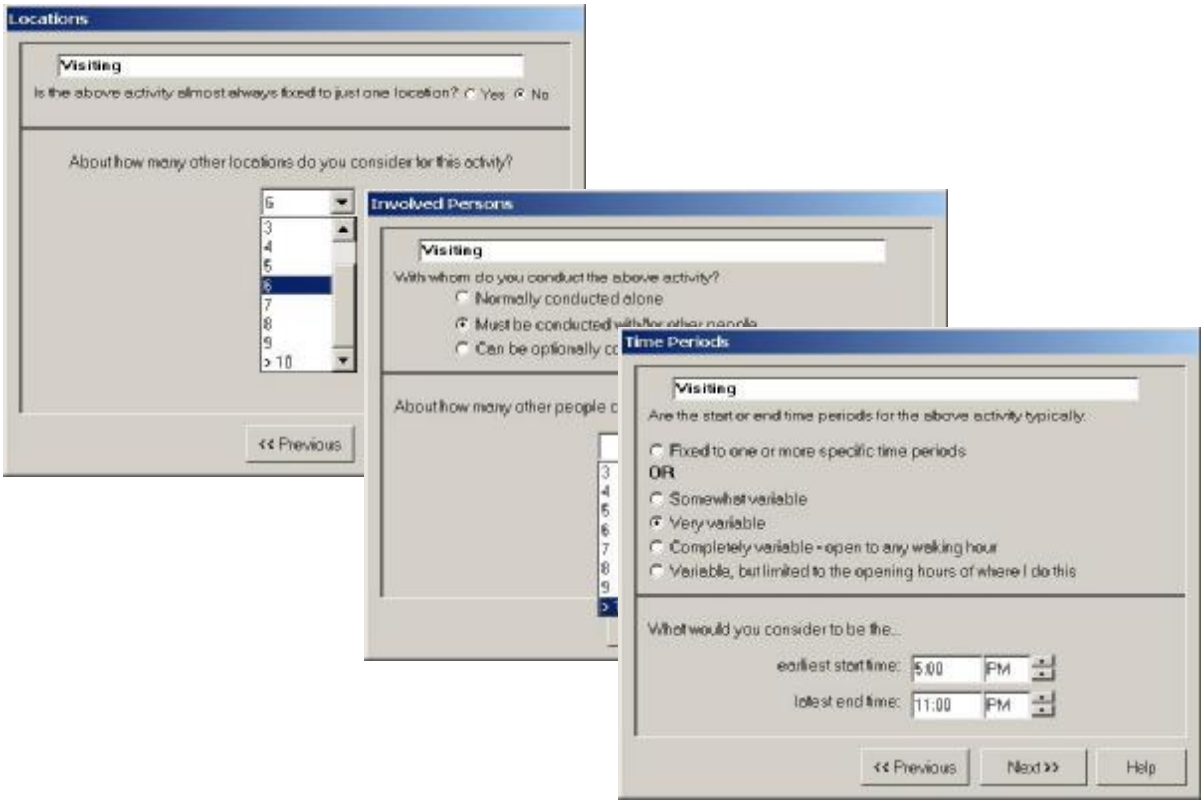

Should we abandon activity type analysis?

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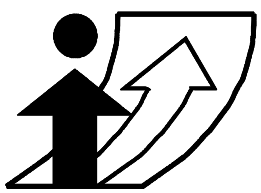
Conference paper
Session 1.2



Moving through nets:
The physical and social dimensions of travel

10th International Conference on Travel Behaviour Research

Lucerne, 10-15. August 2003

Should we abandon activity type analysis?

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Keywords

Activities, attributes, scheduling, International Conference on Travel Behaviour Research, IATBR

Preferred citation

Doherty, S. T. (2003) Should we abandon activity type analysis? Paper presented at the *10th International Conference on Travel Behaviour Research*, Lucerne, August 2003.

Abstract

This paper poses a challenge and begins a search. The challenge is to reconsider the usefulness of traditional activity types ("work", "shopping", etc.) in the understanding and modelling of travel behaviour. The search is for the more salient attributes of activities that serve to better explain complex travel behaviours such as activity scheduling and tour formation. This paper focuses on spatial, temporal, and interpersonal flexibility of the activities. Data from a recent in-depth week-long activity scheduling survey was used to define and compare these attributes. Results show that considerable variability in the attributes between *and* within traditional activity groups is evident. This casts considerable uncertainty on assumptions that statically assign levels of spatial, temporal, and interpersonal flexibility to any given activity type. A Principal Components Analysis was used to further explore several new composite attributes that discriminate amongst activities. Spatial and temporal flexibility were the first and most significant variables to load into the new component. On the question of which is more important, they appeared equally important, followed by the remaining attributes.

The question of *whether we should abandon activity type analysis* represents a potential turning point in the search to explain complex behaviour. Perhaps at most, we could retain activity type in so much as it helps to better measure the "functionality" of an activity. In the least, we need to vastly enhance how we characterize activities if the intent is to model their subsequent scheduling and execution. More ideally, it would seem appropriate to attempt to explicitly model the spatial/temporal flexibility of activities, rather than assume the average or a fixed measure of the attribute for a given activity group. The vision would be that any infinite number of activities could be generated (label them a, b, c, etc.) that have varying levels of each salient attribute. Future research is needed to assess the potential of emerging data collection techniques to meet this demand, and to explore the links between these spatial/temporal attributes and the activity scheduling decision process.

1. Introduction

This paper poses a challenge and begins a search. The challenge is to reconsider the usefulness of traditional activity types ("work", "shopping", etc.) in the understanding and modelling of travel behaviour. The search is for the more *salient attributes of activities* that serve to better explain complex travel behaviours, such as trip chaining, activity-travel scheduling, and household task allocation. A wide range of activity attributes can be envisioned. This paper focuses on spatial, temporal, and interpersonal *flexibility* of the activities that underlie travel. Although such attributes have been proposed in the past as holding considerable promise in explaining complex travel behaviours, they have gone largely unmeasured. Instead, they have largely been *assumed* to be associated with specific activity types – just as when "work" is assumed to be fixed or mandatory in time and space and "shopping" is assumed to be more flexible on all accounts. So engrained in our approach are these assumptions, that activity type is almost taken as a given in all data collection, analysis and modelling.

The motivation for this paper concerns the growing inadequacy of such assumptions. A much greater degree of variability in spatial, temporal and interpersonal flexibility likely exists for the same activity across different people, cultures, or situations. A variety of examples can easily illustrate this point. Consider how "work" differs for a traditional 9-5 employee versus a telecommuter. Alternatively, consider how shopping for food for your family differs from browsing for new cloths. Clearly, some very significant differences in spatial, temporal and interpersonal flexibility exist for these activities – difference that is simply un-captured via traditional static assumption by broad activity type categories. Now consider how such activities will differ even more cross-culturally, for those in a small versus large city, for males versus females, etc.

These differences are likely to continue changing over time, as new technological changes and other trends continue to blur the lines between flexible/fixed activity types. The implications for travel behaviour modelling and forecasting are significant – if their goal is to replicate the complexities of travel behaviour decision making, then implicit static assignment of spatial/temporal/interpersonal attributes by activity type is most likely to hamper the behavioural validity of such models.

