



Complexity in daily life – a 3D-visualization showing activity patterns in their contexts

Kajsa Ellegård and Matthew Cooper

Prof. Kajsa Ellegård
Technology and social change, Linköping University
SE-5 81 83 Linköping, Sweden
email: kajel@tema.liu.se or kajsa.ellegard@geography.gu.se

Dr. Matthew Cooper
Department of Science and Technology, University of Linköping, Campus Norrköping
601 74 Norrköping, Sweden
email: matco@itn.liu.se

Abstract

This article attacks the difficulties to make well informed empirically grounded descriptions and analyses of everyday life activity patterns. At a first glance, everyday life seems to be very simple and everybody has experiences from it, but when we try to investigate it from a scientific perspective, its complexity is overwhelming. There are enormous variations in interests and activity patterns among individuals, between households and socio-economic groups in the population. Therefore, and in spite of good intentions, traditional methods and means to visualize and analyze often lead to over-simplifications. The aim of this article is to present a visualization method that might inspire social scientists to tackle the complexity of everyday life from a new angle, starting with a visual overview of the individual's time use in her daily life, subsequently aggregating to time use in her household, further at group and population levels without leaving the individual out of sight. Thereby variations and complexity might be treated as assets in the interpretation rather than obstacles. To exemplify the method we show how activities in a daily life project are distributed among household members and between men and women in a population.

JEL-Codes: C88, D13, P46, R29

Keywords: household division of labour, time-geography, 3D method, visualization, diaries, everyday life, activity patterns. Complexity in daily life – a 3D-visualization showing activity patterns in their contexts

Approaching the fabric of daily life

While we all experience daily life as time goes by, many social scientists find that daily life turns out to be quite a complex task when put under study. Since all activities take time to perform, studying time use may serve as a starting point for approaches to everyday life studies. Traditional ways of describing time use, by accounting for the average number of minutes for certain activities per individual in a population, are suitable for example when introducing discussions on time use topics. Averages also serve as measures and indicators when the purpose is to give a brief overview over daily life in a population.¹⁴ But the average time use gives limited guidance when questions arise on more complex relations in everyday life. For example, how do various activities interrelate with each other in purposeful projects, what is the distribution of activities among the individuals in households and what are people's opportunities to realize projects that engage them?

People shape their daily life by continuously performing activities to satisfy their wants and needs. But their opportunities to act according to their wants and needs are restricted, first, by the natural and manmade material environment, second, by the individual's own capacity and capabilities, and third, by social institutions and structures like agreements, regulations and laws on social and economic couplings between individuals (Hägerstrand & Lenntorp 1974, Hägerstrand 1982, Mårtensson 1979, Giddens 1990). Individuals' various goals and strivings, their different resources and the specific restrictions they experience, result in each individual living her life in a different manner from everybody else. There are, however, some basic similarities in people's daily performance. The necessity for humans to allocate time for physiological needs, like sleeping and eating, do not differ according to culture and location on the earth, while the specific activity patterns and rhythms (when, for how long, where, and with whom people eat and sleep) may give rise to culturally constructed patterns that differ between regions on the globe (Szalai 1972). Hence, the study of everyday life is ambiguous and therefore investigations claim for methods that may reveal both variations and similarities according to how people organize their activities.

The aim of this paper is to present a new 3D method, dealing with the complexity of everyday life by regarding daily activities from a time-geographical perspective. A 3D visualization system is worked out for developing the method. In this article the method is used to show aspects of division of labor (gender and generation) related to the basic human need for food, in the context of a household and a population.

Theoretical and conceptual framework for analysing the complex everyday life

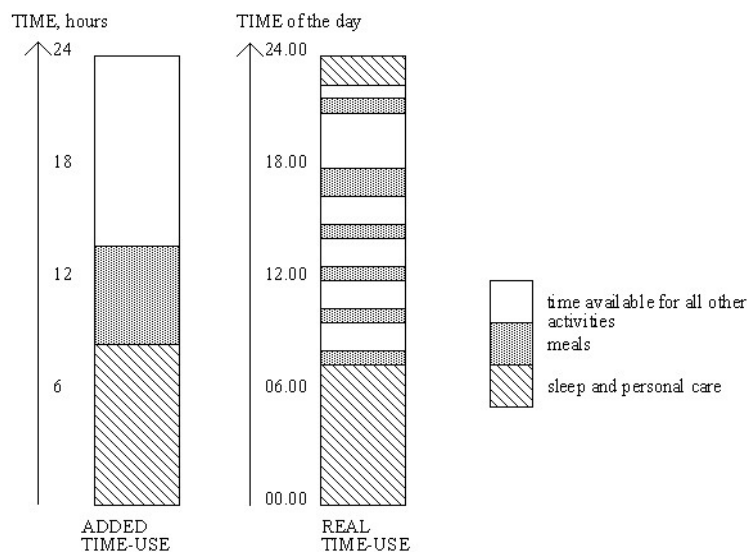
Approaches to study time-use data

Time use data collected in time diaries reveal what people write that they actually have done. To get a hold on the contexts in which activities are performed by individuals (alone, as household members or in other social groupings) we must rethink the traditional approach to present time use figures collected from diaries. The added time use (figure 1, left) is the way we usually are

¹⁴ See for example Multinational Time Use Study, MTUS at <http://www.iser.essex.ac.uk/MTUS/>.

presented time-use figures, showing the sum of hours and minutes spent for activities by one individual during a day (24 hours). The added time use neglects important aspects: first that some activities are performed several times during a day and second what contexts the activities are parts of.¹⁵ The real time use (figure 1, right) is an alternative way to present the same data, picturing the sequence of activities over the 24 hours of the day. The real time use shows how activities are intertwined in the course of the day¹⁶ and it may also serve as a base for analysing, opportunities to co-ordinate activities in a household. The impressions from the two illustrations are different even though exactly the same individual, the same day and the same diary data is the starting point for both of them.

Figure 1 Differences in time-use of an individual during a day



The figure shows the differences in principle between added (left) and real (right) time-use of an individual during a day. The total number of hours used for “meals”, “sleep and personal care” and “other activities” is exactly the same in the diagrams.

Source: Ellegård (1999 b), 170.

When looking for activity patterns, division of labour and habits embedded in the daily life of people in their households (section 5) the real time use approach is suitable. We claim that our method in addition may show how the principle of real time use may reveal interesting information on the population level (section 5.2).

About time-geography

With what do people fill their days to survive, enjoy, educate and develop themselves? How do they organize socially and make efforts to achieve personal and collective goals? How do they utilize resources available at the various places where they spend their time? Questions like these

¹⁵ At an aggregate level the added time use equals average time use. Average time use for populations was first presented by Szalai (1972) and it is used in most national time use studies.

¹⁶ Real time use might be transformed into added time use, while the reverse transformation is impossible.

are fundamental to most social sciences and several theoretical approaches and methods are developed to deal with them (welfare studies, time use studies, social interaction).¹⁷

The roots of time-geography¹⁸ are found in geography, wherein the physical world and the human utilization of it are in focus. Time-geography is deeply rooted in the material world where human individuals live side by side with (and utilize) individuals from different kinds of populations (animals, plants, artefacts etc)¹⁹ (Hägerstrand 1993). Human individuals exert strong power over individuals in other populations due to technologies developed to master the environment. Relations between individuals from different populations that co-exist in time and space are important in time-geography (Hägerstrand 1991).

Our time-geographic method focuses individuals in the human population. Each individual is a member of a household and many individuals live in households with more than one member. The individuals in a household are coupled to and dependent on each other²⁰, because they have many projects in common. Therefore, it is important to be able to move from the individual level to the household level without losing important information about the individual when the household is put in focus (Hägerstrand 1974). Hence, in our method one may concentrate on "the individual as a whole" at one level, but it is obvious that the "individual as a whole" constitutes just one part of "the household as a whole" on the next upper level.

Two basic assumptions in time-geographical thought are that everything takes place somewhere on the earth's surface, and that it takes time for everything to happen. Processes might be depicted in time and space – the time-space (Hägerstrand 1974, Lenntorp 1976). The process approach underlines the importance of not only the events going on, but also of relics of past events and of the seeds for future events immanent in present events (Hägerstrand 1961).

Individuals' struggle to overcome restrictions when they pave their way through life is a question of process and continuity. Now is continuously transformed into a past situation in the individual's biography and it constitutes her stepping stone when she takes her next step into the future. The plans and intentions of individuals are of importance for this transformation, and the power and resources controlled by each individual are decisive for what will turn out. However, routines and habits are developed and they help the individual to make her choice of activities and to live her life without deeper reflections over everything she chooses to do (Åquist 1992, Lindén 2001).

Indivisibility of the individual at one and the same level is another important assumption in time-geography.²¹ This implies that an individual only can exist at one place at the same time, and therefore the time and space dimensions may be taken as basic descriptors of daily life.

Time-geography utilizes individuals' indivisibility in its specific notation system: an individual's existence in the time-space is illustrated by a continuous line - labelled individual path - that

¹⁷ See also Allardt (1975), Thompson (1999), <http://www.iser.essex.ac.uk/MTUS/>

¹⁸ The time geographical approach was developed by Hägerstrand and his research group in Lund, Sweden from the late 1960's and on. The activity oriented time-geography is developed in Ellegård (1993, 1994, 1996, 1999a, 1999b) and in Nordell (2000, 2002).

¹⁹ Different populations consist of individuals of different kinds and there are, consequently, not only human populations.

²⁰ Family is the concept for biological relationships while household is the concept used here for individuals living in the same home.

²¹ Looking at the human body at another level of analysis, however, it may be divided into organs, into cells and so on.

constantly moves in time and space²², from birth to death of the individual²³ (Hägerstrand in Carlestan 1991). From the individual path we can read when the individual is located where, and how fast she moves between the different places she visits. Hence, the focus of this original individual path is where people are located (geography) in the course of the day (time) (Lenntorp 1976).

The original time-space based individual path is modified in our method, where focus is put on when and for how long people perform what activities. The result is an activity oriented individual path, see figure 2. The individual's activity oriented individual path shows her activity sequence and other phenomena important to the individual might be related to it. For example, factors like together with whom activities are performed, what places are visited, what means of transportation are used, and what feelings may be related to the activities performed (Ellegård & Nordell 1997).

