



# 15

## Spatial-Behavior Studies: Concepts and Contexts

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### Summary

Mobility, as expressed through trips and journeys, is viewed as a special realization of human spatial behavior. Behavior, in turn, is to be understood as the result of an interactive process between environment and population on a macro social level. The corresponding components on a micro social level are activities, situations, and people.

To bridge the gap between these levels of investigation, two level-structure chains are employed and explicated: environment–infrastructure–facilities–opportunities on the supply side, population–inhabitants–households–dispositions on the demand side. Within the supply branch, regimens are the controlling regulations; within the demand branch, budgets exhibit constraints and possibilities as well. Both regimens and budgets can be differentiated according to their time, means, and information components.

To explain mobility decisions, one must take into account the limitations on free choices exerted by regimens and budgets, which in turn provide the basis for the development of routines and habits. Decision situations are conceptualized as being characterized by the interaction of options and intentions. The interaction between adjacent levels is perceived to follow a variation-adaptation scheme. Dependent on the variations occurring within budgets or regimens, followed by an adaptation of regimens and budgets, it is possible to describe hierarchic and synergistic processes within the same framework.

No attempt is made to bring the proposed scheme down to an operative level. This will be the task of future research.

### *Kurzfassung*

Mobilität - ausgedrückt durch Wege, Fahrten und Reisen - wird als spezieller Ausdruck menschlichen Raumverhaltens aufgefasst. Verhalten wird dabei verstanden als das Ergebnis eines Wechselwirkungsvorgangs zwischen Umwelt und Bevölkerung auf einer makro-sozialen Ebene. Die

entsprechenden Komponenten auf der mikro-sozialen Ebene bilden Aktivitäten, Situationen und Personen.

Um die Kluft zwischen diesen beiden Untersuchungsebenen zu überbrücken, werden zwei Folgen von Ebenen-Strukturen benutzt und erläutert. Umwelt—Infrastruktur—Einrichtungen—Gelegenheiten auf der Angebotsseite und Bevölkerung—Einwohner—Haushalte—Dispositionen auf der Nachfrageseite. Innerhalb des Angebotsstranges wirken Regime als steuernde Größen; innerhalb des Nachfragestranges wirken Budgets als Beschränkungen und als Möglichkeiten. Beide, Regime und Budgets, lassen sich nach ihren Zeit-, Mittel- und Informationsbestandteilen untergliedern.

Die Erklärung von Mobilitätsentscheidungen hat die Begrenzungen in Betracht zu ziehen, die der freien Wahl durch Regime und Budgets gesetzt sind. Diese bilden andererseits die Grundlage für die Entwicklung von Routinen und Gewohnheiten. Entscheidungssituationen werden aufgefasst als Wechselwirkungszusammenhänge zwischen Wahlmöglichkeiten und Absichten.

Die Wechselwirkung zwischen benachbarten Ebenen wird verstanden als Ausprägung eines Schemas von Veränderung und Anpassung. Abhängig davon, ob Veränderungen in den Budgets oder Regimes auftreten, gefolgt von Anpassungen in den Regimes oder Budgets, lassen sich hierarchische und synergetische Vorgänge innerhalb desselben Rahmens beschreiben.

Es wird nicht versucht, das vorgeschlagene Schema bis auf die Handlungsebene herunter zu führen. Dies wird eine Aufgabe künftiger Forschungen sein.

## Introduction

The intention of this chapter is to explore a conceptual framework that can serve as a general contextual scheme for a unified approach to spatial behavior studies.

The methodological background of the framework to be outlined is published elsewhere;<sup>1</sup> it owes much to the methodological concepts developed by Mario Bunge.<sup>2</sup>

At present the framework still lacks important components necessary to put it to operative use. But as Larry Laudan<sup>3</sup> and Rainer Specht have argued,<sup>4</sup> changes in the scientific treatment of problem areas come about not only by the collecting and processing of more and more empirical information. Time and again the introduction of new concepts or the amalgamation of hitherto unrelated ones constitutes a change in research traditions that provides different observation devices, new chances to

detect overlooked relationships within the factual reference system, and new ways of interpretation.

To avoid any confusion, it should be stated that the prime basis for scientific research is the factually existing real world. But because any factual phenomena have to be represented by linguistic entities before we can communicate about them meaningfully, the ways and means of representation become crucial for any scientific endeavor. It is at this point that the role of concepts should not be underrated; answers depend on questions, and the questions one asks are inseparable from the language with which one is familiar. Thus an improvement of the vocabulary might indeed be a precondition for better questions and consequently for better answers.

The basic ideas behind the approach proposed here are few and simple.

1. Spatial behavior, as exemplified by travel activities, is to be recognized as a special realization of general human behavior (figure 15-1).
2. Trips must be understood as links connecting nontravel activities.
3. The realization of trips is the outcome of an interactive process between environment and population or, more precisely, between situations and persons.
4. Individual decisions are embedded in a broader framework of decision premises limiting the multitude of individual decision situations to a reduced number of types.
5. The connections and coherence between the macro level of environment/population and the micro level of individual activities are governed by a mesolevel interface structure.

A last word might be in order to warn potential readers before they start reading. The chapter remains on the level of concepts without refer-

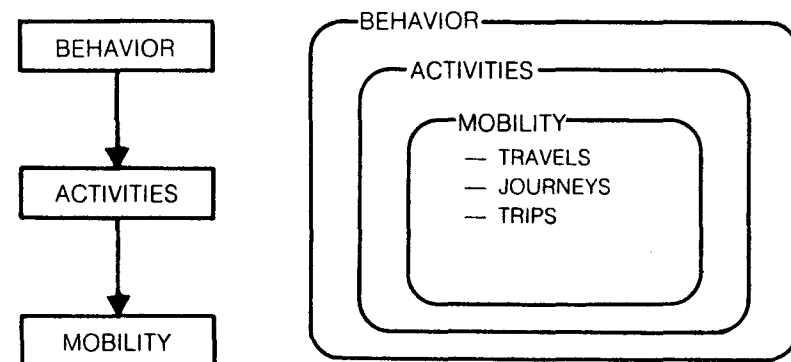


Figure 15-1. Contextual Frame of Mobility

ring to the possibilities of application on an operative level. For some this might prove to be a serious drawback. But it is hoped that enough will accept Bunge's aphorism: "[I]n our science we must know what we are talking about even if what we are saying is false."<sup>5</sup>