One approach to this problem is to abandon the use of activity type labels in favour of identifying and explicitly measuring those salient attributes of activities that make them unique and explain resulting complex observed patterns of behaviours. Of course, it is always more useful to pose such a challenge and potential solution with the prospect of an available dataset from which to move forward. This paper utilizes evidence from a recent survey of 444 individuals who completed an individual-depth computerized one-week activity scheduling survey in Toronto from 2002-2003. The survey included queries for a vast array of activity attributes. At this early stage in our understanding, the analytical focus of this paper is very much on exploration of this data, including examination of the distribution and variability of spatial/temporal/interpersonal flexibility (and other attributes including frequency, duration, and location) across activity types and the identification of clustering of activity types on these attributes. The overall goal is to assess the relative importance/salience of each attribute, and explore the notion that like activity types share homogeneous attributes.

2. Background

The last several decades have seen a dramatic paradigm shift from trip to activity-based analysis of travel behaviour. Proponents of this shift have argued that a complete understanding of travel cannot be had without examination of the activities that give rise to the need for travel. The dominant conceptual approach to understanding activity patterns focuses on the notion of space-time prisms or paths, as originally proposed by Hägerstrand (1970). A person's daily activity and travel pattern is conceptualized as a sequence of activities over space (in two dimensions), and time (as a third dimension), governed by opportunities and a variety of capability, coupling, authoritative constraints.

Despite the paradigm shift, there has been relatively little attempt to explore new data collection and modelling methods unique to the problem. The majority of data collection continues to focus on "diary" based methods, and models are largely dominated by random utility-maximization approaches. Important questions concerning ***how*** activity patterns are derived and ***how*** they change have remained largely unexplored. As a result, most researchers use functional activity types (work, school, shop, leisure, etc.) as a preliminary, if not primary, means to explain when and how activities patterns are formed. For example, "work" is often assumed to be fixed in space and time, and thus assumed to be high "priority" and/or assumed planned/modelled first in emerging trip chain (e.g. Kitamura *et al.* 2000), tour (e.g. Bowman and Ben-Akiva 2001) and activity scheduling models (e.g. Arentze and Timmermans 2000).

In revisiting the original roots of the activity-based approach, there appears to be several key concepts that have been largely over-looked, including the basic concepts of activities, their attributes, and what gives rise to observed activity patterns. In particular, the pioneering work of Cullen and Godson (1975) appears very relevant here. They were the first to ask "How do space-time paths come about?", stressing the importance of attributes of activities, ***not just their function*** (as indicated by the activity type), that effect the "priority" of activities and their subsequent planning and execution. These attributes included: fixity in time and space of the activity; financial importance; presence of certain other participants; special ordering considerations due to "projects"; and preferences of individuals. They also recognized that activities have varying degrees of planning that are affected by these attributes, including: arranged joint activities; planned activities (need not involve others); routine activities; and unexpected events. Taken together, they largely set the stage for recognition that a *scheduling process* exists, although such concepts have been largely ignored in data collection and modelling frameworks

Building on these early principles, this paper argues for an abandoning of the use of traditional activity types (work, school, shopping, etc.) in the modelling of travel behaviour, save perhaps only for the convenience of data collection (so that people can associate a label with a given unique activity), interpretation during analysis, or for their possible use in defining the functionality of an activity more specifically. Much discussion (but little measurement) in the literature has focussed on spatial and temporal flexibility of activities as key dimensions – i.e. the degree to which activities could take place at different locations and at different times, or alternatively the degree to which they are fixed to a specific location at a specific time. To a similar extend, interpersonal flexibility could also considered – i.e. the degree to which activities could optionally take place with different people, or alternatively the degree to which an activity must be conduct with or for other people. A range of other familiar attributes could also be explored, include frequency, duration, and location. The "functionality" of an activity is also a key dimension – what underlying function (or combination thereof) does an activity really support, beyond

what is implied by the activity type alone. The "resource requirements" of an activity are likely also to be key factor, including not only time commitment, but the financial, travel, emotional, etc. resources required of the activity.

3. Objectives

The analytical focus of this paper is very much on data exploration, including two key contributions:

1. Examination of the distribution of spatial/temporal/interpersonal flexibility across activity types, and comparison to the other attributes such as duration, frequency, involve persons, and location.

2. Identification of clustering of activity types on this combined set attributes.

The overall goal is to assess the relative importance of each attribute in defining activities, and explore the notion that like activity types share homogenous attributes. Through this analysis, identification of potentially new categories of activities (via Principal Components Analysis) that are free of traditional generic activity labels will be made. These new components will consist of clusters of characteristics that may hold potential in better explain how activities are subsequently scheduled and executed leading to observed patterns of travel behaviour.

4. Methods

4.1 Survey Design

This paper utilizes evidence from a recent survey of 444 individuals from 270 households who completed an individual-depth computerized one-week activity scheduling survey from April 2002 to May 2003. Subjects were recruited from a range of sub-regions within the Greater Toronto Area, including Mississauga, Etobicoke, York, North York, East York, Vaughn, Richmond Hill, Markham, Scarborough, Pickering as well as the central/metro Toronto area. Four interviewers were assigned to these regions of the city. A random list of household phone numbers and addresses was obtained, and recruitment performed via telephone. Of the 1070 households successfully contacted, 270 agreed to participate, representing an effective response rate of 25.2% - deemed quite reasonable given the level of commitment involved in the study. It should be noted that an additional 490 households (not included in this calculation) could not be reached via telephone for a variety of reasons, including an inability to make contact after six call backs, phone numbers that were actually fax numbers, or number that were no longer in service.

Those whom agreed were visited by an interviewer, and an initial set up interview was conducted lasting approximately 45 minutes. This interviewers recorded standard socio-demographic information, followed by the systematic probing of the types of travel modes used, the names of potential involved persons, and a thorough list of activity types likely to be conducted over the coming week. The range of activity groups and generic activity types probed for is shown in Table 5. In most cases, the labels assigned to a given activity category would have been in the words of the respondent (e.g. "Playing hockey with my buddies"), whereas for analysis purpose,

the activity was assigned a generic label (e.g. "Active sports"). In most cases, these labels were assigned during the upfront interview, but in cases where new activities were defined during the study week by subjects, generic labels were assigned after-the-fact. During the interview, interviewers entered all information directly into a database via custom designed forms. Much of this information was subsequently utilized by the activity scheduling survey software to follow.

After the interview, participants were given the use of a laptop computer for a week in which they were to keep an on-going record of their scheduling behaviour, starting on a chosen day of the week (which varied). This was accomplished using the CHASE (Computerized Household Scheduling Elicitor) survey software program. CHASE was originally by Doherty and Miller (2000), and has spawned several related studies in the U.S. (Lee and McNally 2001) and in Germany (Kreitz 2002; Rindsfüser *et al.* 2003). Enhancements for the Toronto sample included the ability to start on any day of the week, improved prompts, the ability to capture multiple modes, querying of involved persons by name and relationship, as well as several other improvements (see Doherty 2002 for more details). Interviewers demonstrated the program to subjects, and left a short manual in the home for further reference.