An illustration showing the activity oriented individual path in the course of the day is a good base for analysing passing everyday phenomena like activities that usually are taken for granted. In the diagram, activities are clustered according to a general categorization scheme with seven activity spheres (Care for oneself, Care for others, Household care, "Recreation/reflection", Transportation, Procure & prepare food, Gainful employment & schoolwork). The activity oriented individual path does not reveal the motives behind why the activity pattern came out as it did. To answer to the why-question interviews are important complements in analysing the individual paths derived from diaries. When an individual looks at the activity path illustrating her day, based on her own diary notes, she easily recognises her unique daily life. Discussions between researchers and diary-writers might in this way deepen, compared to ordinary interview situations (Forsell 2002, Nordell 2000, 2002, Westermarck 2003).

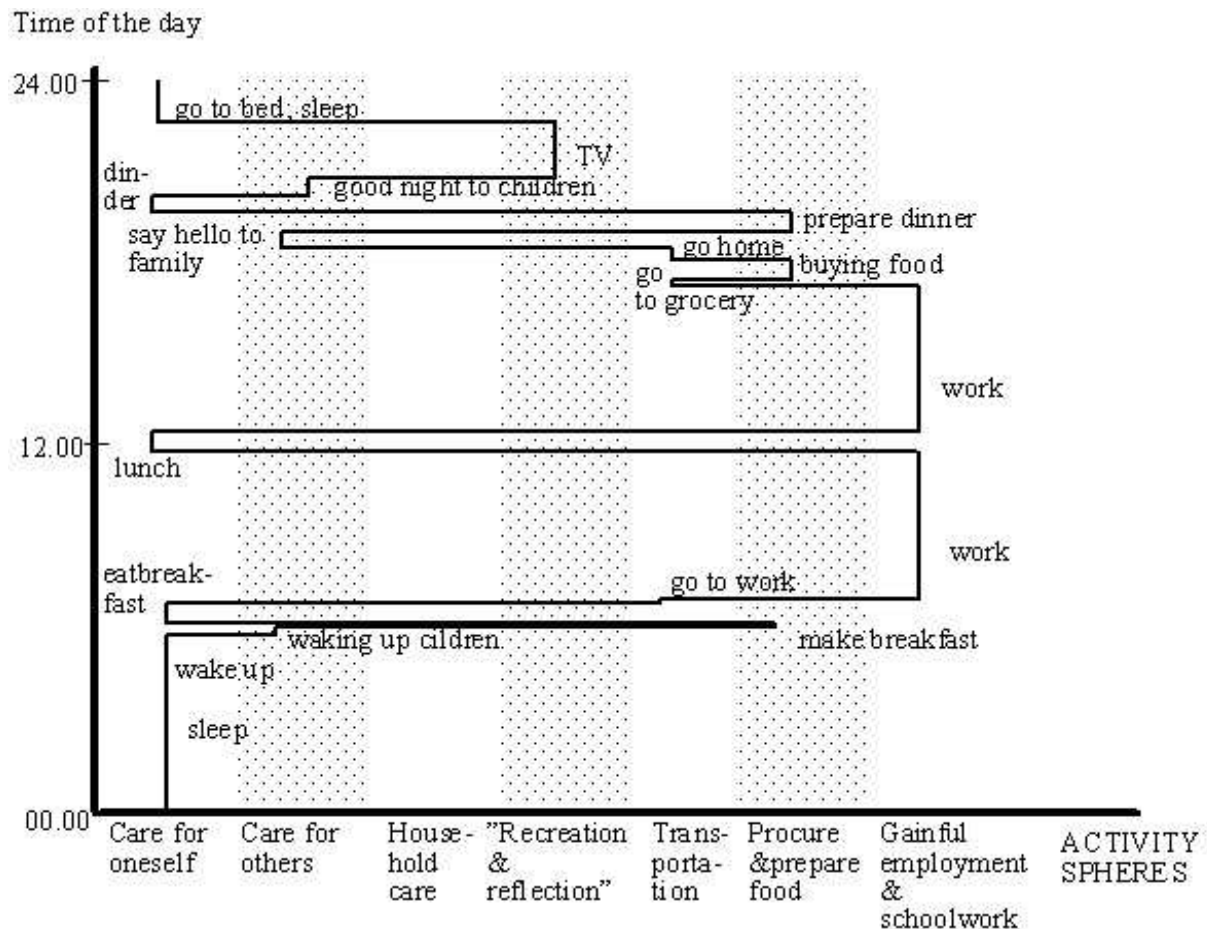
Concepts for analyzing everyday life activity patterns

Our 3D method utilizes the following concepts as tools to systematically investigate the complexity of everyday life: activity, project, activity contexts (everyday context and project context), social context and geographical context. *Activity and project*. An *activity* is defined as a handling, tied to the individual performing it and her location in time and space. Activities are regarded as processes since they take time and have duration. From the perspective of the individual activities are meaningful since they are means for her to reach goals. Activities aiming at fulfilling the same goal constitute a *project* (Hägerstrand 1985). A project is an analytical concept, containing activities that have passed, activities that are ongoing and that are planned. Thereby we may link activities of now to their history and to their future. The overall project, common to all individuals, is assumed to be "to live one's life". Within this all embracing project other, more specific projects are contained and exactly how they are performed varies from individual to individual and from time to time (Ellegård 1994, 1999b). There are, however, similar patterns and routines common to several individuals of the same culture. A project, hence, consists of a variety of activities that taken together aim at achieving the goal of the project, and they are performed in accordance with the specific circumstances of every individual (Hägerstrand 1982, 1985).

²² The individual path moves along the time dimension when the individual is stationary at a place, and it moves simultaneously along the time and space dimensions when the individual moves over the earth's surface.

²³ In most studies the time perspective is shorter than the whole life, and it comprises a day, a week or a year.

Figure 2 Activity oriented individual path of one individual during one day



The activity path illustrates the sequence of activities performed by the individual from 00.00 to 24.00. Time is depicted on the y-axis and there are seven activity spheres on the x-axis. The individual path should be read from the bottom of the figure and upwards. The vertical sections of the individual path show the time use for activities and the location on the x-axis shows within which of the seven activity spheres the activity performed is classified. Horizontal sections of the individual path indicate that the individual stops one activity and starts another. This individual path illustrates a unique daily life starting with sleep and waking up (in the sphere Care for oneself), waking up children (sphere: Care for others), make breakfast (sphere: Procure and prepare food), have breakfast (sphere Care for oneself), go to work (sphere: Transportation), work (sphere: Gainful employment), have lunch (sphere Care for oneself), work (sphere: Gainful employment), go to a shop (sphere: Transportation), buy food (sphere: Procure and prepare food), go home (sphere: Transportation), say hello to the family (Sphere: Care for others), prepare dinner (sphere: Procure and prepare food), have dinner (sphere Care for oneself), say goodnight (Sphere: Care for others), watch TV (sphere "Recreation/reflection") and finally go to bed and sleep (sphere Care for oneself).

Source: own calculation from a one day diary.

Activities in daily life, and, to a considerable extent, also projects, may be studied from people's time diaries. To analyse them we need a robust category structure and a categorization scheme is developed for clustering the activities in diaries (Ellegård 1993, 1994, Ellegård & Nordell 1997, Westermarck 2003). The categorization scheme is also a base for coding activities to prepare them for computerised illustrations. The categorization scheme takes as its points of departure the perspective of the individual as a handling subject and that the most general project, involving all

individuals is “to live one’s life”. As mentioned before this overall project is classified into seven activity spheres.

In individuals’ time diaries, where notes are written on activities occupying the day, the level of detail varies a lot.²⁴ One individual may write “household chores” while another writes “scrub the floor” when doing exactly the same thing. As a researcher one must be able to compare the diaries despite their different levels of specification. The categorization scheme handles variations by including five levels of detail (Ellegård 1993, 1994, 1999a, 1999b). Therefore, it is possible to use the level that fits a not very detailed diary when comparing it to a very detailed one. The principle is illustrated in figure 3. There are about 600 different activities in the categorization scheme.

Specific projects may consist of activities found within one or more of the spheres. For example, the project “serve meals for the family” involves activities from the sphere “procure and prepare food”, and, if transportation is needed to buy ingredients, it also involves activities from the sphere “movements, transportation”.

So far the discussion has focussed on projects as *individual projects*, but there are *organizational projects* too (Ellegård 1975). There are formal organizations like companies and public organizations, and informal ones, like households and other voluntary organizations. Influential individuals in an organization decide upon the goals of organizational projects and the other individuals involved in the organization are expected to perform the activities that are necessary for realising the organization project. In this paper informal organizations (households) are put in focus.