### Explication of Basic Concepts

As was stated elsewhere, the general reference scheme to be employed here is based on three very general concepts: *environment*, with the organizing skeleton of infrastructure; *population* as a framework for the elaboration of organizing principles facilitating the accommodation to different and changing environments; and mobility as areal *behavior* embedded in general behavior schemes that result from the interaction of environment and population (figure 15-2).<sup>6</sup> This approach is borrowed

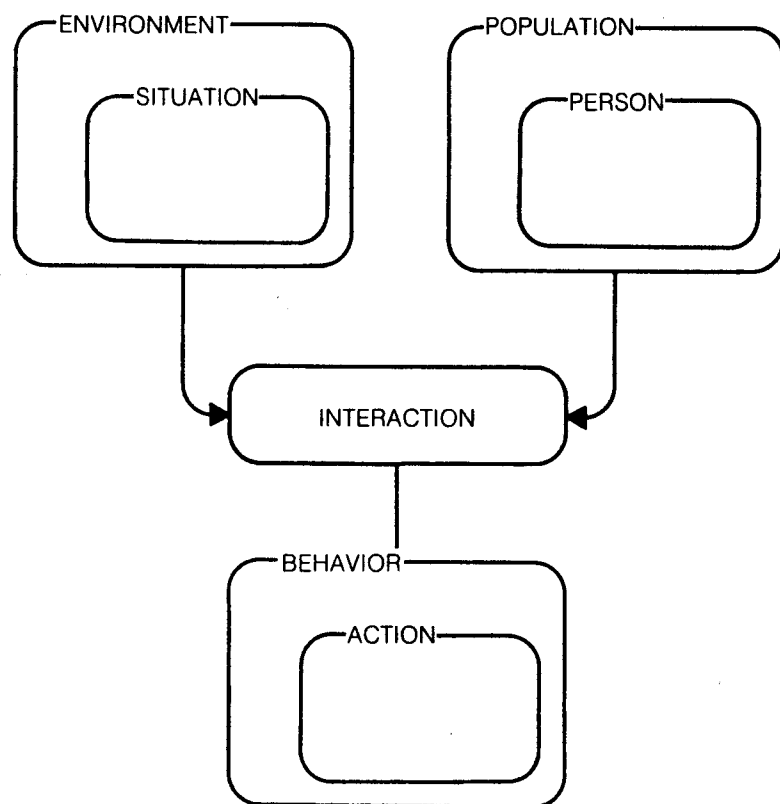


Figure 15-2. Socioecological Approach

from biology, where ecosystems are conceived as being the result of the two interacting components of biotop and biocenosis, coupled by exchange processes of mass and energy.<sup>7</sup>

To escape any accusation of biological reductionism, it is necessary to emphasize the importance of *societal forces*, which have to be taken into consideration as indispensable preconditions for the applicability of the respective concepts of sociotop and sociocenosis, whereby the fundamental coupling processes must be complemented by that of information exchange. The organization of information acquisition, storage, and retrieval is perhaps the most prominent feature differentiating humans as a unique species from all others, even those that also live in highly organized societal situations.<sup>8</sup>

The supplementary concept employed here is borrowed from economics. Environment and population are related to the abstract concepts of supply and demand, respectively. *Individual behavior*, then, is conceived as the outcome of matching procedures by which the natural laws governing biotic or abiotic exchange processes are substituted for by the levels of social interaction.<sup>9</sup>

However, the concepts employed so far are much too general to serve as a base for research on an operative level. They have to be differentiated, specified, and put into a relational scheme. This is the task of the following section.

### Social Systems, Regimens, and Budgets

In traditional sociology the concept of social systems is restricted to the sociocenotic aspect of the interacting environment-population complex, leaving out the sociotopic component. Only recently have there been singular attempts at a reintegration of the environmental conditions into a sociological theory.<sup>10</sup>

This is quite astonishing because a short historical analysis would reveal that all kinds of higher-level social organizations that emerge in a population, probably originated through the attempt to establish and maintain controlling systems for safeguarding stable and predictable societal relations with regard to different and changing environmental conditions. On the other hand, there is little doubt that the environmental conditions of existing modern societies have developed through an accumulation process of combined efforts to reduce and control the effects of otherwise uncontrollable external forces. Thus societally controlled territories were covered by layers of artifacts superimposed on an early natural physical environment and, increasingly, on older layers of artifacts. Being built according to the rules of the then governing societal

system, each layer mirrors to a large extent the norms of its period of erection, preserving them and transferring them to any subsequent generation as part of its respective socialization conditions. Consequently, although they are not norms in the traditional sense of sociology, the transmitted artificial environment works as norms through the built-in rules for adequate utilization.<sup>11</sup> Any changes in the constructed environment, therefore, mean also changes in the existing social norms that must be observed in order to avoid the experience of negative sanctions.

If we try to conceptualize the normative framework set up by societal rules for the operation and utilization of different components of the natural and artificial environment, it seems useful to employ the concept of *regimen*. In hydraulic engineering and climatology, the concept of *regimen* is used to comprise the multiplicity of regularities governing the appearance of natural phenomena like temperature, precipitation, and runoff, in order to delimit the boundaries that have to be observed for the development of operating schemes.

In natural science, regimens specify the regularities of *temporal order* and quantities of *means* governing the availability of natural resources like water, wind, and sunshine. To be adapted to a social-science context, the concept must be extended by an additional category, that of *information*. To minimize confusion, it would be convenient to introduce a special notation for the application of the concept of *regimen* in a social context—perhaps the expression *societal regimen* will serve this purpose.

Societal regimens comprise all the rules and regulations governing the availability of public and private goods and services to potential customers and users. Being formulated and controlled on a metaindividual level of social organization, societal regimens determine the conditions of possibilities as a contingent framework for individual behavior. Societal regimens employ three different categories of control:

1. *Time*: By the enactment of age limits for admittance to and dismissal from opportunities, rights, and duties; of schedules for operation times; of duration limits for office terms; of deadlines for nominations, submissions, and contradictions; of closed seasons; and so on the continuous flow of time is socially modulated, thus exerting structuring and organizing effects in superposition to the natural regularities of night and day, seasonal changes, and aging.