The main scheduling interface as shown in Figure 1 depicts the days across the top, and time along the left, in a typically calendar-type format. Users are asked to login to the program preferably every day, and do the following:

- ✓ On the first night, add activities anywhere in your schedule that you have already planned or thought about doing before logging on to the computer – meaning those activities for which you have at least tentatively planned the day, time, location, and involved persons.
- ✓ On subsequent days, continue to:
  - ✓ Add new activities to future scheduling days
  - ✓ Review future planned activities and update/modify/delete them according to further changes or refinements in your plans
  - ✓ Review past time periods and modifying/delete them to reflect what actually occurred.
- ✓ *Remember* each preplanned activity, modification, or deletion entered by you is *recorded by the computer*, and is of extreme value to the research team – i.e. we are interested in how you put your life together and how it changes, as well what you actually do.
- ✓ Include all activities that last longer than 10 minutes. The exception is for activities involving travel – include all of these, regardless of how long they take (e.g. dry cleaning stop; dropping off kids).

Scheduling activities involved selecting a box on screen and choosing the "add" command, which was followed by the presentation of the dialog box shown in Figure 1. This dialog queried for 11 attributes of observed activities, including:

1. Activity group
2. Activity specific type
3. Location (by address or nearest intersection)
4. Mode of travel *to* the activity, if any (up to 3 modes)
5. Start time of travel, if any (for each of up to 3 modes)
6. # passengers (if auto mode)
7. Activity start time
8. Activity end time
9. Activity day
10. Involved persons (up to 6, by name and relationship)
11. Children under care at the time (up to 6, by name and relationship; for parents and select activities only)

Additional prompts (not analyzed in this paper) may have immediately followed this main prompts to query for information such as when the activity was planned (or when modified), why it was modified, and what types of telecommunications may have been involved. The main screen shown in Figure 1 also shows the other main scheduling options, including modifying and deleting activities.

One of the most important enhancements to CHASE for this paper was the addition of an "end-of-week review" (EWR) that followed completed of the survey week. The purposes of this review was to systemically query subjects concerning the general attributes of the types of activities that the person performed during the week, including the spatial, temporal and interpersonal flexibility of activities, as well as normal durations and frequencies. This was accomplished by presenting the user with the series of dialog boxes shown in Figure 2, for each main activity type observed during the week. Note especially, that these questions concerned the type of activity and the users "stated" attributes concerning this activity type, not each individual occurrence of the said activity (thus, if "work at the office" was observed 5 times, it was queried for only once in the EWR)

Following completion of the survey, subjects were visited in order to retrieve laptops computers and present the household with a gift valued at approximately $20 as a sign of gratitude for their participation.

Overall, what makes CHASE unique is the ability to trace both the underlying decisions process (adding, modify, and deleting of activities over time and space), as well as the observed outcome of this process in the form of activity and travel patterns, over a multi-day period as they occur. Past studies have shown that the CHASE approach is able to capture a high degree of detail with a reasonable respondent burden – about 15-20 minutes per day (Doherty and Miller 2000). The combination of survey techniques utilized for this study – multi-day diary; multi-day activity scheduling survey; end-of-week and stated attribute survey – go a long way in demonstrating that, contrary to earlier doubts (e.g. (Axhausen 1998), we can indeed consistently obtain a wider array of data from people than previous thought possible. That's not to say that such data doesn't come at a price – both in

terms of field costs and respondent burden - but when weighed against the opportunities it allows for analysis, such efforts are well justified, especially for relatively modest sample sizes.

4.2 The sample

Of the 444 individuals in the sample (from 270 households), sixteen of teen age were excluded from analysis in this paper, limiting the sample to adults-only. A further 42 individuals (including 12 whole households) were excluded as a result of missing or obviously poor quality data. The final dataset included 398 adults from 258 households.

The types of households in the sample varied from those with just one adult, to those with 2 adults plus a variety of children and other adults, as shown in Table 1. The types of individuals in the sample included 89 single adults, 275 adults in partnerships, 28 adult children, and 6 other adults with varying status living in a larger household.

4.3 Activities and their Attributes

The 398 adults in the sample yielded a total of 7915 *unique* types of activities conducted during the study week which form the units of analysis for this paper. The average frequency of these activities was 4.03 per week (the total number of observed activities during the study weeks was thus 32,923). The activities were generically classified into 10 main activity groups, with 3-7 specific types in each group (52 specific types in total), as shown in Table 5.

The exploratory factors included a set of flexibility-related variables along with several traditional attributes described below. Each of these attributes required careful consideration during data collection and preparation.

'Frequency per week (average)': derived directly from the EWR prompt in Figure 2 a), unless the observed frequency of the activity was 4 or more during the study week – in which case, it was set to the observed frequency.

'Average Duration (minutes)': derived directly from the EWR prompt in Figure 2 b), unless the observed frequency of the activity was 4 or more – in which case, average duration was based on the average of the durations of the observed instances of the activity during the study week.

'Temporal flexibility indicator': this value ranges from 0 to 1, with values close to 0 indicative of activities fixed in time, and values close to 1 very flexible in time (see also, Figure 4 for distribution). Values were calculated as the divisor of average duration (from above) by the duration of the time window that the activity could occur in. The duration of the time window was calculated as the difference between the earliest and latest end time of the activity as derived from the prompt Figure 2 d) for activities that subjects indicate were "somewhat variable" and "very variable" (see also, Figure 3 for the frequency of response to each item). In the case "Completely variable – open to any waking hour", the duration of the time window was taken as 18 hours. The average durations divided by these constants produced values specific to each activity. In the case of "Variable, but limited to the opening hours of where I do this", the window was taken as 10 hours. For activities selected as "Fixed to one or more specific time periods", the value of the flexibility indicator was set to 0.95. Defining temporal flexibility in this matter (as an indicator) was deemed more reflective of the actual temporal flexibility of activities than what

the prompt in Figure 2 d) provided alone, since it incorporates the notion that higher duration activities are less flexible than shorter activities given the same time window of opportunity.

'Spatial flexibility': measured as the number of locations considered for this activity, wherein a value of 1 indicates that it is highly fixed (to just one location), and higher values indicating greater level of flexibility in space (see also, Figure 5 for distribution). Responses from Figure 2 c) were used to calculate this value. The number of locations associated with very obvious activity types were taken as given, such as the case with household activities that occur only in one location (the home).

'Duration fixity indicator': this value ranges from 0 on up, with values close to zero indicative of activities with a high degree of duration flexibility, values close to 1.0 a modest amount of duration flexibility, and value greater than one a higher degree of duration fixity (see also, Figure 6 for distribution). Indicator values are calculated as the divisor of the average duration by the difference between maximum duration and minimum duration, based on duration values from the dialog in Figure 2 b). Activities with durations that subjects indicated did not vary were assigned a value of '0' for this indicator by default.

'Interpersonal flexibility': is a binary indicator variable that takes on the value of 0 if the activity "must be conducted with/for other people", and a value of 1 if it is "normally conducted alone" or "optionally conducted with/for other people", based on response to the query in Figure 2 e). Of the 7915 activities, 21.1% were considered to have to be conducted with/for other people, whereas 78.9% were alone or optionally conducted with/for others. In certain obvious cases (e.g. dropping-off children), the value of this indicator was assigned by default.

'Involved persons (average)': taken as the average number of involved persons for all observed instances of the given activity. Hence, partial values between 0 and 1 are possible, but generally this ranged from 0 to 6, as shown in Figure 7.

'Location': a binary indicator variable equal to zero if the activity type was observed exclusively in the home, or set to 1 if the activity type was observed out-of-the home. Overall, 51.6% of the 7915 activities occurred only in the home, with 47.4% occurring out of the home.