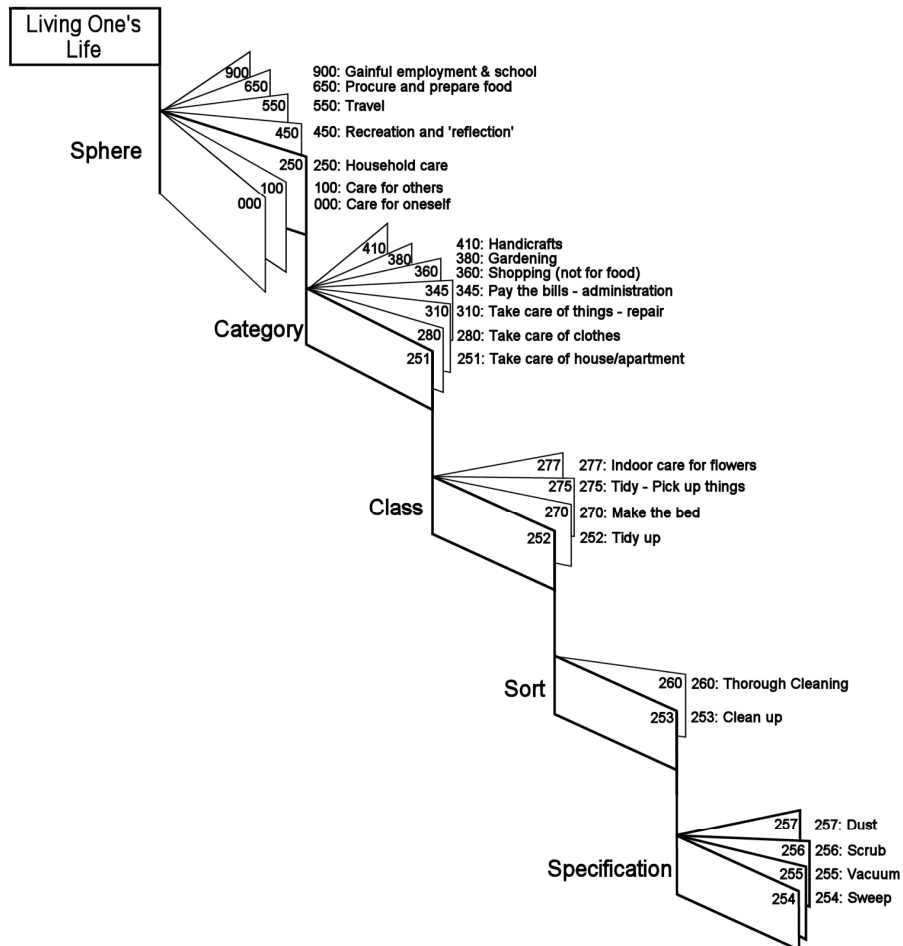
Contexts in daily life. There are two types of *activity contexts* used in the method, the *everyday context* and the *project context* serving different analytical purposes. The continuous sequence of activities performed by an individual during a day constitutes her everyday activity context. The *everyday context* pictures how activities sequentially follow upon each other, and we can see when an activity is interrupted by another activity and how the former activity is resumed. The everyday context is based on activities that already have passed and is visualized by an activity oriented individual path (figure 2), based on the principle of real time use (figure 1).

To a considerable extent, it is possible to derive from the everyday context what *projects* the individual is involved in, since activities appearing in the everyday context constitute realised parts of projects that the individual aims at fulfilling. The concept project is used when talking in general terms about activities oriented at one and the same goal, but then it lacks reference to the everyday context in which its activities it appear. Therefore, we need a concept for talking about the activities that in fact have been performed to realise the project, and we use the concept *project context* for this purpose. Consequently, the project context is always related to activities that have passed. Activities in one specific project context, hence, appear now and then in the everyday context of the individual who tries to reach the goal of the project. Activities related to one specific project do therefore appear intertwined among the activities of other projects. An example of a project context located in the everyday context of figure 2 is revealed by the activities performed for the project “serve meals for the family”. Four types of activities appear as parts of this project context, namely "make breakfast", "buy food", "transportation (to and

²⁴ The diaries contain notes on time, activity, and place, and together with whom each activity is performed.

from the shop)" and "prepare dinner".²⁵

Figure 3 Five levels of detail in the activity categorization scheme



Within the activity sphere 250 Household care examples of activities on more and more detailed levels are given.

Source: Ellegård (1994), 53, authors translation.

²⁵ Since there are some activities lacking to bring the project to full meals, someone else in the household obviously performs these activities, i.e. "lay the table" and "wash the dishes", and lunch is probably eaten in the workplace restaurant – and then it is prepared by someone else.

Our 3D method enables us to describe and analyse activity patterns in terms of everyday contexts and project contexts and it will help us to a deeper understanding of circumstances that affect people in performing their projects of daily life. The method may reveal *rhythms, habits* and *routines* that are at hand. The distribution of activities *among the household members* reveals the outcome of power relations in the household: Who buys the food, cooks, and washes the dishes? When and in what contexts are these activities performed? From such analyses the household members are enabled to articulate and discuss their division of labour, as revealed by their activity paths. However, this approach does not say anything about meanings behind the projects performed (Nordell 2000, 2002, Westermarck 2003). To get deeper information on intentions and meanings, interviews are necessary. Interviews are facilitated when the discussion can start from a time-geographic illustration of the everyday context of the family members. Then all participants get a common reference point for their discussion (Nordell 2002).

The *geographical context* tells us about where (in what place) the individual was located and at what time the various activities were performed. The *social context* informs about togetherness: are there other individuals present when an individual performs her activities and, if so, who are they? These contexts (activity, geographical and social) may easily be related to each other since they all have the time dimension in common. However, in this paper we will limit our focus to the activity contexts at individual, household, group and population levels.

What about the distribution of activities *among groups* in the population (for example according to age, sex, income, urban- or rural location)? The 3D method may be utilized to reveal if there are specific activity patterns tied to specific groups by defining criteria for sampling groups of individuals from the whole population in the database. The distribution of activities *within the population as a whole* shows a cultural everyday activity pattern. Hence, we might shed light on questions about how everyday life is organized and lived in a society from inter-relating the time, activity, place and other dimensions, starting on the individual level and subsequently aggregating to group and population levels.

The database

The database consists of 926 diaries collected during the autumn months in 1996 by Statistics Sweden for a pilot study.²⁶ A total number of 464 individuals in 179 households have written diaries. Most of the individuals have written one diary on a weekday and one on a weekend day. The age span of the individuals writing diaries ranges from 10 to 97 years. The individuals live in households with different characteristics (couples, singles, with and without children at home etc), living in different types of regions (rural and urban). The households and diaries are briefly presented in table 1.²⁷ The database has close to 30000 activity entries, equalling the 1333440 minutes of the 926 days.

²⁶ The pilot aimed at testing a diary form to be filled in by all household members of 10 years of age and above. The test was successfully performed. The data has not been utilized by Statistics Sweden.

²⁷ In total there are 38 households with one adult, and 28 of them live alone while 10 of them have 27 children altogether. The number of children living with one adult varies between one and five. Evidently, there are not as many diaries as there are household members. The main reason is that children under 10 years old were not asked to write diaries. Another reason is that in some households all individuals approached did not fill in the diaries.

Table 1 Household types in the Swedish pilot study

Household size	No of households	Sum of household members	No of individuals writing diaries
1	28	28	28
2	45	90	87
3	15	45	39
4	24	96	74
5	41	205	128
6	17	102	65
7	6	42	24
8	1	8	6
9	1	9	6
10	1	10	7
Total:	179	635	464

Source: Statistics Sweden, Time Use Diaries Pilot Study (1996).

The 3D Visualization System

We have developed a powerful, flexible and extensible visualization system for visual data analysis from the diary data gathered (Cooper et al. 2002). The system has been developed using AVS/Express, a popular modular visualization environment, which can be used to facilitate rapid application development using both standard methods, provided by the Express system itself, and additional algorithms and methods provided by the developer. AVS/Express includes functionality to interact directly with an SQL database allowing the user to drive the analysis from within the application, interactively selecting data and controlling the visualization of the selected data in real-time as they work.

Goals of the 3D Visualization System

The overall purpose of developing the system was to construct a flexible tool to improve ease of access to powerful analyses of diary data from a time-geographic perspective and, hence, illustrate the complexity of everyday life. Consequently, it includes several dimensions that are of importance for analysing an individual's performance of daily activities in the contexts (section 2.3) within which they are performed.

Through the use of multidimensional display techniques, the visualization system shows when, how often and in what contexts individuals perform activities in the course of the day. Most traditional visualization methods (circle, bar and other types of charts and diagrams) of time use are limited in this respect. Our method is flexible: *First*, it permits the user to select a range of individuals from a single person up to the entire population of the data with many intermediate levels based upon any combination of selectable search criteria. This allows the user to focus upon the single individual, the individual together with other household members (if any), and the individual together with other individuals with similar properties (such as sex, age, home region and various socio-economic factors) and the individual in the population as a whole. *Second*, it is possible to illustrate activities on different levels of detail. *Third*, it is possible to relate the activities performed to what places individuals visit during the day (geographical

context), *fourth*, to what other people the individual was together with when activities were performed (social context) and, *fifth*, to what technologies the individual can use to perform those activities. The latter means that a new context is included in the analyses, the technical context.²⁸

The dimensions of the 3D representation

In our 3D-representation *time* is always located on the y-axis, and the individuals are always mapped onto the x-axis. The z-axis is used to display other factors, one at a time, for example *activities*, *places*, *togetherness* and *technologies* used. When the third axis (z) is used for depicting activities, the result is an activity oriented individual path (as shown in figure 2). The program also offers the facility to use colour to simultaneously depict an extra dimension than can be contained in the three axes mentioned above. For example, the program shows (1) at what time (y-axis), (2) one or more individuals (x-axis), (3) perform what activities (z-axis) and (4) what specific place they are located at (using colour).

Technically, the data representation in the 3D visualization system can then be interacted with by the user in real-time. The user can rotate the displayed objects to examine the picture from different angles, either to align and compare specific data items or to avoid obscuring them, or might zoom into it or look at it from a distant point of view. These properties are of special importance when there are a large number of individuals and when the activities are illustrated with a high level of detail.