2. *Means*: Although money is the first item that comes to mind, the establishment of admission regulations is only partly exerted in financial terms by the fixing of fees, tolls, fares, tariffs, taxes, and other kinds of prices.<sup>12</sup> There are also requirements to be met on numerous occasions that cannot be substituted for by monetary payments. Within this domain we find certain standards of physical and mental capabilities serving as admittance barriers to professions or even to preparatory education; for-

mal educational preconditions for the acquirement of licenses; behavioral records as requirement for recruitment or promotion to certain positions; but also properties of disablement, deficiency, poverty, or discrimination that entitle the respective bearer to certain rights.

3. *Information*: Within this category one can differentiate two types of information: factual and normative. *Factual* information is to be understood as knowledge that something is the case. This is not meant to be limited to scientific knowledge, but rather contains also the subjective beliefs and opinions about natural and social objects and processes. Clearly there is a societal regulation with regard to the generation and distribution of knowledge through the educational system; public-information media; governmental announcements and comments; publications by political, religious, professional, and other organizations; and so on. *Normative* information is embodied and explicitly stated in laws, directives, guidelines, decrees, and so forth enacted by the responsible authorities within a societal organization. They serve as instructions for the appropriate conduct of behavior, linking the performance of actions to the occurrence of predescribed situations. Besides, there is a wide range of norms and rules of conduct that are expected to be followed by certain subpopulations. One of the most important types of normative information in the present context is that of instructions for use by which the proper handling of tools, machinery, installations, and so on is secured, regulating the interaction of artifacts and users.

It is essential to recognize that, although the regimens as outlined here do not contain an explicitly stated spatial category, the effects of regulations of time, means, and information all contribute to the establishment of a certain spatial organization within the environment. Even if the naturally given environment was uniform, with equally distributed opportunities for an equally distributed population, not only will each additional layer of material artifacts change the original uniformity in the direction of a less equal distribution of opportunities, but each additional regimen will also have the same effects. Thus if these indigenous tendencies are not regarded as desirable, there is a strong need for the enactment of counterbalancing measures, which in turn can only be met by the provision of additional funds.<sup>13</sup>

Having shown how the societal system influences the supply side of this scheme, we must deal with the demand side. If one tries to find a concept corresponding to that of regimens, the best suited seems to be that of *budgets*. Like the concept of regimens, which does not predetermine whether regulations work as constraints or as opportunities, the concept of budgets avoids any hasty valuations in either direction.

Whereas regimens describe the regulatory influences exerted by metaindividual levels of societal organization, *budgets* emphasize the dis-

positional possibilities for individuals, groups, and other social decision units as a prerequisite for decisions about different utilizations. Regimens can be seen as part of the hierarchical structure of society, whereas budgets are an expression of the level structure. Although the contents of budgets are largely determined by superior conditions, there is a certain autonomy on each budgetary level with respect to the specific employment of the available potential.

As with regimens, three different categories of budgets can be distinguished:

1. *Time*: The exceptional importance of time can be traced to the fact that the basic feature of time is its irreversibility, which provides all processes with an unambiguous direction from past to future. In addition, time is inseparable from material processes.<sup>14</sup> If regarded as an economic resource, time has the unique property that it cannot be accumulated, stored, shipped, or produced.<sup>15</sup> In a social-science context, time inevitably has the meaning of *lifetime of individuals*; hours are, in the first place, man-hours. Time budgets of groups and social units consist of superimpositions of individual time budgets; an increase or decrease in any collective time budget depends on the gain or loss of individual members. But any increase in membership implies the reallocation of at least one individual time budget in order to supply the additional time needed for synchronization and coordination. On the other hand, group membership implies the adjustment of individual time budgets to those of the other members. Therefore, we can add to the collective use of a common territory as one constituent feature of group living, the collective use of amalgamated individual time budgets as a second necessary attribute.<sup>16</sup>

Membership of an individual in different and usually spatially-separated social units means a high demand for synchronization efforts to ensure the presence at the appropriate periods of time. Because the amount of time needed for the synchronization increases more than proportionally to the number of social units, any individual tends to reduce the excess time needed. There are different strategies available—from becoming chairperson in each unit to dropping out of all of them—but the specific choice will depend on situational conditions.

Experience with the effects of staggering working hours, however, indicates that there is a certain basic reaction pattern if the time budget of primary groups such as families or households is affected. In these cases the collective time budget is adapted to the most rigid external regimen. This is normally provided by the schedules of kindergarten and school. The collective time budget is arranged in such a way that these demands can be met permanently. If these schedules are changed, the whole collective time budget has to be rearranged. Any increase in flexibility, which theoretically is a result of staggered working hours, therefore will only be

utilized if it is compatible with the regimens to which other family members must adapt. This explains why the effects of the introduction of staggered working hours for office employees did not show up in a considerable reduction of peak-hour traffic volumes; the necessities of following the arrangements of the collective time budget of the primary group are regarded as more severe than the possibilities offered by a less rigid schedule of working hours.

Despite the central role of time in everyday life, there is only accidental coverage of the phenomenon by the traditional social sciences. Therefore, the available knowledge of the utilization of time is still very limited. The majority of empirical work so far has been devoted to the allocation of time to certain categories of activities.<sup>17</sup> Questions such as activity sequencing, periodicity of activities, synchronization of activities within social units, and routine building and utilization have been neglected.

2. *Means*: Every individual is equipped with a multiplicity of means that he can utilize for different purposes. They comprise such things as fundamental physical and mental abilities; acquired skills and capabilities; and the possession of tools, funds, landed property, and so on. Although the availability of means generally is controlled by societal regulations, there is still to a varying extent the possibility for decisions about the utilization of these means.

Means serve the purpose of exerting operative control of the environment.<sup>18</sup> In cases where effectiveness of control cannot be reached by the application of individually employed means, a need for cooperation arises. Group living then *enables all participants to pool their means and ensure their effective use*. This can be regarded as the third relevant feature of group living.

Quite different from the strictly limited time budgets, budgets of means are open in the sense that additional means can be acquired, improved, produced, generated, discovered or invented. This is valid even if one takes into account that the number and categories of means available during a certain epoch is dependent on the general cultural and technological level of development. But it is also true that means deteriorate, break down, become useless, are lost or stolen or simply forgotten, thus making way for the possibility of a decline of the budget of means.