4.4 Analytical techniques

Two main analytical techniques were utilized in this paper to explore the data, using the statistical software SPSS (version 11.5). Initially, basic frequency counts and graphs were used to examine the overall distribution of the activity attribute variables. Kruskal-Wallis H (KWH) tests were then used to determine whether the values of such attributes differed significantly across activity groups, and between specific activity types within each group. This addresses the question of whether traditional activity labels, even those as detailed as that captured in this study, share stable attributes, or whether significant differences exist. The KWH test is the non-parametric equivalent of a one-way analysis of variance and detects differences in distributions. It was chosen in response to the binary nature of several variables, and in reaction to the non-normal distribution of the remaining activity attributes (as shown in shown in Figure 3 through Figure 7). The KWH test outputs the mean rank of each variable, which can then be compared across categories for interpretive purposes (with higher mean ranks analogous to higher average values in an ANOVA analysis). Mean ranks are essentially derived by ordering all records (as many as 7915), followed by derivations of the average of the ranks of each record belong to a given

activity category. A χ^2 test statistics is used to test the significance of the differences in mean ranks across all categories. To further assess the degree of variability (if any) between categories, the range of the mean ranks was calculated. Furthermore, the rank of the "mean rank" was also calculated post-hoc to assist in differentiating categories more easily – for comparisons across the 10 activity groups, these latter rankings will range from 1 to 10, with 10 being the highest mean rank.

A Principle Components Analysis (PCA) was then conducted to explore the interrelationships among the activity attribute variables, and to define several new combined indicators of activity type. PCA is a factor extraction method involved in Factor Analysis. It is used to form uncorrelated linear combinations of the observed variables into several new combined "components" – themselves, useful as new combined indicator variable. The first component has maximum variance, whereas successive components explain decreasing amounts of variance. All extracted components are uncorrelated with each other. Although PCA technically requires interval-level data due to its reliance on correlation matrices, ordinal and binary-level variables are generally accepted when the underlying correlations amount variables are expected to be moderate (less than 0.70), and the analysis is of an exploratory nature (McDade and Adair 2001). Both these conditions apply to the analysis in this paper.

The output of PCA shows the number of underlying components, the % variance explained by each component, and the loadings for each variable on that particular component. Loadings larger than +4.0 or smaller than -0.40 are considered most dominant in the given component. What variables load first, and what variable have the highest loadings, can be considered more significant. The combination of variables in each component may also have a conceptual interpretation. Component "scores" can then be calculated and treated as a new variable for subsequent analysis (regression was used as the method for calculating the scores). In particular, the component scores provide a single value that can be used to characterize each original activity with respect to the new component variable. Component scores are standardized with a mean of zero and standard deviation of one. Analysis of the mean scores across activity types can be used to further address the issue of whether like activity types are strongly associated with a the new components (by looking for high average values). Although factor analysis rotation can be deployed to increase the chances of obtaining more easily interpretation components, they had little to no effect on the results in this study when tested, and were thus not employed.

5. Results

5.1 Descriptive analysis

Of fundamental interest to this paper are the basic distributions for the activity attribute variables, especially those related to flexibility, which have largely gone unobserved in past studies. The 'temporal flexibility' indicator, as shown in Figure 4, is highly skewed at the extremes, reflecting the notion that that large sets of activities are considered to be either fixed in time, or completely flexible. In contrast, the 'Spatial flexibility' indicator appears to be gradually skewed to the right as shown in Figure 5, save for a drastic spike in the number of activities (80.3%) considered to fixed to just one location. Duration fixity appears to have a somewhat more normal distribution as shown in Figure 6, but again has a spike at the origin that reflects a high number of very flexible durations. The distribution of (actively) involved persons is skewed to the right as well, with the majority of activities occurring alone, followed decreasing frequencies of 1 or more involved persons, as shown in Figure 7.

Equally valuable is an examination of how such distributions differ between and within various activity groups. Table 2 presents the results of the KWH tests for differences in the distribution of the various activity attributes by the 10 main activity groups. The differences across activity groups for all attributes were significant at the 0.000 level. Thus, it appears that considerable variation in flexibility, involved persons, average duration and frequency exists between the 10 traditional activity type groups. These differences are particularly acute for duration, frequency, and involved persons, whereas the flexibility indicators (temporal, spatial, and duration) are less variable as indicated by the range of mean ranks. Many of the differences conform to expectations. For instance, work/school, night sleep, and entertainment tend to have the highest ranked durations compared to drop-off/pick-up, services, and meals. Similarly, household obligations, meals, and night sleep tend to be highly flexible in time, whereas work/school, active recreation, and services tend to be more fixed in time. Similar analysis can be made for spatial flexibility (shopping, social and meals are spatially flexible, whereas household obligations and night sleep are not), and other variables.

To a similar extent, the distribution of the binary activity attribute variables interpersonal flexibility and location also differed significantly by activity group type when tested using cross-tabulation and related χ^2 statistic, as shown in Table 3 and Table 4. In particular, drop-off/pick-up and social activities exhibited a much higher degree of interpersonal fixity (as expected). The location where various activity groups are conducted (in versus out-of-home) also exhibited some expected differences. More interesting were those activity group types that occur both in and out-of-home, including work, social and entertainment acts.

Whilst differences across major activity group is somewhat as expected, the same may not be true of activities within the same group. The analysis above was repeated separately for those activities within each activity group - resulting in comparison of six attributes across 10 activity groups, with 3-7 specific types within each group (52 specific types in total). Results are summarized in Table 5. Of the 60 possible KWH tests, only 9 were statistically *in*significantly ($p>0.01$), four of which were associated with one particular activity group (active recreation). This provides strong evidence that activities even of the same traditional activity group exhibit considerably variable in the temporal, spatial flexibility, as well as classic difference in average duration, involved persons and frequencies. There are many possible examples to draw upon from the table. Within the meals category, in-home meals differ significantly from restaurants and bagged lunch meals in terms of spatial and temporal flexibility. Within the work category, telework is clearly much different from work, which is clearly much different from school. Different types of shopping on the other had tended to have varying temporal flexibilities, but no significant differences in spatial flexibility. All entertainment and social activities differed significantly on all dimensions. A similar analysis of the binary variables location and interpersonal flexibility was also conducted, leading to the discovery of similarly significant differences within most activity group categories.

5.2 Principal Components Analysis

Two types of PCA are presented in this paper – one for all activities, and one for out-of-home activities only. This was done for two main reasons – firstly, the database contains a large number of in-home activities (such as night sleep and wash/dress/pack/snacks) that by their nature are very frequent, and may inadvertently overshadow comparisons of activities. Secondly, a special focus on out-of-home activities is reflective of our desire to better understanding travel.

Results of the PCA of all activities are presented in Table 6. Three of the components meet the general requirement that eigenvalues be greater than 1.0. The first component, explaining 27.4% of the variance, has six variables that load significantly upon it. It is characterized by high spatial flexibility, yet low temporal and interpersonal flexibility (or alternatively, high temporal and interpersonal fixity). This group also tends to have a high number of involved persons, low frequency, and strong tendency to occur out-of-the home. Examining the mean factor scores in Table 8 by activity type reveals that this component tends to be characterized by a wide range of social events such as visiting, planned social events, and special clubs, but also several other activities in other categories, including restaurants, drop-off/picking people, and spectator events. Perhaps conceptually, this component could be desired as "planned out of home social events at a variety of locations".