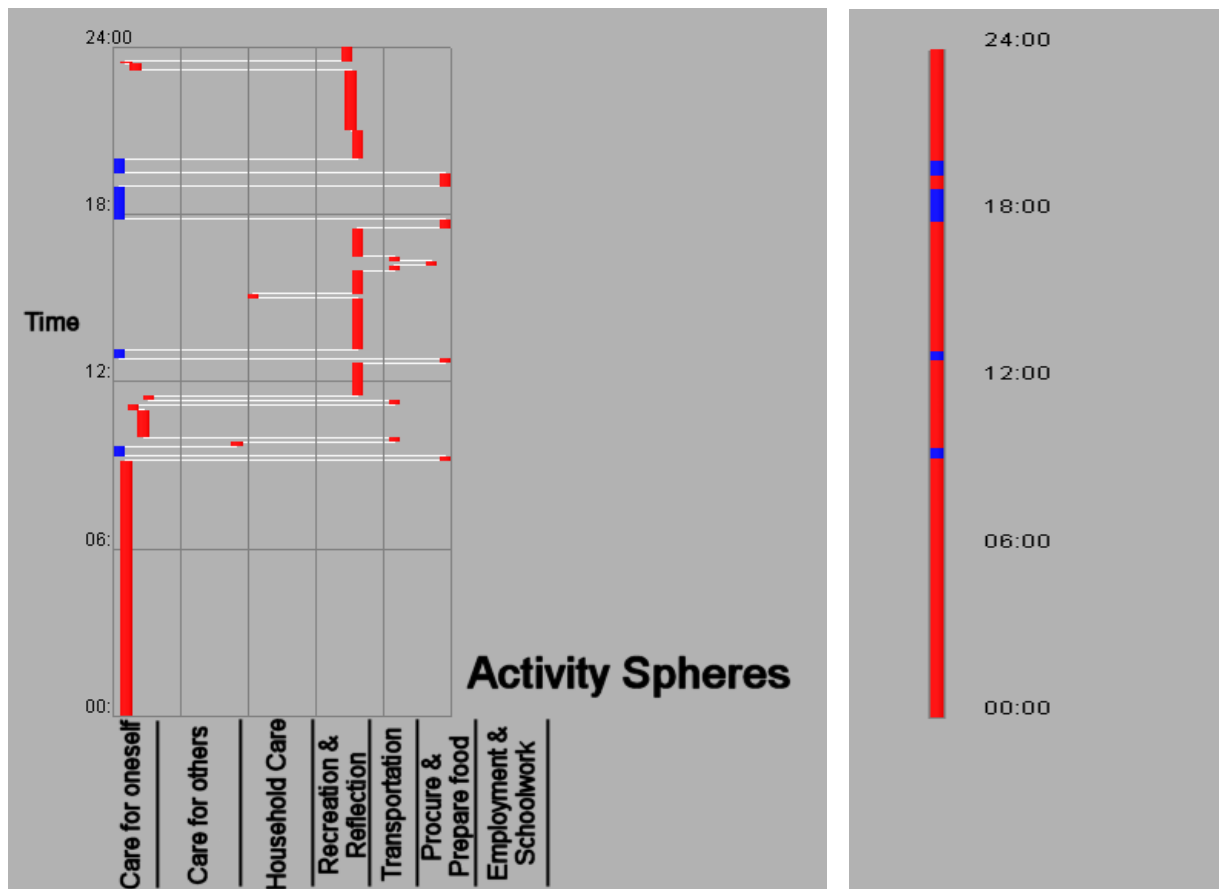
We intend to develop the 3D visualization system to include the facility to incorporate features for stereo display and three dimensional interaction tools to enable the use of the tool in VR environments which will further enhance its ability to enable complex visual interaction. We will also add the facility for the program to include more than one day.

Activity patterns illustrated by paths and logs in the 3D visualization system

An *activity oriented individual path* is exemplified by one individual in figure 4, where the dimensions chosen are time (y-axis), individual (x-axis) and activities (z-axis). The path is constructed according to the principle presented in figure 2. In figure 4, however, the principle is developed visually and the path consists of two types of elements: *activity logs*, symbolising activities and *connecting lines*, helping the eye to read the order of the activities (logs) performed. An activity oriented individual path moves constantly along the time axis (y) when an activity is performed (visualized by an activity log) and it turns horizontally from one activity to the next on the activity-axis (z) when the individual changes from doing one activity to another (visualized by a connecting line). Activity logs are coloured red or blue.

²⁸ Activities, places, togetherness and technology will in the next version of the programme be related to energy use and to emotional state.

Figure 4 Activity oriented individual path



Left: One individual's activity oriented individual path (the everyday context) during a weekend day. The diagram shall be read from the bottom and upwards, from 00.00 to 24.00 along the time axis. On the activity axis the activity spheres are ordered according to the principle shown in figure 2. This individual does not perform any activities in the sphere "Gainful employment/School" during this weekend day, and consequently the activity logs to the right in the diagram shows activities in the activity sphere "Procure and prepare food". Activity logs coloured blue indicate when and for how long the individual has performed the activity "eat meals" (it occurs four times during this day). In the everyday context as a whole, there are three clusters in time of activities within one and the same sphere using a lot of time. First to the left in the diagram (in the activity sphere "Care for oneself") where the "eating" activity belongs. Second, the activities in the activity sphere "Reflection/recreation" take considerable time to perform, firstly in the afternoon, secondly in the evening.

Right: Using the opportunities offered by the 3D visualization system, the activity oriented individual path shown in figure 4a is rotated 90° to a front perspective. The blue activity logs showing when and for how long the individual performed "eating" activities stand out from the background of all other activities (red).

Source: Statistics Sweden, Time Use Diaries Pilot Study (1996), own calculation.

In figure 4 we have coloured "eating" activities performed by the individual in blue. Hence, the blue logs indicate meals eaten and the red logs indicate all other activities. The order in which the activity spheres appear on the activity dimension (z-axis) is the same as on the x-axis in figure 2, and the activity "eating meals" (blue) belong to the sphere "care for oneself".

In the right part of figure 4 (front perspective) the connecting lines are not visible and the illustration resembles that of the real time use in figure 1. It reveals when and how often "eating"

activities (blue) appear in the course of the day. The front perspective is especially valuable when many individuals are to be compared to each other in the same illustration.

So far, the illustrations do not differ very much from what might be drawn by hand or by older computer programs. When there is more than one household member the picture of household activities often becomes fuzzy in most illustrations, because when adding individual paths for the rest of the household members, the different individuals "shadow" each other. This is not necessarily the case when utilizing the 3D representation since it is possible to rotate the illustration and, hence to look at the illustration from many angles so that each and every household member's path are clearly shown at least from some directions.

Representation of projects in the course of a day on different levels

Illustrating a project in the everyday context of individuals in a household

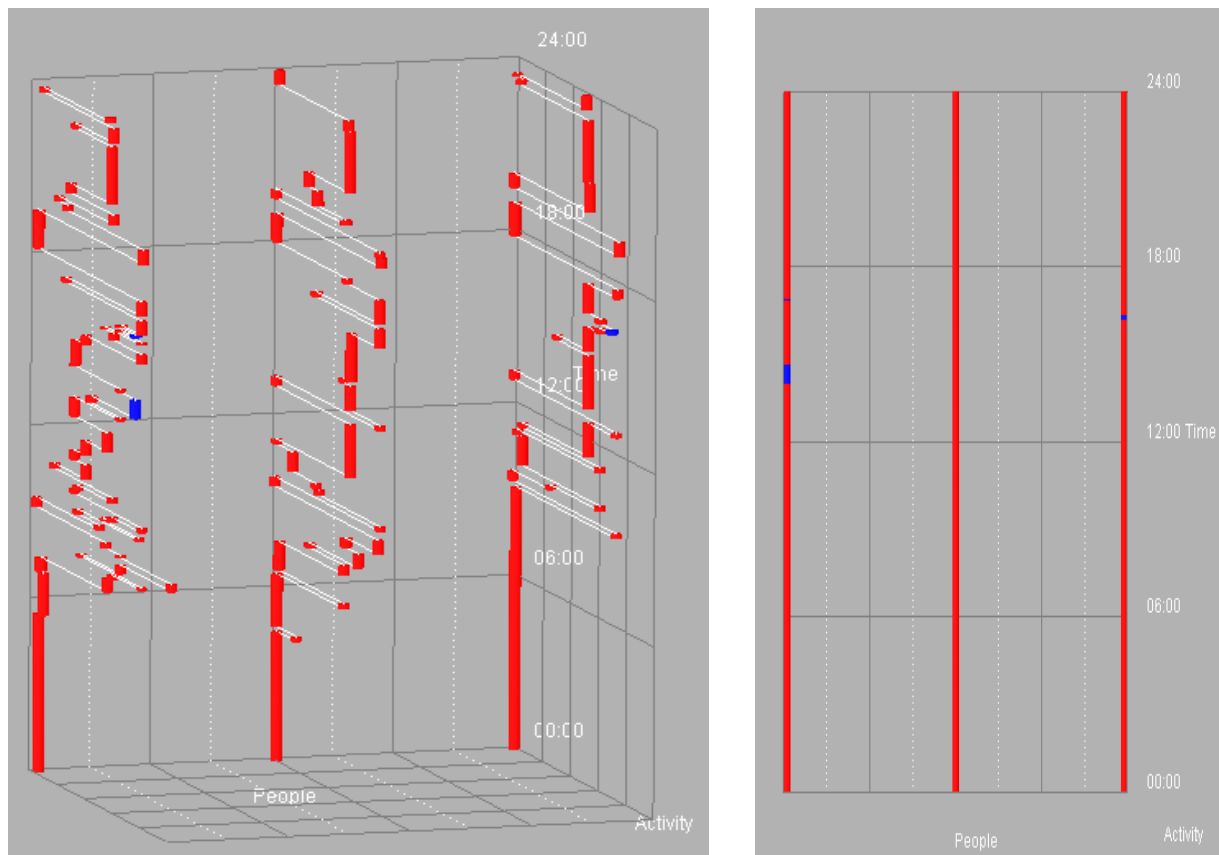
In everyday life most individuals depend on activities performed not only by themselves but also by other household members. In this section we will show how individuals in a household cooperate to fulfill the goal of an organizational project to "serve meals for the family". We will discuss the household's division of labor by a 3D representation of how the household organizes the project. We have chosen a household with three members: a mother aged 35, a father aged 45 and a son aged 14. We display their weekend day diaries.

Three specific activities within the project "serve meals for the family" are focussed: "buy food", "prepare meals" and "wash the dishes". Questions like who performs which activities in the project, when and for how long and do the household members perform their activities simultaneously or sequentially, may be discussed from the illustrations. The everyday context, revealed by the activity oriented individual paths of the three individuals respectively, is the descriptive starting point for the analysis. The path to the right in the figures 5-9 emanates from the diary presented in figure 4, written by the 14 year old son.

During this weekend day all the household members for some time are occupied by activities aiming at fulfilling the goal of the project "serve meals for the family". The pattern for "buying food" in the everyday contexts is illustrated in figure 5. The son performs the activity "buy food" once in the afternoon, the father "buys food" twice in the afternoon, while the mother not is occupied with this activity at all during this day.

The second activity in this project is "prepare meals". All three family members perform this activity, see figure 6. The mother and son make breakfast – to some extent simultaneously (figure 6 right), the son prepares lunch by himself, and all the household members participate in preparing the dinner. The father spends most time of them all for making dinner. Dinner preparation activities occur more than once in the mother's (twice) and the father's (three times) everyday contexts, while the son performs this activity only once. As a whole, the dinner making is time-consuming and occupies in total more than two hours for the father, close to two hours for the mother and about 20 minutes for the son. One dinner making activity of the father ends because of lacking ingredients. This is revealed by his everyday context: After a very short dinner making activity, his path turns into the sphere "transportation" (when he goes to the grocery), thereafter it appears in the sphere "procure and prepare food" (more specific when he perform the activity "buy food", compare figure 5), then it moves back to "transportation" (as he goes home), and after that he continues to "prepare dinner".