There exist interesting interrelations between time budgets and budgets of means; to explore these in full is beyond the scope of this chapter.<sup>19</sup> One example, however, may serve as an illustration. Car ownership often is rationalized (in the Freudian sense) with the argument that, although travelling by car is more expensive than using any other mode, the time saved will compensate for the higher expenses. But this calculation normally does not allow for that the proportion of the time budget

necessary for maintenance and repair. If this is included, the overall amount of time will prove to be much higher than that needed for using less expensive modes of travel.

Neglecting the interdependence of time and means is presumably the most serious obstacle to the application of economic theories to the explanation of human behavior. This becomes obvious in the field of leisure-time utilization. It has already been acknowledged that recreational traffic follows patterns quite different from those serving other purposes. Despite a mushrooming leisure-time industry living off considerable parts of the budgets of means, sufficient theoretical attempts have not yet been developed to cope with this phenomenon.

3. *Information:* As with regimens, the category of information is divided again into the two subcategories of factual and normative information.

*Factual* knowledge of the environment, its hazards and chances, is one fundamental precondition for the appropriate utilization of means to secure survival; the acquisition of food, mate, and shelter; and well-being. In order to control individual behavior, this knowledge must be processed individually, even if it was generated, accumulated, and stored collectively. Of the three types of memory any species relies on—environment, heredity, and experience—the last one is the most important for humans.<sup>20</sup> Because the transmission and exchange of experience is an interindividual process, one can identify therein the fourth significant feature of group living. Exchange of experience under conditions of illiteracy depends on verbal communication, which in turn presupposes the existence of face-to-face relationships. In addition, although the ability to speak may be inherited, the acquisition of a certain language depends on the social environment of early childhood.

Clearly, the information budgets of individuals and social units are dependent on the general information level of the society. The transmission of knowledge is largely organized by governmental agencies. But because the acquisition of information is also an active operation, controlled by the anticipations and intentions of the receiver, there is room for interpretation and modification. Furthermore, because every individual is imbedded in an intersecting set of different information fields and is confronted with divergent messages, he or she must select, amalgamate, and recode the information offered in order to build up an individual information budget of his or her own.<sup>21</sup>

It is obvious that, however necessary factual information is for the explanation of behavior, it is not sufficient because in most situations there are several possibilities open to choice, all of which are compatible with the factual conditions. In order to facilitate the selection procedure, some kind of metafactual information is needed, according to which an assessment of the different actions possible can be executed.<sup>22</sup>

Any such assessment is based on *normative* information. This heading is used to cover the different kinds of norms, values, goals, standards, orders, rules, prescriptions, instructions, and so forth that make up the individual budget of behavior regulating prohibitions, permissions, and obligations.

As with the budgets mentioned previously, normative information budgets are developed over time under the influence of societal conditions. But despite numerous attempts to construct complete, contradiction-free, and eternally applicable value systems—the poor copies of which fill pages of recent planning reports—it is difficult to understand how static and hierarchically organized value schemes could be useful with regard to a turbulent decision environment. Therefore, the activation and rearrangement of values according to the respective environmental conditions is a permanent individual task, even presupposing the existence of a fixed set of values.<sup>23</sup>

In view of the unsolved theoretical problem of constructing collective value systems from individual ones and the contradicting empirical observation that collective actions indeed happen to be performed daily, one gets the impression that there must be some bugs in the conceptual framework of a situation-free approach to decision-making analysis. But because this is not of much concern within the present discussion, it can be left open here.

Only one speculation should be mentioned here, which is employed subsequently in discussing the concept of the decision situation. The idea of a fixed and time-invariant individual value system is in conflict with several well-established theories in social science, such as role theory<sup>24</sup> and the theory of cognitive dissonance.<sup>25</sup> In different ways, both state the importance of situational conditions for the explanation of behavior and stress the potential of reactions that individuals can rely on while dealing with changing circumstances. Therefore, the search for a decision-reference scheme perhaps will be more successful if features of real decision situations rather than those of idealized value systems are analyzed. In brief, these considerations can be illustrated, as in figure 15-3.

### *Infrastructure and Inhabitants*

In determining the reference system at the beginning of this chapter, the concept of physical infrastructure was already introduced as the fundamental “furniture” that generates an additional layer of environmental organization above the naturally given one. However, the concept of infrastructure exhibits all the features of a fact-coordinative concept or a block variable, whereby we use it as a shorthand notation for an empirical entity constituted by lower-level components and their factual interac-

REGIMENS

- TIME
- MEANS
- INFORMATION

ACTOR

BUDGETS

- TIME
- MEANS
- INFORMATION

Figure 15-3. Interface of Regimens and Budgets

tions.<sup>26</sup> For the purpose of this chapter, therefore, a more specific decomposition of the concept is needed.

With respect to the environment-organizing effects, it is suitable to distinguish between two categories of physical infrastructure according to their different and inherent organizing principles, which can be described as network and point-pattern configurations.<sup>27</sup>

Examples of infrastructural furniture forming point-pattern configurations are all installations for the production/supply, distribution/release, collection/storage, and consumption/demand—or combinations thereof—of goods and services, with the one exception of transportation services. The characteristic feature of these installations is that functionally they are dependent on some sort of transportation to serve their prime purpose of operation.<sup>28</sup>

Located at fixed positions and usually sheltered by specific constructions, they display typical physiognomies that stamp the pictorial appearance of their surroundings. It is by the regularities of location and appearance, in connection with the stylistic peculiarities of the period of erection, that the respective buildings serve an additional purpose external to their economic functions, namely that of presenting a framework for orientation and even identification for inhabitants and foreigners.

Any spatial behavior is dependent on the existence of some kind of transportation means. Technological evolution over the centuries has brought about an increasing differentiation of transportation systems for

the movement of people, goods, information, and energy. Independent of their specific purpose, all these systems exhibit a common characteristic: the topological structure of networks. Despite all the differences that exist with respect to the technical properties of transport route, rolling stock, and propulsion power employed, the topological components of networks—arcs and nodes—impose an additional layer of organization on the physical undercoat, which gives rise to and predetermines all future utilization, especially the configuration of the point-pattern infrastructure. Therefore, transportation planning and land-use planning must be treated as interactive processes; changes in the configuration of point patterns have repercussions within the transportation network, and changes of the transportation network likewise influence the point-pattern infrastructure furniture.