The second component explains 15.5% of the variance, and has three contributing variables with high loading – high spatial flexibility (as before), but also high temporal and duration flexibility, with no other obvious defining characteristics. Unlike the previous component, the mean factor scores in Table 8 do not yield any obvious activities associated with this component. Conceptually, this component could be described as "highly flexible in space and time". The third component explains 14% of the variance and has one main variable that loads heavily upon it – average duration. Activities such as night sleep, attending to children, and hosting visitors exhibited high mean factor scores on this component as seen in Table 8. Consequently, this component could simply by characterized as "High duration".

Overall, these results suggest that temporal and spatial flexibility variables do indeed appear to be equally important factors in discriminating activities, as evidenced by their frequent and early loadings in the components beyond other factors. Additional attributes such as impersonal flexibility, and involve persons also play a significant by somewhat secondary role. It is interesting to note that average duration by itself did not load heavily until the 3rd and 4th component, whereas when embodied in the calculation of temporal and duration flexibility (as the numerator), it becomes a much more significant factor. It is also interesting to note that the mean factor scores in Table 8 for many activity types and groups are relatively low and quite variable (as indicated by the standard deviations), such as the case with shopping activities.

The fact that location had the highest (positive) loading of all the factors in the PCA above, lends further support to specification of a supplemental PCA limited to out-of-home activities. Such an analysis is presented in Table 7 and Table 9. The principal components in this case are more distinctly characterized, whereas the factors scores are not as distinctly associated with any given number of activity types (at least not to the same extent as PCA 1 in the previous model). The first component is clearly distinguished as having a high degree of spatial and temporal flexibility, whereas the second has a high degree of interpersonal flexibility and tends to involve few persons and have low durations. The first and second components explain roughly the same amount of variance. The third component is much like that of the previous model, being characterized by high duration and frequency. Thus, overall, each attribute played a significant role in just one component, accounting for relatively similar amounts of the overall variance.

6. Discussion and conclusions

The results presented in this paper strongly suggest that considerable uncertainty should be associated with assigning static levels of spatial, temporal, and interpersonal flexibility to any given activity type. Even the new principal components elicited from the data, with such labels as "highly flexible", "planned out of home events", and "high duration, high frequency activities", themselves did not tend to associate strongly with any particular activity type or category, and instead varied widely throughout activity groups. On the question of which is more important, it appears that spatial and temporal flexibility are equally the most important, followed by the remaining attributes.

Should we abandon activity type analysis? Perhaps at most, we could retain activity type in so much as it helps to better measure the "functionality" of an activity, or at least organize activities into a list. In the least, we need to vastly improve how we characterize activities if the intent is to model their subsequent scheduling and execution (as in the analysis of PCAs). More ideally, we need to explicitly model several new dimensions of activities, rather than assume the "average" or a fixed measure of the attribute for a given activity group. The distributions of each attribute exhibit several interesting trends that most modellers would likely have suggestions for – from use of Poisson or negative binomial for discrete attributes such as spatial flexibility, and location, to logarithmic transformations for duration and frequency, to a Tobit model for temporal and duration flexibility indicators (given the high degree of censuring at the extremes). Instead of listing out activities by discrete types, the vision would be that any infinite number of activities could be generated (label them a, b, c, etc.) that have varying levels of each salient attribute – perhaps via a microsimulation.

In support of such modelling efforts, the results of this paper do lend promise to the future provisions of data that captures the salient attributes of activities, albeit the use of emerging new technologies that attempt to ease respondent burden allowing more in-depth exploration. Whilst more expensive than traditional diaries, continued advances in internet and computerized surveys, hand-held computers, and passive tracing technologies (such as Global Positioning Systems), offer continued promise for such technique in providing adequate data for model development of this sort. This addresses many early concerns, such as that raised by Axhausen (1998) that it is difficult to obtain all the data we need consistently from one person.

From a policy perspective, an argument for renewed focus on activity attributes is even more important for forecasting the effects of emerging vehicle-reduction policies such as car-sharing and telework that inherently change the attributes of activities (e.g. telework making work more temporally flexible) and not necessarily the activity type distribution. What other types of emerging policies and trends will serve to continue to blur the lines between traditional activity types should also be of concern. For instance, growing use of telecommunications is blurring the traditional notion that "work" is fixed to one location, specific times, frequencies, durations, etc. This in turn, naturally effects how work is "prioritized" in a given persons schedule, both for preplanning and for later modifications, substantially effecting how other activities are planned, executed, and realized (including the implications for travel).

In terms of future research, I would suggest foremost that a more definite link be made between the activity attributes explored in this paper, and their impact on the activity scheduling decisions process. For instance, how do the various notions of activity flexibility effect when activities are planned and how they are modified?

When and how do more traditional attributes such as frequencies, duration and location interact in this process? And finally, what role to individual and household characteristics play in this process – have we reached a level of measurement of activity attributes that is stable enough across different people, or do individual and cultural differences play a role? Clearly, if activity analysis is to succeed, we simply must begin to identify those attributes of activities that both make them unique, and explain how and why they are planned, modified and subsequently executed.

7. Acknowledgements

The author would like to tank all those who contributed to the collection of the data for this paper, including especially Matt Roorda, Erika Nemeth, Eric Miller, Martin Lee-Gosselin, Kim Tran, May Lynn Fong, and all those who graciously contributed their time to completing the survey. Special thanks also go to Chris Storie and Len Hunt for their timely advice on statistical techniques. The author would also like to acknowledge the financial support received from the Social Sciences and Humanities Research Council of Canada.

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Figure 1 CHASE (Computerized Household Activity Scheduling Elicitor) main screen showing add/modify dialog box for the entry of single activities and their observed attributes