Figure 5 Activity: “buying food”



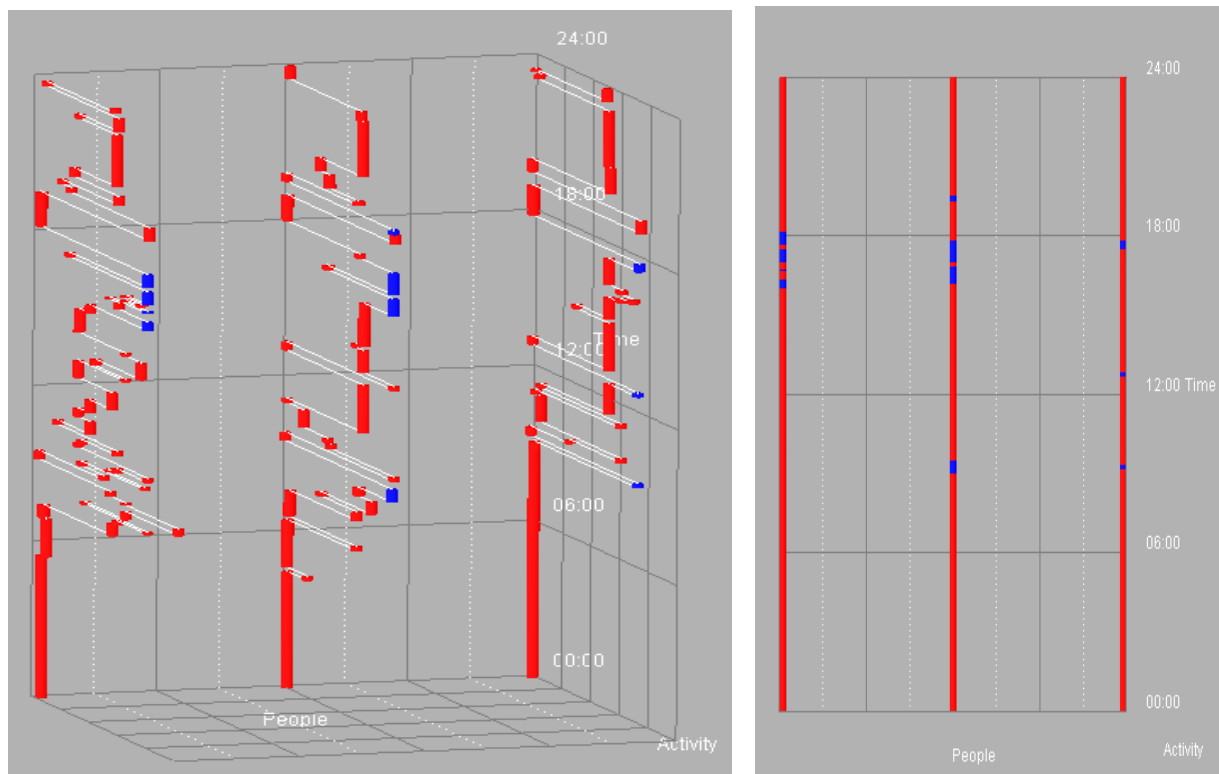
Left: The activity oriented individual paths (everyday contexts) of the three individuals in one household are shown during a weekend day. There is a father (left path), a mother (middle path) and a son (right path). The path of the son is the one already presented in figure 4. One activity, "buy food", is chosen from one organizational project of one household ("serve meals for the family"). The activity "buy food", shown by blue activity logs, occurs twice in the everyday context of the father (at about 14 and 17) and in the everyday context of the son it occurs once, at about 16. The late occurrence in the father's path is hard to see since it had a very short duration.

Right: The activity "buy food" (blue activity logs) in the household project "serve meals for the family" shown from a front perspective as performed by the three members of the household. Father (left), mother (middle) and son (right). The principle of the diagram is the same as in figure 4 (right). The dimensions are time (y-axis), individuals (x-axis) and the activities shown on the z-axis are seen from the front, here the activity "buy food" is blue.

Source: Statistics Sweden, Time Use Diaries Pilot Study (1996), own calculation.

The third activity in the project is "wash the dishes". The mother and the father "wash the dishes" three times each during this weekend day, while the son "washes the dishes" once, see figure 7. The son and the mother "wash the dishes" together after 19.00 and the father takes over from them at 19.30. The mother and father also "wash the dishes" after breakfast and lunch.

Figure 6 Activity: “prepare meals”



Left: One activity, "prepare food", is chosen from the organizational project "serve meals for the family" of the household. The activity oriented individual paths for father (left), mother (middle) and son (right). The activity "prepare food", shown by blue activity logs, occurs four times during the father's day, four times during the mother's day and three times in the course of the son's day.

Right: The activity "prepare food" (blue activity logs) in the household's project "serve meals for the family" from a front perspective. Father (left), mother (middle) and son (right).

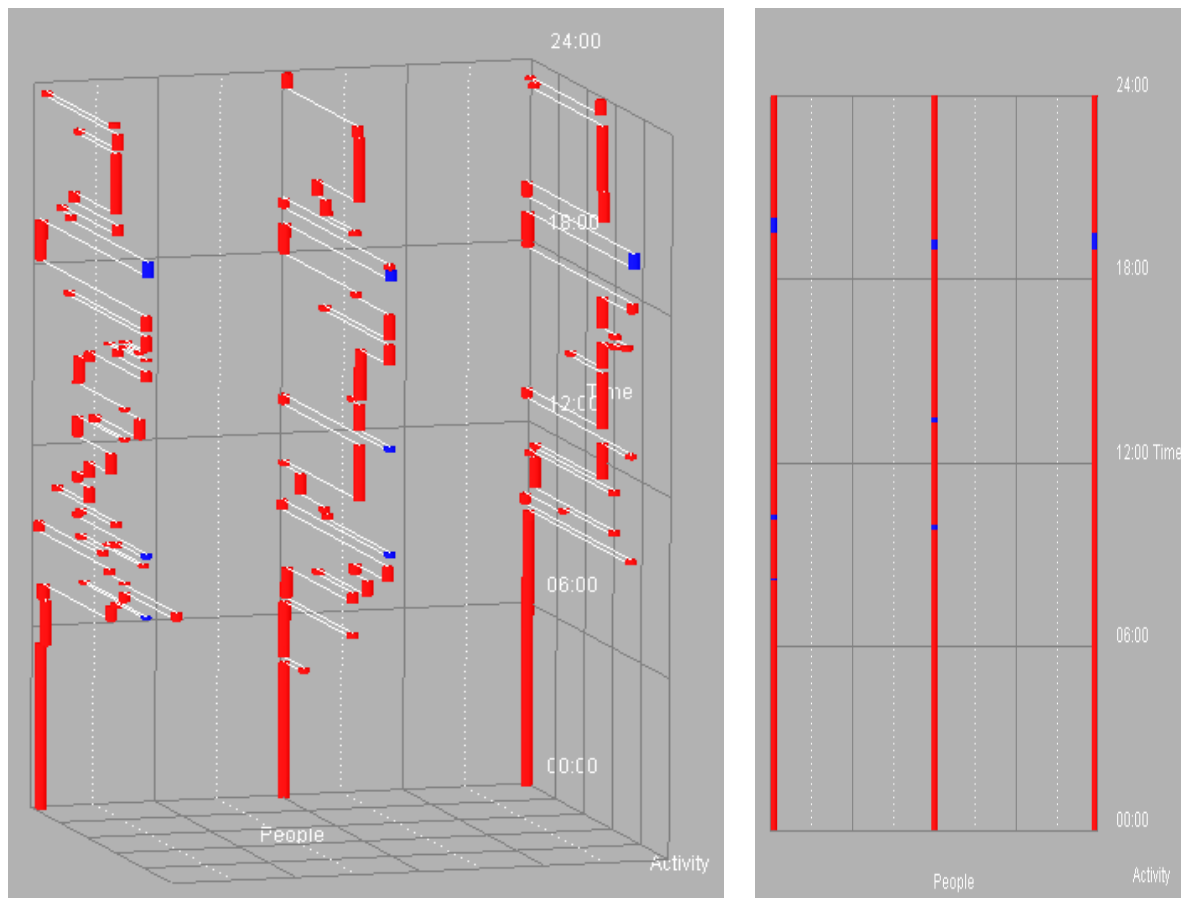
Source: Statistics Sweden, Time Use Diaries Pilot Study (1996), own calculation.

From the everyday contexts of the members of this household, the complete project context is revealed by the appearance of all the different activities contained in the project “serve meals for the family”: when do the activities in the project appear in the everyday contexts and for how long time does each individual perform the various activities in the project? The project context shows that in this family all members are involved in the project "serve meals for the family" and it also shows that this particular day "buying food" is the men's duty. Hence, the family arranges the project according to a co-operative strategy, revealed by the project context.²⁹

To eat the meals served is at a higher level the goal of all the activities performed in the project "serve meals for the family". In figure 8 all "eating" activities performed by the family members are illustrated: breakfast (all three members), lunch (mother and son) and dinner (all the family). However, on this weekend day the individuals eat in a kind of overlapping sequence: the father starts eating breakfast and the son joins him after a while, but the mother starts eating just as the father is finished and the son finishes his eating before the mother.

²⁹ Another household strategy is based on specialisation, which means that one individual perform more or less all activities within a project herself which may be revealed by the project context.

Figure 7 Activity “wash the dishes”



Left. The activity "wash the dishes" in the organizational project "serve meals for the family" of the household. The activity oriented individual paths for father (left), mother (middle) and son (right). The activity "wash the dishes ", shown by blue activity logs, occurs three times during the father's day, three times during the mother's day and once during the course of the son's day.

Right. A front perspective of the activity "wash the dishes" (blue activity logs) in the household's project "serve meals for the family". The occurrences of the activities are indicated with blue activity logs. Father (left), mother (middle) and son (right).

