regions in time-space than of points. It is proposed that the outcomes of the strategies like those identified in the literature review above are evaluated with respect to these reference points.

4. Toward a theoretical model

The notions introduced in previous sections can now be brought together. On the basis of the literature review and theoretical discussion, two main dimensions for classifying interfering events can be identified: the degree to which they can be anticipated; and their relation to projects (Table 1). Interfering events resulting from the packing of multiple projects may differ strongly in terms of their predictability and the same seems to be true for antagonistic behavior on the part of the other individuals in a project. In general, however, deviant behavior on the part of non-human constituents is more difficult to anticipate, which implies that more predictable events associated with non-human entities may occur least often.

It is expected that the choice of coping strategy will vary with the type of interfering event. Logically, more predictable events are more likely to evoke proactive coping strategies: the planning of safety margins before, after or in-between activities with a high degree of space-time fixity (in the case of Type B & F events); avoiding project participation in activities belonging to a project in time-space settings that are susceptible to packing problems (Type

B); the planning of meetings in time-space settings allowing participation in activities belonging to multiple projects (Type F); rather than being tolerant, one can also exert pressure to reduce the probability of antagonistic behavior by a priori making clear expectations and norms, or by regularly checking where the person is via communication systems (Type F); and/or tentative, risk-aversive scheduling: leaving the opportunity open for not participating in a given project (Type A-F). Reactive responses may be applied especially when facing events that are difficult to foresee (Type A, C, F). Many of these seek to gain time or speeding up, and include: cutting back on planned activity durations; choosing another mode, route or destination; multi-tasking or De Certeau's (1984) *perruque*; re-sequencing of planned activities; and/or declining participation in an activity. However, accommodating delays and thus resisting coupling and sometimes even authority constraints are also possible in response to interfering events (in particular type A).

Table 1. Classification and examples of interfering events

		Possibility for anticipation (continuum of predictability) Low ⟷ High	
Between projects	Meeting of multiple projects in a particular area space-time (displacement)	**Type A** e.g., congestion resulting from road accident	**Type B** e.g., queue at counter in a shopping center on Saturday afternoon
Within projects	"Deviant behavior" of non-human entities	**Type C** e.g., bicycle or auto breakdown	**Type D** e.g. mobile device loosing connection in a remote area
	"Deviant behavior" of humans in a project	**Type E** e.g., child falling suddenly ill	**Type F** e.g., scheduled meeting with person often showing up too late

A central tenet of the framework is that the adoption of one or a combination of strategies is constrained or conditioned by multitude factors, whose constellation and configuration vary across situations. More specifically, to explain which strategies have been adopted, one should consider the characteristics of the project(s) involved as well as the constellation of elements within it and the roles and characteristics of separate entities constituting the project. With respect to humans, it is not only important to account for their relatively stable features like their bodily characteristics (e.g., sex, age, ethnicity), cognitive abilities and prior experience and personal routines, as well as more project(s)-related factors like feelings and moods. Especially the social relations in which they find themselves are important. This includes their status as project initiator or element enrolled by others, and differences in power and dependency within projects. Finally, the combination of projects in a bounded part

of time-space should be taken into account, together with the built environment as a configuration of potential non-human entities that may be involved in projects.

It is proposed that the impact of routines, expectations on the part of other individuals, norms and rules can be captured via the notion of the reference points as introduced in cumulative prospect theory. The options offered by the behavioral strategies to cope with disturbing event identified here are assumed to be evaluated with respect to such reference points. Because reference points differ across persons (and even situations), two individuals facing the same disturbing event may interpret that situation differently: for one of them the delay may be a large loss, while being a negligible loss (or perhaps even a gain) for the other person. Consequently, the strategy (or strategies) adopted may differ between these individuals. Thus, the use of insights from cumulative prospect theory offers a promising way of formalizing at least part of the contextuality of individuals' responses to disturbing events.

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