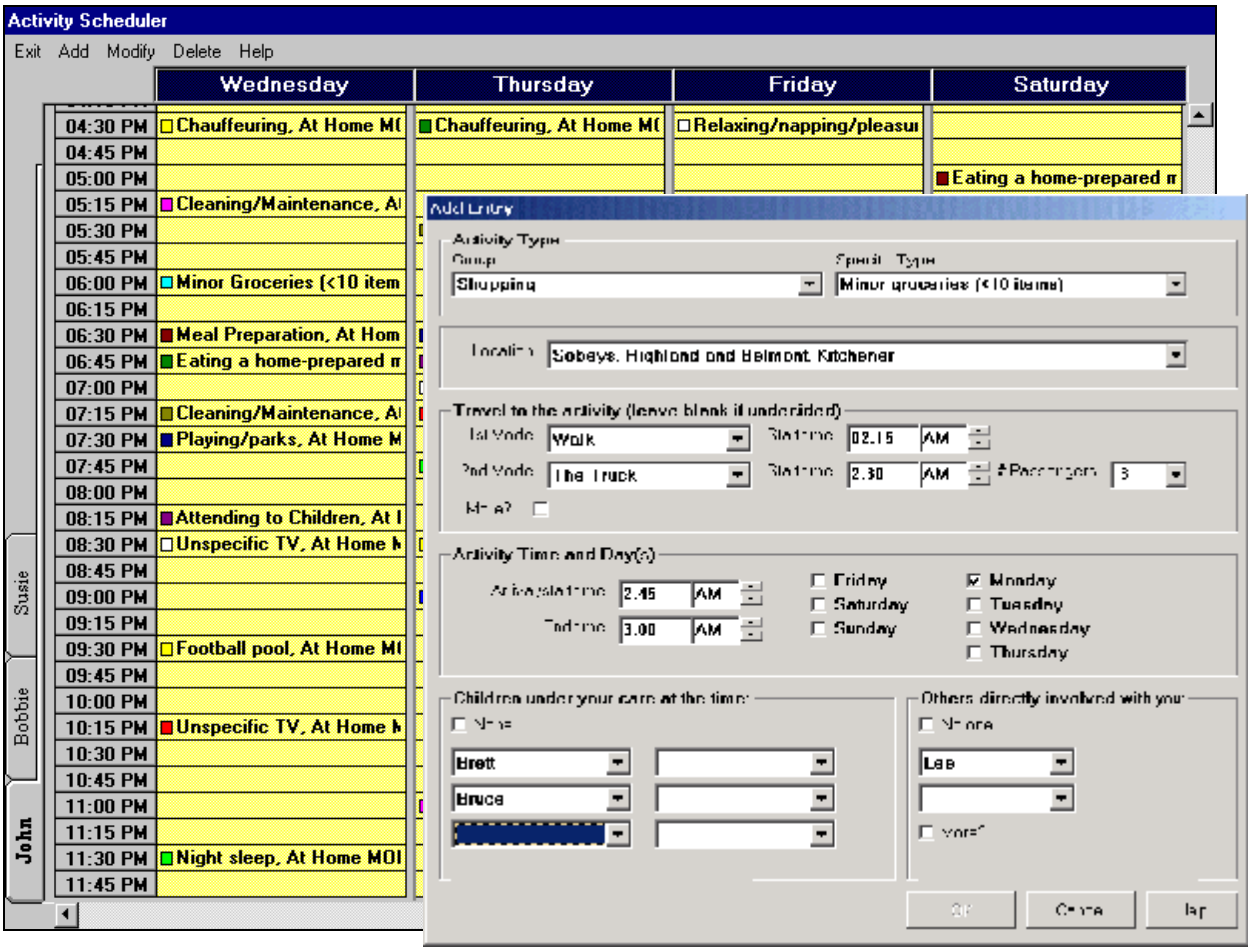
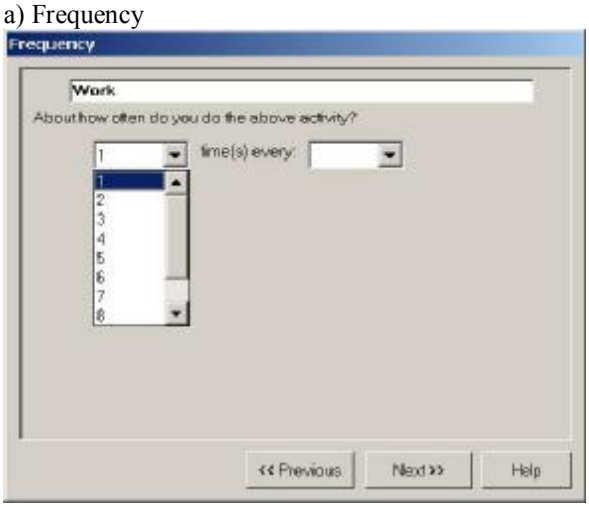
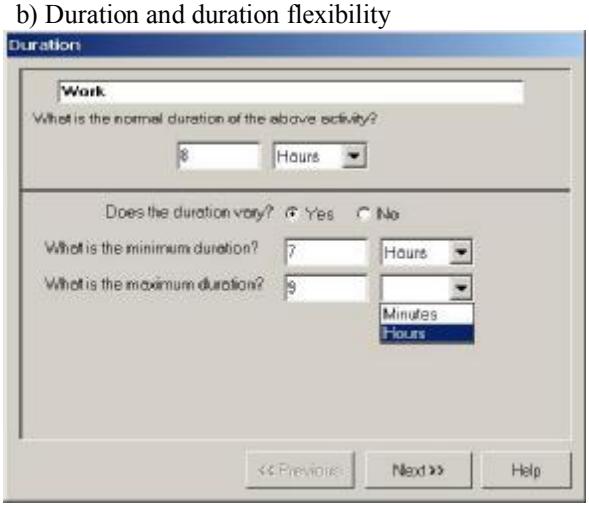


Figure 2 End-of-week Review Prompts used in CHASE to capture attributes of activity types observed (potentially multiple times) during the survey week

a) Frequency

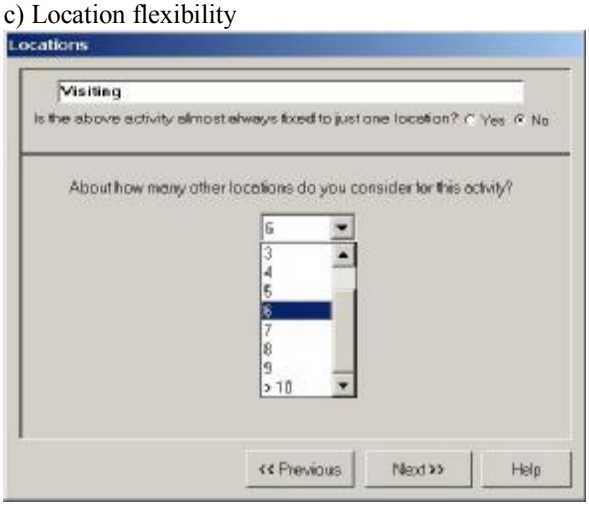


b) Duration and duration flexibility



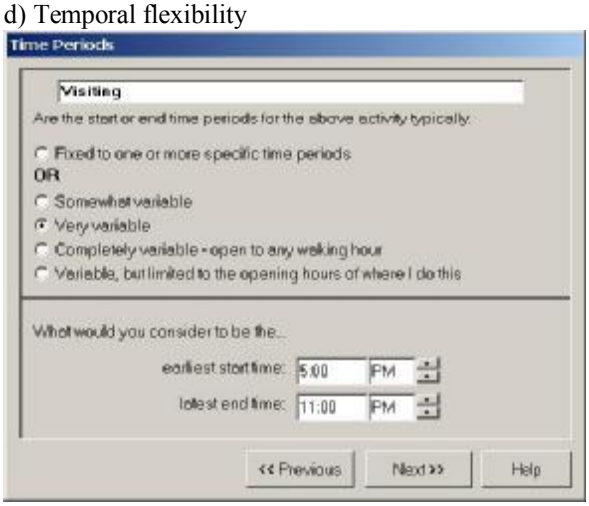
Note: if "No" selected, lower portion does not appear.

c) Location flexibility



Note: if "No" selected, lower portion does not appear.

d) Temporal flexibility



Note: lower portion appears only for first 2 options.

e) Involved persons

Note: lower portion appears only for the latter 2 options.