Both categories of infrastructure, however, show properties of a level-structure organization. This is quite obvious for transportation networks, where we find different construction and operation principles according to levels of catchment areas for the areal range of transport distances served and transport speeds employed. For point-pattern-organized infrastructure the occurrence of synergistic effects is a result of the areal combination, concentration, and interaction of installations that belong functionally to different categories.<sup>29</sup> The existence of different mixtures of point-pattern infrastructures is the reason for the appearance of specialized subareas within urban and rural environments, assigning properties to these areas that are different from those of their constituent components. Urban quarters, for instance, exhibit features quite distinct from those related to the isolated buildings into which they can be subdivided analytically.

If one recalls the interaction principle of exchange processes as a basic feature of biological and social ecosystems, one is led to the component complementary to the infrastructural furniture of an area—its inhabitants. Just as the concept of infrastructure is a specification of the more general concept of environment, limiting the range/domain of application to artificial objects and to certain areas, the concept of inhabitants is intended to specify a subpopulation according to an areal reference scheme. Inhabitants constitute a subpopulation category that is defined by the property of typically living permanently within a well-defined area, the habitat. The concept is neutral with respect to any further implications. It is open to the application of any demographic, social, economic, cultural, or organizational concepts for a more detailed investigation.<sup>30</sup>

It emphasizes, however, that the fact of sharing a common environment—the habitat—is important in explaining behavior, especially spatial behavior. This is due to the factual assumption that if activities are the result of an interactive process between individual and situa-



tion, then the objectively identical environmental conditions of a certain habitat must have explanatory value for all individuals living within this habitat. This assumption is not to be understood as a revitalization of ancient deterministic ideas, which regarded the environmental conditions as the main and only causes for behavior, regardless of the properties of the people living therein. Rather, it takes into account that despite all differences due to the individual cognitive processes shaping the subjective representation of a common environment, there is a really existing surrounding that provides the same information for any individual receiver. The decoding and interpretation of this message, however, is controlled by the individual experiences, expectations, anticipations, and intentions, thus giving rise to a multiplicity of subjective images.

Besides the hardware aspect of the organizing effects of the physical infrastructure on the common environment, there is the software aspect of the regimens in operation. In a hierarchically organized administrative system there exists a correspondence between levels of hierarchy and territories affected. Dependent on the degree of autonomy of each politicoadministrative level, this leads to a more-or-less differentiated areal pattern of regimens. Within one administrative territory, however, all inhabitants are subject to the same regimens, which then serve as a common base for the individually different adaptations to the general regulations.

### *Facilities and Households*

Infrastructure and inhabitants are fact-coordinative concepts of still too high a level of abstraction for the investigation of individual behavior. Applying the level-structure principle, an intermediate and coupling level of units must be found to serve as a means of specification. It seems that this level can be defined appropriately by the corresponding concepts of facilities and households.

*Facilities*, in the sense used in this chapter, form the basic units of infrastructure. The difference between the configurative appearances of network patterns and point patterns has already been stressed. On a phenomenological level, however, this distinction is a very rough classification according to basic topological features, which does not say much about the internal differentiation of the categories employed. Because any classification scheme is dependent on its purpose, it would be beyond the scope of this chapter to develop a complete list of possible subcategorization principles. Instead, it is sufficient to concentrate on the features relevant for spatial behavior.

A first attempt in this direction can be made by analyzing the effects of trip generation and trip substitution of different facilities. Facilities belonging to the point-pattern infrastructure depend by definition on some kind of locational change for their inputs as well as for their outputs, whether it be people, materials, information, or energy. Although there are interactions between the technologies employed within point-pattern facilities and those of the serving network-pattern systems, it can be said that for a given level of technology the overall number of locational changes induced is fairly constant. In other words, any newly erected facility will generate an additional amount of transportation demand.

This is quite different for network-pattern facilities. Historically, one observes an increase in trip-substituting means of transportation by an increasing degree of specialization of networks for materials (water, sewage); information (telephone, radio, television); and energy (electricity, gas, steam, oil). All these work as substitutes for individual travel necessities. The organizational features of these network facilities depend heavily on the technical properties of the medium transported and on the level of technological development. Although the topological components of these systems are limited to two categories—channels and stations—the specificities of their realization lead to a variety of subsystems according to medium (people, fluids, gas, bulk freight, and so on); transportation distance (intercontinental, continental, national, regional, local); configuration of stations (isolated, continuous); location of channels (surface, elevated, underground, air); transportation speed; schedule (periodic, irregular); driving force (human or animal muscle power, combustion engines, electricity, and so on); traveling-gear technology (wheel/rail, wheel/road, air-cushion, and so forth); and technology of transportation channels (road, rail, pipes, cables, waterways). Each of these subsystems requires specific operation techniques in accordance with the properties of the hardware components.

Within the present context interest can be limited to the features of configuration of stations, volume of transportation units, and degree of control.

The configuration of stations shows a strong tendency toward continuity of access in covariation with the frequency of utilization, changing the pattern of locational factors from the naturally given one of uneven spatial distribution to an artificial one of ubiquity within their respective catchment areas. Typical facilities of this type of development are the supply networks for water, sewage, telephone, electricity, gas, and so forth. On the other hand, one can observe an intensification of disparities between areas served by a multiplicity of networks and those with only limited access to a minority of facilities. It is obvious that such differences



in environmental conditions are directly relevant for the spatial behavior of the respective inhabitants.

Quite similarly, there has been a line of development from larger to smaller units at least in surface transportation; trains and streetcars have lost importance relative to cars, which have become the multipurpose, all-weather, any-road vehicles for large proportions of the population. Obviously, the comparatively higher costs of traveling have been offset by the higher flexibility of time-budget utilization.

Certainly there has been also a shift with respect to the level of control. Although large and highly complicated networks are operated by centralized authorities to ensure the observation of regimens on the supply side of the interaction scheme, there is a highly decentralized type of control on the demand side; the individual utilization of facilities is feasible only in accordance with the possibilities governed by budget constraints. Consequently, any spatial separation between the locations of demand and supply generates the necessity for additional travel, whereas a locational coupling reduces at least the distances to be covered and thereby the range of suitable travel modes.