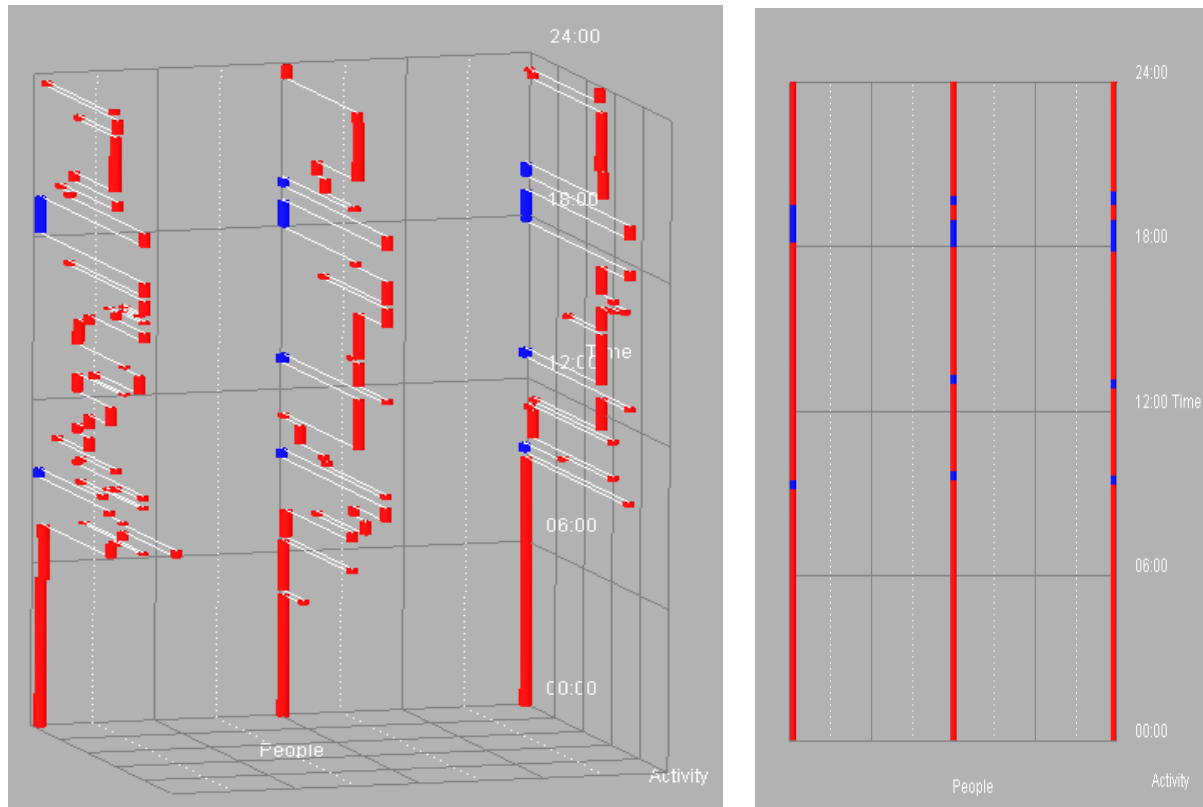
Source: Statistics Sweden, Time Use Diaries Pilot Study (1996), own calculation.

From figure 6 we can see that the son prepared lunch and from figure 8 we can see that he starts eating lunch before his mother comes to the table. The family members start eating dinner at different times, and the activity “eating dinner” occurs twice in the diary of mother and son because they "wash the dishes" before finishing their meal. Probably they have the dessert after "washing the dishes", while the father "washes the dishes" when he has finished his dinner completely. To explain why this pattern is the case interviews are needed. Without the illustration, however, we would not have known that this is their eating pattern, and we would probably not have asked them questions about it.

The example shows how the 3D program can be utilized to illustrate how individuals in a household co-operate and participate in the activities of a basic household project. Now we will

show how these activities are distributed among the individuals in the population of the database during weekend days.

Figure 8 Activity: “eating the meals produced”



Left: The organizational project "serve meals for the family" aims at "eating" the meals produced. This illustration shows when and for how long "eating" activities occur in the everyday context of the three household members. "Eating" is indicated with blue activity logs. Father (left), mother (middle) and son (right). "Eating", shown by blue activity logs, occurs twice during the father's day, four times during the mother's day and four times in the course of the son's day.

Right: When and for how long the family members' "eating" (blue activity logs) activities are performed during the weekend day shown from a front perspective. Father (left), mother (middle) and son (right).

Source: Statistics Sweden, Time Use Diaries Pilot Study (1996), own calculation.

Activities in the project "serve meals" at population level

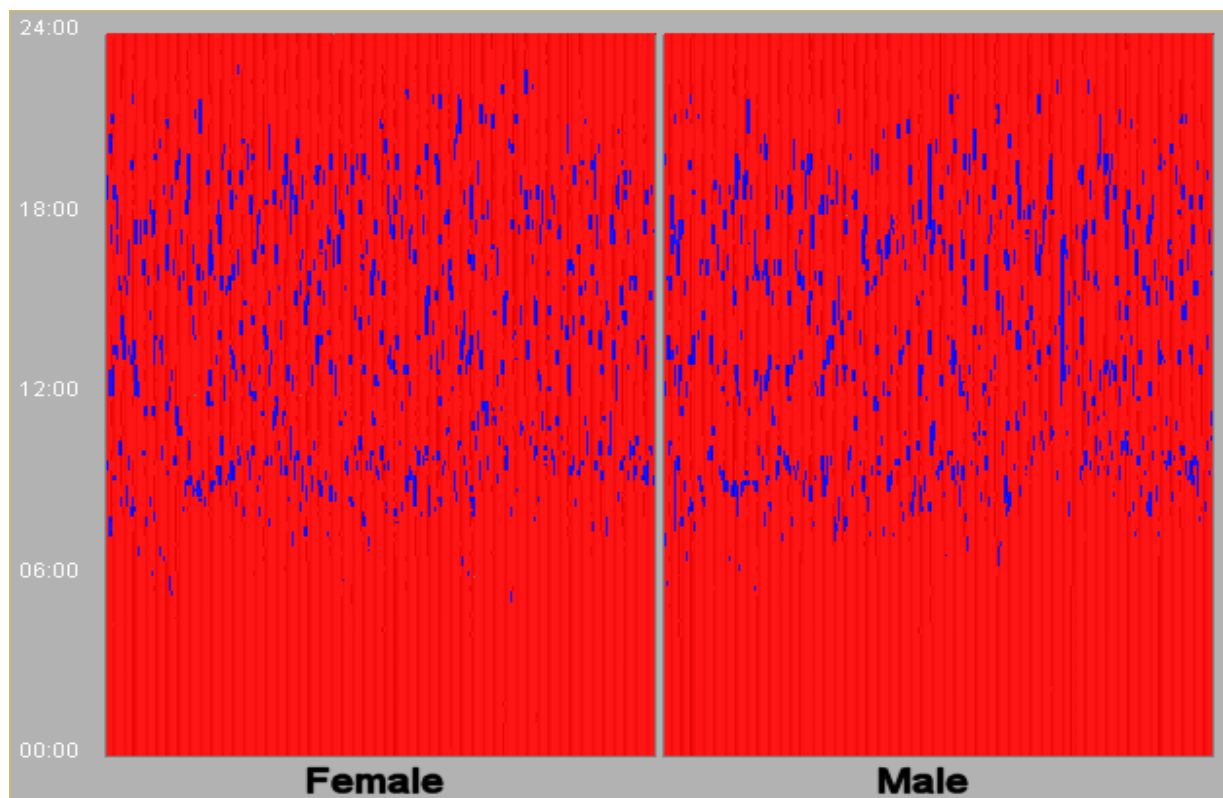
The diaries from weekend days written by individuals in the 179 households in the database are the point of departure in the following section. We will show how the 3D program can be used to visualize the pattern on population level of time use for the activity "eat meals" and for three activities in the project "serve meals" ("buy food", "prepare meals" and "wash the dishes"). Since a visualization of population patterns in three dimensions is difficult to read in a two dimensional medium, we will use the front view perspective of the activity oriented individual paths of the members of the population. Then the blue activity logs for the activity in focus will stand out from the red background of all other activities (compare right part of figures 4-8). An individual's time use may be traced on the y-axis in the diagrams by following a vertical line from the bottom at 00.00 up-wards to the top at 24.00, and the individuals in the population on

the x-axis are ordered by age. We have prepared separate diagrams for men and women to identify gender differences.

In the left part of figure 9 all “eating” activities performed by the women in the population are illustrated as they appear in the course of the day for each one of them. The blue logs show that women’s eating activities have different duration and obviously breakfasts have shorter duration than dinners. Breakfast is eaten by most of the women some time between 08.00 and 11.00. Some women have breakfast very early. There is a tendency showing that girls (left) have breakfast later than older women (right) and that young women eat later in the evenings than girls and older women.

The right part of figure 9 represents the “eating” activities of the men in the population. The pattern resembles that of the women, and the same age related breakfast time pattern is apparent among boys as among girls.

Figure 9 Eating activities for women and men



Left: A front perspective of when and for how long the women in the population in the database use time for "eating" activities during weekend days. "Eating" activities are indicated with blue activity logs. The individuals are ordered by age, girls to the right and oldest to the left. Each individual path is drawn from 00.00 to 24.00.