Figure 3 Temporal flexibility *rating*, distribution (n=7232)

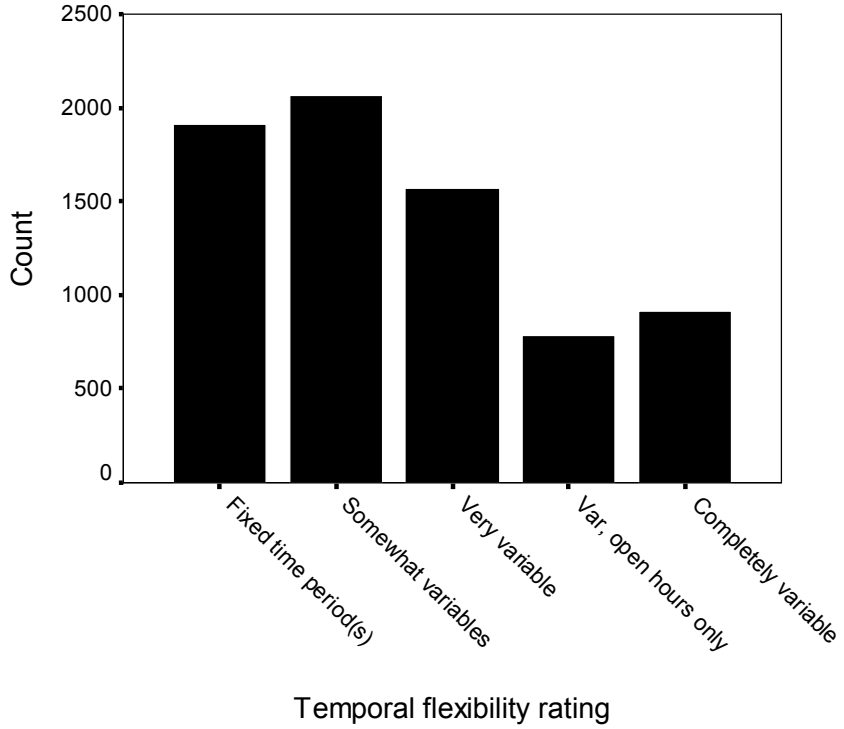


Figure 4 Temporal flexibility *indicator*, distribution (n=7230)

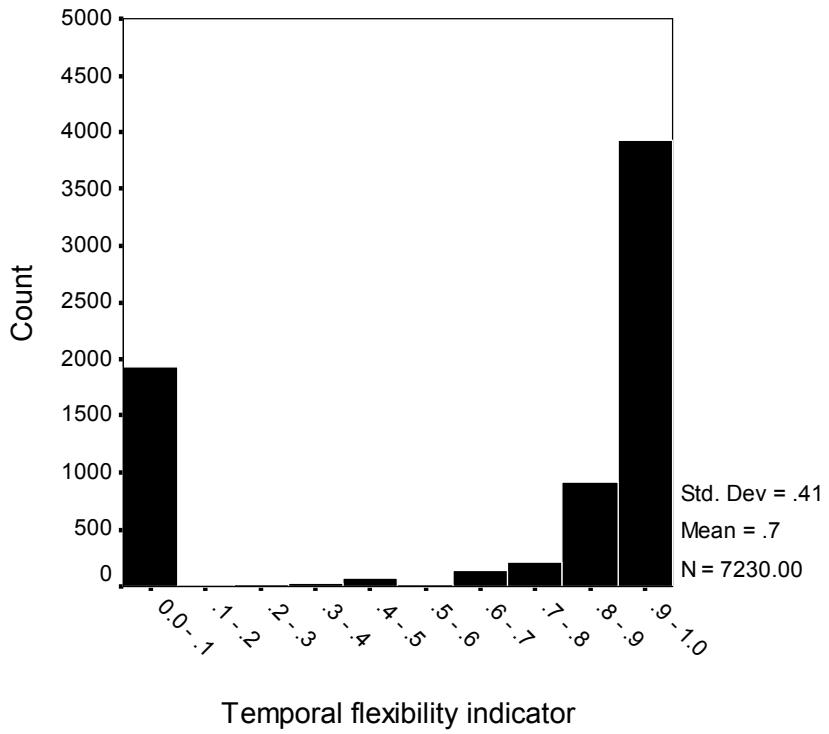
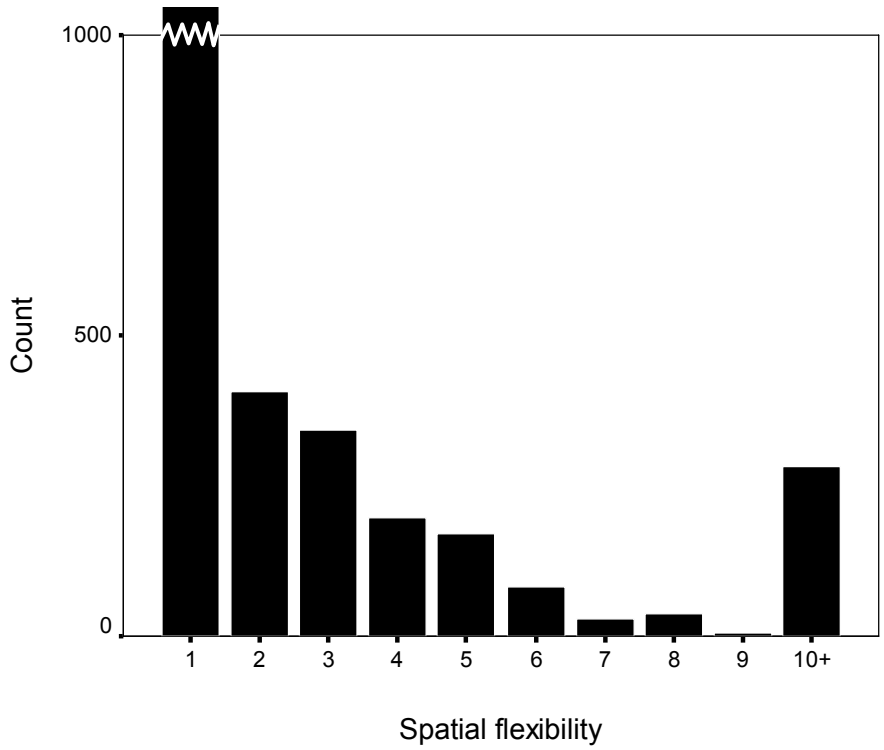


Figure 5 Spatial flexibility (measured as # possible locations), distribution (n=6976)



Note: The bar associated with value 1 above is actually equal to 5602.

Figure 6 Duration Fixity Indicator (n=6889)

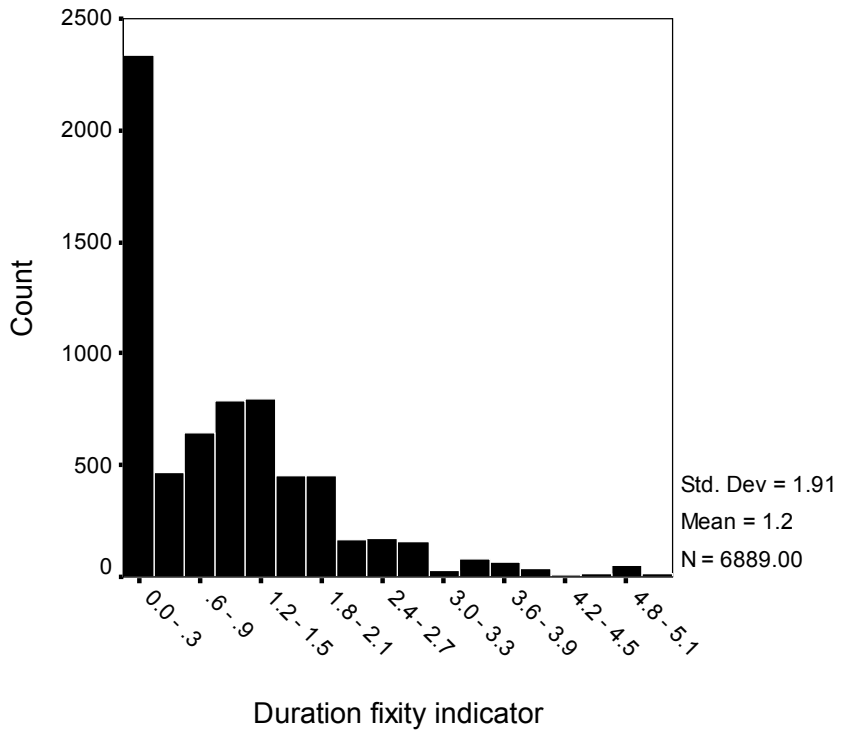


Figure 7 Average number of observed involved persons (n=7915)