However, one feature of the interface between facility networks and the respective body of users is often overlooked in areal behavior studies. This is the fact that there is a lowest level of units on the demand side, where the coupling of facilities and users takes place, and which is well above the level of individuals. This is not primarily due to technical or economic constraints, but rather to the social phenomenon of group living.<sup>31</sup> This phenomenon finds its representation in the formulation of many standards whereby the number of homes, cars, or appliances is related to the number of households, because the basic unit of demand origination or articulation is a social unit and not a mere sum of individuals. Changes in the volume of demand, therefore, are often caused by a change of size of these basic units. If, for instance, there is an increase in the number of single-person households, this alone will increase the demand for dwelling units, cars, and so on, even if the population figure remains constant.

If our observation of the importance of group living for the development of individual behavior is correct, then the explanation and prediction of individually articulated demand depends heavily on the understanding of the interrelationships within these basic societal units and the diversity among different categories of these units.

Although the concept of households has primarily economic traits and is not identical with the sociobiological concept of family, it is adequate for representing the basic units of demand formation and activity origination.<sup>32</sup> Exchange processes within this unit serve as a buffer against adverse effects from the environment and allow for a wide range of adapta-

tion. Substitutional procedures between household members make it possible to enlarge the reaction potential of the unit beyond the range of a mere addition of budget components. This means that individually observable behavior patterns like trips, locations visited, and goods and services asked for must be regarded as the expression of the demand situation of the complete unit.

Because of the coherence that obviously exists among individuals forming a household, the whole pattern of individually performed activities must be related to the household as the basic unit. Clearly, interactions between households and facilities are observable only on an individual basis. Adequate interpretation of such findings, however, necessitates the consideration of the factual reference system.

Although normally all members of a household have a multiplicity of contacts with the environment, there is a functionally determined set of arrangements constituting a certain invariance of relationships between individuals and activities. Lewin introduced the concept of *gatekeeper* to explain the linkage, channeling, and filtering processes between the household and its environment.<sup>33</sup> To extend his approach, one can say that each member of a household has a special gatekeeper function: heads of households usually are the main earners of household income and provide all the other members with information about their working world and related social activities; housewives normally provide the means for the physical and psychological well-being of their families and keep in contact with relatives, neighbors, local stores, and so forth; offspring normally extend the contact field of the household by means of activities related to education, sports, peer groups, and so on.

Living within the same territory and sharing common budgets of time, means, and information, the household operates as a collective decision unit, providing all members with common decision premises.<sup>34</sup> Thus there is no doubt that the availability of certain types of goods within a household changes the activity options for all members quite significantly. Clearly, the proportion of households equipped with specific goods depends on the overall level of economic development, which in turn influences the internal division of labor within household units as well as the morphology of household types within the population.

Although in economics households traditionally are perceived as consumption units, there is a growing tendency to recognize the productive functions of households as the more relevant feature.<sup>35</sup> From this point of view, expenditures for durable consumer goods like cars, appliances, and communication machinery must be regarded as investments for producing services, thus providing the means for the household to become more independent of outside forces. On the other hand, the production-unit approach to households emphasizes the importance of synchronization

and coordination of individual activities. Within this context the seemingly irrational behavior of people with regard to travel-mode choices should be judged differently. The selection of a more expensive mode of transportation can be a completely rational decision if viewed in the overall context, where additional characteristics such as flexibility, reaction potential, and redundancy must be considered.

### *Opportunities and Dispositions*

Up to now the concepts used have been of the kind that can be related to their factual referents in a fairly objective way, that is, without referring to additional relationships. By lowering the level of abstraction to more specific and differentiating concepts, the conceptualization must recognize that supply-and-demand aspects form more and more reciprocal conditions.

For instance, it makes sense to speak of *facilities* without mentioning additional aspects like ownership or clientele. But the use of the term *opportunities* depends on the specification of those categories of supply that certain facilities are suited to provide.

Although there is a broad range of facilities capable of offering anywhere from one category of supply to a multiplicity of different categories, there is a limit to the number of purposes a single facility—even of the multipurpose brand—is able to handle. Therefore, the spatial pattern of opportunities differs from that of facilities according to the category of supply in question. Whereas facilities impose a certain structure on the natural and historical foundations, opportunities differentiate this fabric with respect to specific actual realizations of supply.

In a sense, this explains to a certain degree the well-known fact that subjective representations of factual spatial structures differ widely among individuals.<sup>36</sup> The individually recognized and stored pattern of spatial organization is governed much more by demand-steered search processes than by explorative research endeavors aiming at complete, reliable, and true-to-scale representations.

The concepts of *demand* and *supply* as used in economics refer to highly aggregated levels of goods and services. Resulting from mere additions over a huge number of different items, these definitions often obscure their real meaning by neglecting their factual references: there is no *supply* as such, only the provision of certain goods and services by certain facilities; neither is there *demand* as such, but there is always the demand of certain people for certain goods and services.

The factual realization of exchange processes between demand and supply depends on the congruence of the respective profiles of goods and

services. Because of the existing complementary and substitutive relationships between whole arrays of goods and services, it seems to be inadvisable to conceptualize fixed patterns of demand (and supply), allegedly deducible from a stable matrix or hierarchy of invariant needs. Instead, it seems more appropriate to employ the concept of disposition as a basis for discussing the formation and realization of demand patterns.

Dispositions refer to the budgets people have at their disposal. Any private investor considering the installation of a new facility is aware of this; he explores carefully the potential of the location under consideration by checking the number and proportions of financial budgets he seeks to attract. Only if the planned facility is accepted as opportunity by the prospective clientele can the intended economic endeavor succeed.

Dispositions encompass the time, means, and information budgets as well as spatial aspects like location and distance. Any change of budgets constitutes a different dispositional frame relevant for the actually performed activities, and any change in location of a household's home causes a reorientation for possible and acceptable realizations of dispositions that may lead to new arrangements of activities.

Certainly not all activities are equally affected by a change of budgetary and locational conditions. Numerous requirements imposed by societal regimens must be met. This will give rise to a regular pattern of responses for coping with a persistent pattern of external stimuli. To reduce the burden of decision making, people employ habitualized or routinized patterns of reaction when facing recurrent decision situations. In a sense, habits and routines form the skeleton of the actualization of dispositions. They inhibit the generation of new performance styles as well as offering a platform for the development of hitherto unfamiliar realization schemes.