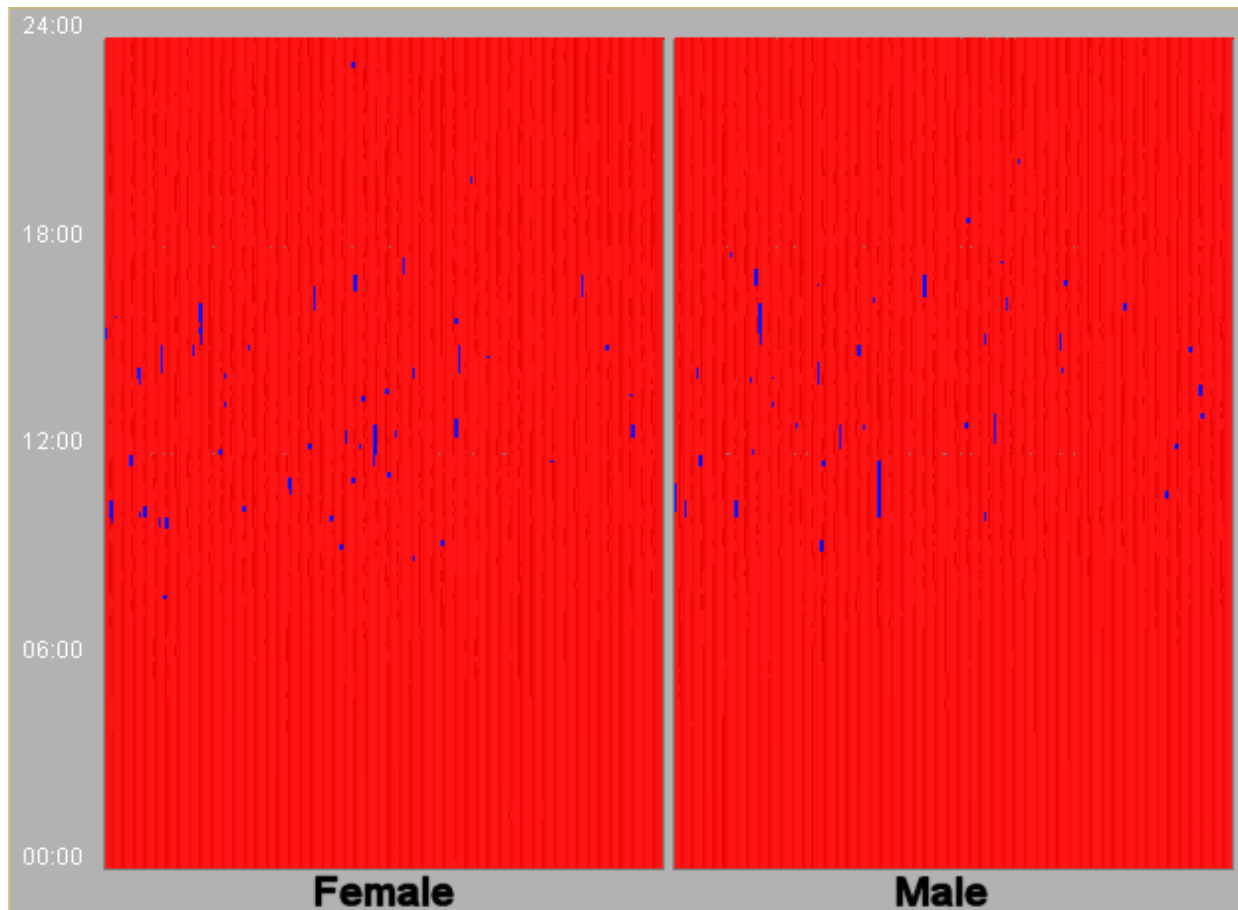
Right: A front perspective of when and for how long the men in the population in the database use time for "eating" activities during weekend days. "Eating" activities are indicated with blue activity logs. The individuals are ordered by age, boys to the right and oldest to the left. Each individual path is drawn from 00.00 to 24.00.

Source: Statistics Sweden, Time Use Diaries Pilot Study (1996), own calculation.

The basic activities of the project “serve meals” from a population perspective are the same as on the household level (“buy food”, “prepare meals” and “wash the dishes”). A scattered pattern appears when the 3D program is asked to represent the activity “buy food” both for the female

part of the population (figure 10 left) for the male part (right). “Buy food” appears mostly in the afternoon, and most of the appearances are quite short in duration on weekend days. There are more occurrences of the activity "buy food" among the women than among the men. One obvious thing is that very few of the youngest individuals (to the right) perform this activity.

Figure 10 Buying activities for women and men



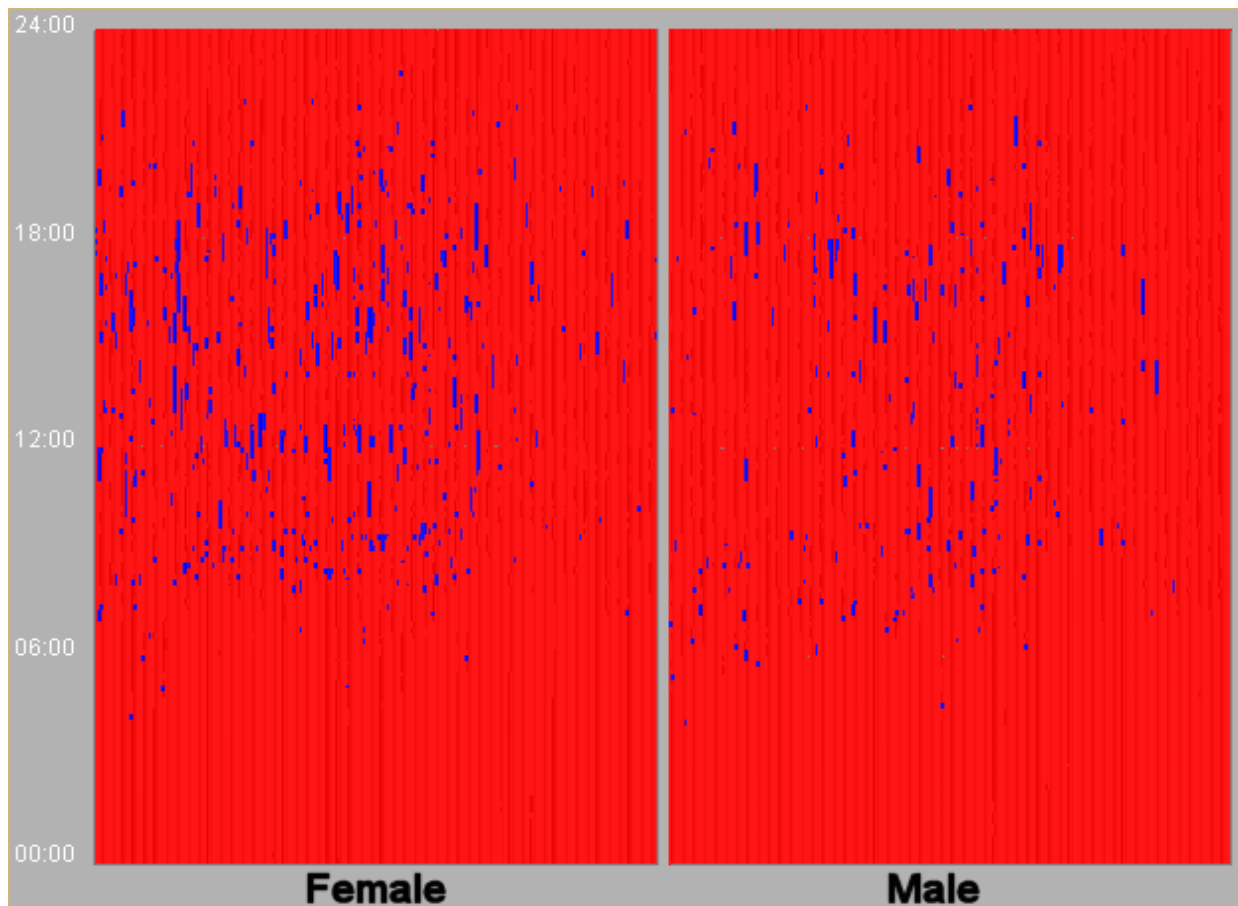
Left: A front perspective of when and for how long the women in the population in the database use time for the activity "buy food", in the project "serve meals", during weekend days. "Buy food" activities are indicated with blue activity logs. The individuals are ordered by age with the girls to the right and the oldest to the left.

Right: A front perspective of when and for how long the men in the population in the database use time for the activity "buy food", in the project "serve meals", during weekend days. "Buy food" activities are indicated with blue activity logs. The individuals are ordered by age with the boys to the right and the oldest to the left.

Source: Statistics Sweden, Time Use Diaries Pilot Study (1996), own calculation.

In figure 11 (women left, men right) the distribution of the activity “prepare food” in the population is illustrated and a clear gender difference appears. It is much more common that women “prepare food” than men doing it on weekend days. There is also an age effect shown in the diagrams. There are not many children (to the right in the diagrams) involved in “preparing food” and older men do “prepare food” more seldom than middle aged men.

Figure 11 Preparing activities for women and men



Left: A front perspective of when and for how long the women in the population in the database use time for the activity "prepare food", in the project "serve meals", during weekend days. "Prepare food" activities are indicated with blue activity logs. The individuals are ordered by age, with the girls to the right and the oldest to the left.