Habits and routines mirror the internal adjustment requirements and procedures of a household with respect to externally generated offers and obligations. The more complex the internal organization process, the more rigid will be the pattern of exhibited activity patterns. This explains, at least partially, the variety of life-styles displayed by single persons, who, lacking group-adjustment pressure, can make decisions much more on a day-to-day basis and, consequently, have a much richer repertoire of activities from which to choose.

The employment of classification schemes to reduce the variety of cases to be considered was guided traditionally by the search for largely time-invariant socioeconomic characteristics. It cannot be doubted that different levels of education, profession, and income constitute important stratification schemes. On the other hand, the actualization of activity patterns is strongly mediated by influences stemming from household characteristics such as stage in family life cycle, size of household, and

home location, all of which are subjected to processes of rather discontinuous change. The data base for these attempts normally consists of cross-sectional figures, relating representations of events (such as number, frequency, and duration of trips) to presumably characteristic features of individuals and households. This procedure violates the context-determining temporal order of activity sequences and takes as a given that the ergodicity assumption holds true. Because of this, one may doubt whether it will be possible to identify the extent and importance of routines and habits as basic activity components. Without sufficient knowledge about the nature and stability of these building blocks, it is almost impossible to detect persistent and recurrent patterns of behavior at the level of activity sequences.

There are theoretical considerations as well as empirical findings that lead to the conclusion that individual activity decisions must be viewed not as a series of independent events but as realizations of dispositions constituting a coherent and stable level-structure framework.

#### *Options, Intentions, and Decision Situations*

Up to now, the display used to delineate the conceptual framework has employed a top-down approach to specify subsequent levels of concretization. Each level was intended to represent a factual layer of reference that could be referred to without considering explicitly psychological aspects of subjective perception or cognition. Narrowing down the focus of investigation, however, the present level of exploration deals with individual choice-making behavior. Unless one restricts oneself to the utilization of traditional, normative decision-making schemes, one faces serious difficulties in conceptualizing an adequate framework for the exploration, description, and explanation of factual human decision processes.

For the present purpose, it might well be sufficient to postpone questions of rationality and optimality and to concentrate instead on the constituent components of choice situations, namely options and intentions.

*Options* refer to the set of factual possibilities open to any decision unit. Within the terminology employed so far, options can be conceived as a subset of opportunities that exist factually and are represented subjectively within the cognitions of a decision unit. Options are those representations of opportunities that are part of information budgets.

Spatially, options constitute an accessibility domain on the opportunity surface that is delineated by the reach of potential users. Physically, the reach is determined by budget constraints that define the boundaries of individual activity spaces.<sup>37</sup> Any change of the means budget—by the acquisition of more effective transportation equipment, for instance—

leads to an extension of the reach of an individual. However, only in the case of a complementary extension of the information budget is the domain of options also widened.

Although options refer to subjective memory contents, they nevertheless carry factual meaning because of the unquestionable fact that mental or cognitive processes are real, despite their lack of observability and the current insufficiency of knowledge about their functioning.

Options constitute the range of possible decision results. Before the final choice is made, there must be some kind of assessment procedure in order to obtain a rank order of options according to the expected results and their positions on some valuation scale. This, at least, is the position of traditional decision theory. Recent research results, however, suggest that this conceptualization is an undue oversimplification.<sup>38</sup>

Because a lengthy discussion of decision techniques would be beyond the scope of this chapter, it seems appropriate to concentrate on the concept of intentions as the corresponding characteristic to that of options.

As with options, *intentions* refer to individual memory contents that become actualized in accordance with the occurrence of specific decision situations. Intentions can originate from different sources: shortfalls or excesses of physiologically determined levels of well-being (hunger, thirst, sleep, pain); aberrations from psychologically bound levels of satisfaction (sorrow, anger, shame, fear); discrepancies with regard to socially accepted standards (dominance, approval, gregariousness, physical activity); lack of economic opportunities or success; and so forth.<sup>39</sup> Although the actually relevant mix of these motives is the result of the prevailing specific conditions and cannot be regarded as an invariant structure, the effects are nevertheless the same: the development of more or less strong intentions to overcome the perceived difficulties by restoring the balance of budgets.

One point needs to be stressed, however, because it finds almost no attention within the traditional debate about decision making: the role of habits and routines. Even under the assumption that humans are completely rational animals, it does not make sense to regard them as being permanently involved in decision-making activities as prescribed by traditional decision theory: searching for information about states of nature, exploring and inventing options, assessing valuations to the expected consequences, performing calculations to determine the optimal solution, and so forth. With all that is known about the evolutionary process, one can be sure that any species with these behavioral properties would not have survived.

Although these arguments are far from new, they had little influence on empirical research on factual human decision-making behavior.<sup>40</sup>

Therefore, the opinions expressed here are highly speculative and deserve critical examination:

1. Rational behavior implies the reduction of decision load to as low a level as possible.
2. From this, one can expect the proportion of habitual and routinized activities to be dominant.
3. Even under changing environmental conditions, people tend to preserve their familiar behavior patterns as long as possible.
4. Rearrangements of behavior patterns will employ as many familiar components as possible.
5. Rearrangements of activities will occur more often in connection with significant changes in permanent decision-situation features such as home and job location, and expansion or reduction of household size.
6. The structure of decision situations will be perceived as being as simple as possible.
7. The search for hitherto unnoticed options tends to be minimized.
8. To minimize the number and seriousness of future decision situations, those options tend to be selected that contribute to the accomplishment of as many intentions as possible.
9. Decisions concerning trip-making behavior are made not in an ad hoc manner but within a framework of regimens and budgets.

### Conclusions and Suggestions

Explication of concepts and construction of contexts are interrelated procedures of clarification; the logical relations between concepts constitute the context for each concept, and the emerging context serves as a base for the reduction of polyguity of the concepts used.

Two methodological principles were employed to arrive at the concept/context pattern suggested here (figure 15-4):

1. The use of fact-coordinative concepts for the representation of the factual reference system.<sup>41</sup>
2. The application of the level-structure paradigm for the organization of the representation scheme.<sup>42</sup>

Fact-coordinative concepts ensure the possibility of differing interpretations of the same factual phenomenon. This is necessary to bridge the gap between the different vocabularies used within different fields of science. The concepts of regimens and budgets, for instance, permit their

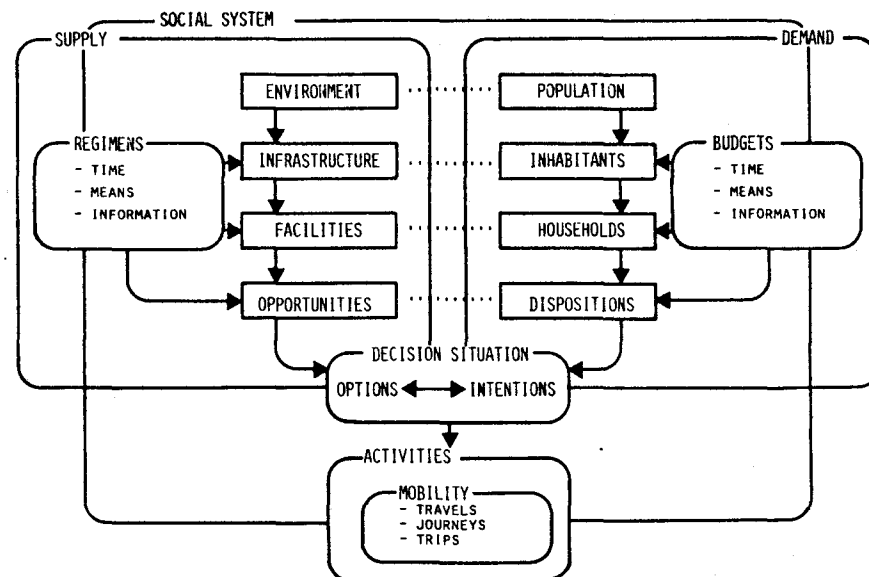


Figure 15-4. Concept-Context Pattern

utilization also within the sociological framework of roles, norms, and institutions; the economic scheme of supply and demand; and the engineering pattern of design, construction, and operation.

The level-structure paradigm is helpful to overcome the fruitless dichotomy of macro versus micro approaches to spatial behavior research. Furthermore, it serves as a guiding principle for the translation of the conceptual scheme into operative procedures.

Despite the symmetry suggested by the representation in figure 15-4, the level-connecting linkages within the supply-and-demand branches are proposed to be of very different kinds. Whereas the environment-infrastructure-facilities-opportunities level structure can be represented easily by formal decomposition procedures of subset construction or partitioning, the population-inhabitants-households-dispositions sequence needs a more complicated treatment. The first step from population to inhabitants seems easiest because it involves only an areal-classification procedure. The decomposition of inhabitants into households also does not imply sophisticated methods. But the segmentation of households into different sets of homogeneous dispositional groupings requires some sort of reshuffling procedure of a less clear-cut relationship.

However, one conclusion can be drawn already on the level of the present investigation. The applicability of linear-regression models even of the multiple-variable type seems to be much more limited than their

prevailing abundant utilization suggests. The formal preconditions of these computing procedures do not allow for the existence of hierarchical interrelations between the variables employed.

One more point should be mentioned. Environment and population were introduced as ecological concepts connected by exchange processes. Although interactive processes are difficult to represent, quantify, and measure, their very concept is rich enough to be employed as a guiding principle for the investigation of factual reference systems. There is no doubt that the existing environmental conditions are the result of historical decision processes now operating as regimens for everyday behavior. Within a level-structure conceptualization, these effects can be represented as the interplay of variation and adaptation between adjacent levels of operation.<sup>43</sup>

As indicated in figure 15-5, there are two different types of level-connecting processes:

1. *Hierarchic* processes originate from the variation of regimens on a certain level and lead to the adaptation of budgets on the next lower level.
2. *Synergistic* processes are initiated by the variation of budgets on a certain level and entail the adaptation of regimens on the next higher level.

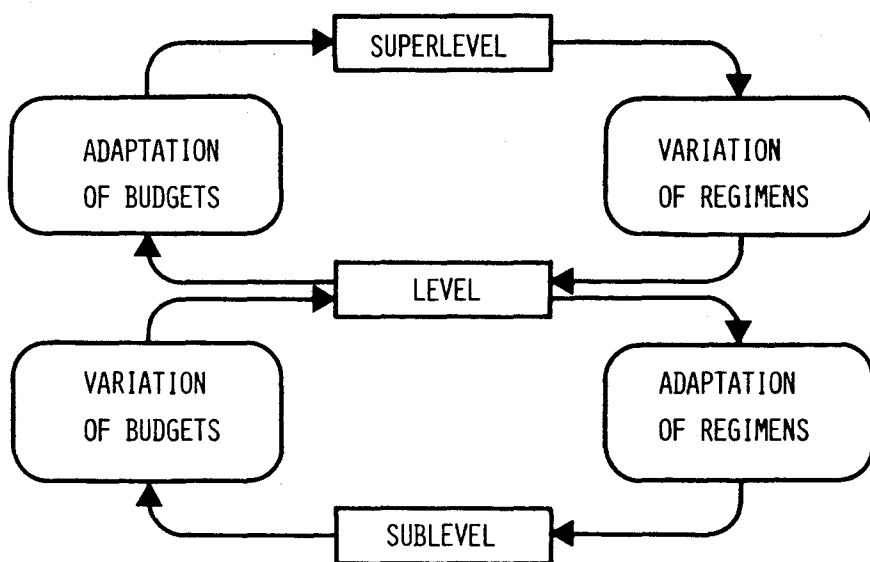


Figure 15-5. Variation and Adaptation as Level-Connecting Processes

It is not difficult to find examples of both types of processes within the field of spatial behavior. An increase in household income, for instance, leads to a growth of car ownership, thus reducing the demand for public transport, which in turn entails the deterioration of public-transport services and gives rise to a further increase in car ownership and utilization.

The neglect of these circular causation processes has two important consequences. First, on the research level there will be a serious lack of adequacy between crucial properties of the factual reference system and the concepts and procedures employed in investigation, data collection, and interpretation. Second, on the planning and programming level these deficiencies will result in badly or even erroneously derived policy proposals with high probabilities for the occurrence of unintended but counterproductive effects in reality.

#### Notes

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