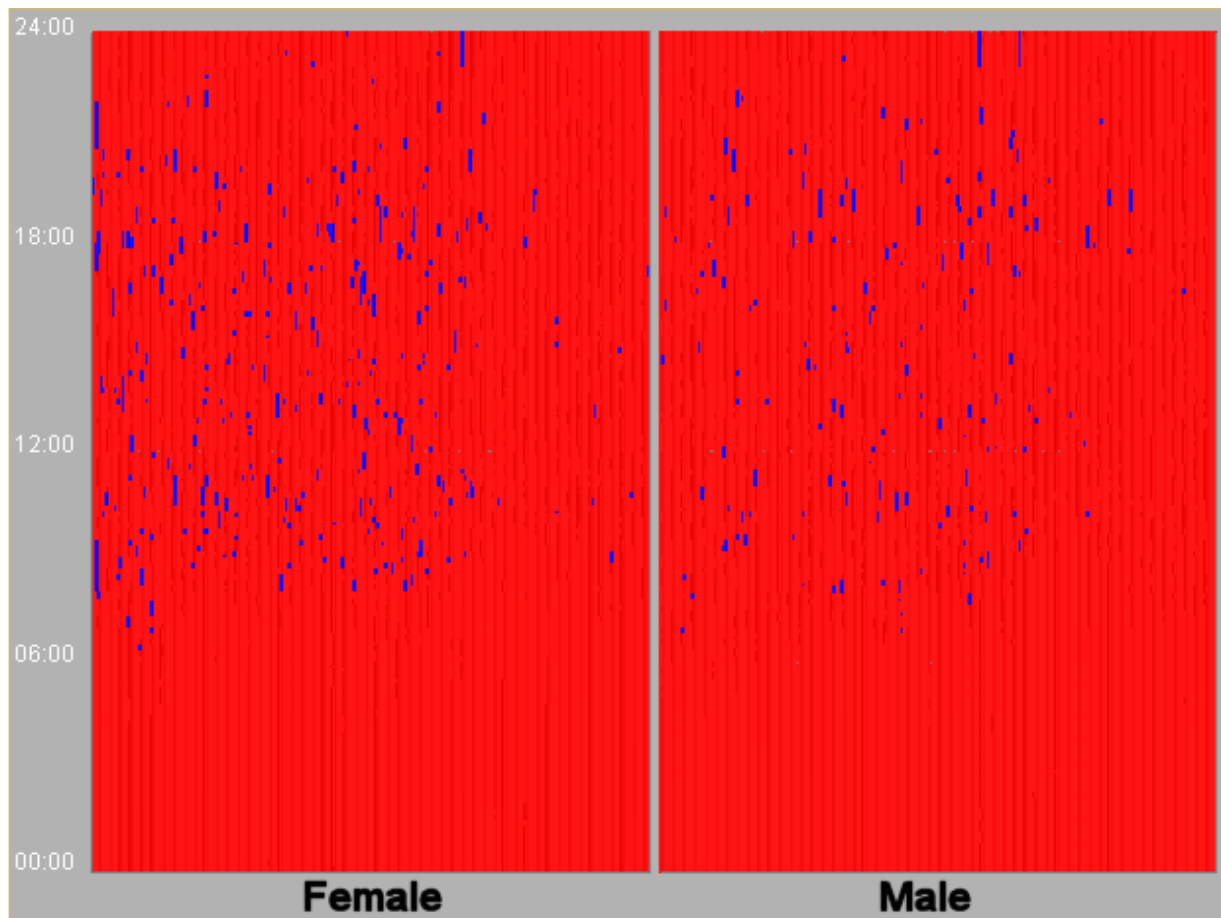
Right: A front perspective of when and for how long the men in the population in the database use time for the activity "prepare food", in the project "serve meals", during weekend days. "Prepare food" activities are indicated with blue activity logs. The individuals are ordered by age, with the boys to the right and the oldest to the left.

Source: Statistics Sweden, Time Use Diaries Pilot Study (1996), own calculation

Figure 12 shows the activity "wash the dishes" in the "serve meal" project as it is spread over the women (left) and men (right) in the populations during weekend days. This pattern resembles that of the activity "prepare meals" shown in figure 11. More women than men are involved, very few children "wash the dishes" and the older men perform this activity to a lesser extent than the middle aged men.

The illustrations of the distribution of activities in the project "serve meals" among the individuals in the population during weekend days show some gender differences. Women "prepare meals" and "wash the dishes" more than men. The youngest individuals of both sexes do not perform these activities very much, and nor do the older men. Middle aged men show a pattern resembling that of women. This generation effect may indicate that within 10 to 20 years the difference between men's and women's participation in this project might disappear.

Figure 12 Washing activities for women and men



Left: A front perspective of when and for how long the women in the population in the database use time for the activity "wash the dishes", in the project "serve meals", during weekend days. "Wash the dishes" activities are indicated with blue activity logs. The individuals are ordered by age, with the girls to the right and the oldest to the left.

Right: A front perspective of when and for how long the men in the population in the database use time for the activity "wash the dishes", in the project "serve meals", during weekend days. "Wash the dishes" activities are indicated with blue activity logs. The individuals are ordered by age, with the boys to the right and the oldest to the left.

Source: Statistics Sweden, Time Use Diaries Pilot Study (1996), own calculation.

Final remarks

This paper gives an overview of how a 3D visualization system based on the time-geographic approach and developed in an interdisciplinary research group, can be utilized to illustrate time-use data from individuals' diaries on individual, household, group and population level. It goes beyond the visualisations introduced by Szalai (1972) since each individual in the population is discernable. It will enable social scientists to come further in the analysis of the complex everyday life of individuals, households, socio-economic groups and populations. Different strategies of division of labour in households may be revealed, like gender inequalities. The distribution of activities among individuals in important everyday projects may be put under

detailed, contextual study. The development of the method is ongoing and many improvements are still to be done. The 3D representations used in this article are static, and do not show the full possibilities of the “live” version of the interactive 3D-program. This is of course unsatisfactory. We hope for comments and that some readers are interested in knowing more about the method and its 3D visualization system.

References

- Allardt, E. (1975), *Att ha, att älska, att vara. Om välfärd i Norden.*, Lund: Argos Förlag AB.
- Åquist, A-C. (1992), *Tidsgeografi i samspel med samhällsteori*, Meddelanden från Lunds Universitets Geografiska Institution No 115, Department of Geography, Lund university, Lund University press.
- Carlestam, G. (1991) Samtal om verklighetens komplexitet, kunskapens och språkets gränser, in: Carlestam, G. & B. Sollbe (eds.), *Om tidens vidd och tingens ordning*, Texter av Torsten Hägerstrand, BFR T21: 1991, Stockholm, Statens råd för byggnadsforskning, 7-18.
- Cooper, M., Ellegård, K., Joanson, H., Ollila, M., Törne, J. & A. Ynnerman (2002), “*The time geography project - using computer graphics to visualize problems in social science*”, presented in Sketches and Applications, SIGGRAPH 2002, San Antonio, U.S.A.
- Ellegård, K. (1975), *Relationer mellan och tidsanvändning hos individer och organisationer. Forskargruppen i kulturgeografisk process- och systemanalys*, Department of Geography, Lund University.
- Ellegård, K. (1993), *Olikadant. Aspekter på tidsanvändningens mångfald*, Occasional Papers 1993: 4, Department of Human and Economic Geography, Göteborg University.
- Ellegård, K. (1994), *Att fånga det förgängliga. Utveckling av en metod för studier av vardagslivets skeenden*, Occasional Papers 1994: 1, Department of Human and Economic Geography, Göteborg University.
- Ellegård, K. (1999a), Contexts of everyday life – a new time-geographical approach to the study of everyday life., in: “*New approaches to the study of everyday life*”, University of Helsinki, Department of Home economics and Craft science, Research Reports, Publications 4, part II, 1-10.
- Ellegård, K. (1999b), A time-geographic approach to the study of everyday life of individuals – a challenge of complexity, in: *GeoJournal*, Vol. 48, No. 3, Special issue on “Actors, activities and the geographical scene, Studies on time-geography, mobility and gender.”, 167-175.
- Ellegård, K. & K. Nordell (1997), *Att byta vanmakt mot egenmakt*, Johansson & Skyttmo Förlag, Lund, Studentlitteratur.
- Forsell, J. (2001) Hushållsproduktion med begränsade resurser: om ekonomisk teori och golvrengöring, in: Ellegård K. & E. Wihlborg (eds.) (2001), *Fånga vardagen: ett tvärvetenskapligt perspektiv*, Lund, Studentlitteratur.
- Giddens, A. (1990), *The consequences of modernity*, Cambridge: Polity (in co-operation with Blackwell).
- Hägerstrand, T. (1961), *Utsikt från Svaneholm*, Svenska turistföreningens Årsskrift 1961, 33-64.
- Hägerstrand, T. (1974), Tidsgeografisk beskrivning. Syfte och postulat, in: *Svensk Geografisk Årsbok nr 50*, 86-94.
- Hägerstrand, T. (1982), Diorama, path and project, in: *TESG (Tijdschrift voor economische en sociale geografie)*, Vol. 73, No. 6, Koninklijk Nederlands Aardrijkskundig Genootschap, 323-339.
- Hägerstrand, T. (1985), Time-geography: focus on the corporeality of man, society and environment. The Science and Praxis of Complexity, reprinted from: *The Science and Praxis of Complexity*, New York: The United Nations University, Tokyo, 193-216.
- Hägerstrand, T. (1991), The landscape as overlapping neighbourhoods. Carl Sauer Memorial Lecture., in Carlestam G. & B. Sollbe (eds.) (1991), *Om tidens vidd och tingens ordning*, Texter av Torsten Hägerstrand, BFR T21: 1991, 47-55.

- Hägerstrand, T. (1993), *Region och natur*, in: NordRefo:1, Stockholm. Nordisk institut for regionalpolitisk forskning, 14-59.
- Hägerstrand, T. & B. Lenntorp (1974), *Samhällsorganisation i tidsgeografiskt perspektiv*, Bilaga 2 ur Ortsbundna levnadsvillkor, SOU 1974: 2.
- Lenntorp, B. (1976), *Paths in space-time environments. A time-geographic study of movement possibilities of individuals*, LXXVII, Lund, Department of Geography, Lund University.
- Lindén, A.-L. (2001), *Allmänhetens miljöpåverkan: energi, mat, resor och socialt liv*, Carlsson: Stockholm.
- Mårtensson, S. (1979), *On the formation of biographies in Space-time environments*, Lund Studies in Geography, Series B Human Geography, LXXXIV, Lund, Department of Geography, Lund University.
- Nordell, K. (2000), *Kan omedvetna begränsningar bli medvetna möjligheter? En tidsgeografisk metodstudie av långtidssjukskrivnas livssammanhang*, Choros 2000: 4, Department of Human and Economic Geography, Göteborg University.
- Nordell, K. (2002), *Kvinnors hälsa – En fråga om medvetenhet, möjligheter och makt. Att öka förståelsen för människors livssammanhang ggenom tidsgeografisk analys*, Department of Human and Economic Geography, Göteborg University, Series B, No. 101.
- Szalai, A. (ed.) (1972), *The use of time: Daily activities of urban and suburban populations in twelve countries*, Publications of the European co-ordination centre for research and documentation in the social sciences, Mouton, The Hague.
- Thompson, P. (1999), *Managing the life process. Everyday life and the hestonian professions*, In: Turku K (ed.), *New approaches to the study of everyday life*, University of Helsinki, Department of Home Economics and Craft Science, Research reports publications 3, part I, 44-53.
- Westermarck, Å. (2003), *Informal livelihoods: Women's biographies and reflections about everyday life. A time geographic analysis in urban Colombia*, Departments of Geography (ed.), Dept of Human and Economic Geography, Goeteborg University, Series B, No. 102.
- <http://www.iser.essex.ac.uk/MTUS/>