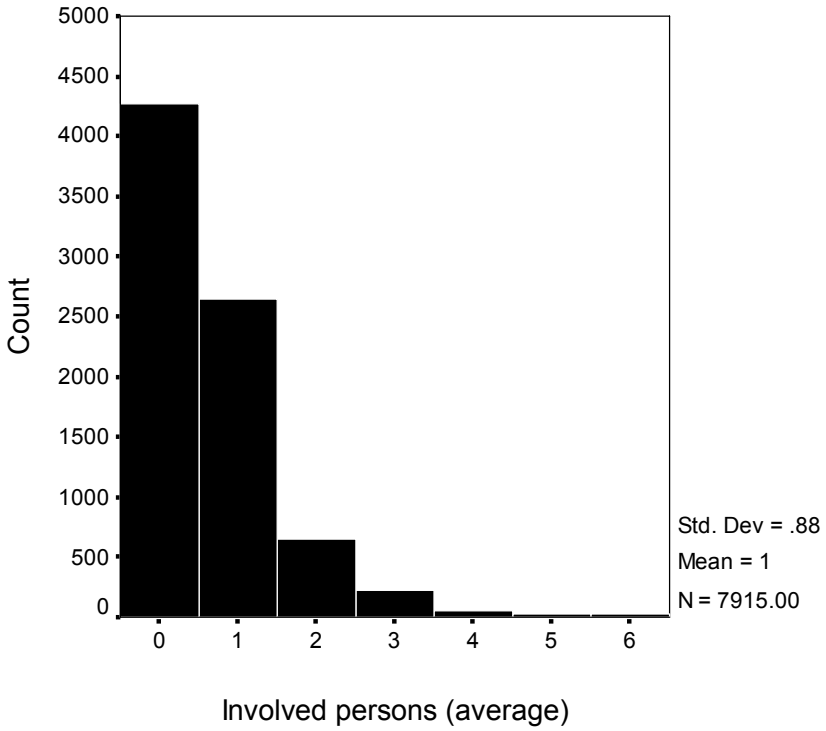


Table 1 Sample households by type

Household type	#
1 adult only	62
1 adult plus …	
children	13
teens and/or children	6
children/teens +other adult child/relative/friends	5
other adult relatives/friends	10
adult children	3
2 adults only	44
2 adults plus …	
children	58
teens and/or children	17
children/teens +other adult child/relative/friends	15
other adult relatives/friends	18
adult children	7
Total	258

Table 2 Results of Kruskal-Wallis H test for differences in distribution of activity attributes by activity group

	Temporal flexibility indicator			Spatial flexibility			Duration flexibility indicator		
Activity Group	N	Mean Rank	Rank of Mean Rank	N	Mean Rank	Rank of Mean Rank	N	Mean Rank	Rank of Mean Rank
Night sleep and other basic needs	937	3965	8	941	2975	2	917	3868	9
Meals	716	4265	9	699	3938	7	661	3367	6
Work/School	318	2277	2	676	3570	5	661	3014	5
Household Obligations	1035	4306	10	1078	2820	1	914	3847	8
Drop-off/Pick-up	497	3025	4	517	3951	8	430	2791	3
Shopping	818	3372	5	372	4674	10	655	2906	4
Services	458	2992	3	394	3456	4	342	2444	1
Active recreation	310	2234	1	332	3692	6	334	2788	2
Entertainment	1310	3671	7	1236	3064	3	1182	3721	7
Social	825	3652	6	725	4321	9	788	3994	10
Total	7224			6970			6884		
Mean Rank Range		2072			1855			1549	

(Continued …)

	Involved persons (average)			Average Duration (minutes)			Frequency per week (average)		
Activity Group	N	Mean Rank	Rank of Mean Rank	N	Mean Rank	Rank of Mean Rank	N	Mean Rank	Rank of Mean Rank
Night sleep and other basic needs	944	2940	2	944	4590	9	944	6307	10
Meals	724	5059	9	724	3105	3	724	4989	9
Work/School	700	2938	1	700	6016	10	700	4391	8
Household Obligations	1078	3570	4	1078	3536	5	1078	4362	7
Drop-off/Pick-up	570	4432	8	570	1641	1	570	3189	4
Shopping	818	3796	6	818	3171	4	818	2197	2
Services	482	3501	3	482	2970	2	482	1963	1
Active recreation	352	3768	5	352	4447	6	352	3553	5
Entertainment	1330	3840	7	1330	4531	8	1330	4240	6
Social	911	5691	10	911	4525	7	911	2729	3
Total	7909			7909			7909		
Mean Rank Range		2753			4376			4343	

Notes:

1. The "Rank of Mean Rank" ranges from 1 to 10, wherein 10 indicates the activity group that ranked highest on the given activity attribute.

2. All tests significant at the 0.000 level (χ^2 ranged from 426 to 2446).

Table 3 Cross-tabulation of interpersonal flexibility by activity group

			Interpersonal flexibility	
			Must be conducted with/for other people	Conducted alone or optionally with/for other peopl
Activity Group	Night sleep, other needs	Count	9	93
		% within Activity Group	1.0%	99.0%
	Meals	Count	103	62
		% within Activity Group	14.2%	85.8%
	Work/School	Count	81	61
		% within Activity Group	11.6%	88.4%
	Household Obligations	Count	229	84
		% within Activity Group	21.2%	78.8%
	Drop-off/Pick-up	Count	257	31
		% within Activity Group	45.1%	54.9%
	Shopping	Count	55	76
		% within Activity Group	6.7%	93.3%
	Services	Count	48	43
		% within Activity Group	10.0%	90.0%
	Active recreation	Count	79	27
		% within Activity Group	22.4%	77.6%
	Entertainment	Count	90	124
		% within Activity Group	6.8%	93.2%

Note: χ^2 test significant at the 0.000 level.

Table 4 Cross-tabulation of location by activity group

			Location	
			Only at-home	Out of home c in/out of hom
Activity Group	Night sleep, other needs	Count	868	7
		% within Activity Group	91.9%	8.1%
	Meals	Count	402	31
		% within Activity Group	56.3%	43.7%
	Work/School	Count	137	54
		% within Activity Group	20.0%	80.0%
	Household Obligations	Count	1020	5
		% within Activity Group	95.0%	5.0%
	Drop-off/Pick-up	Count	47	50
		% within Activity Group	8.5%	91.5%
	Shopping	Count	4	81
		% within Activity Group	.5%	99.5%
	Services	Count	56	42
		% within Activity Group	11.7%	88.3%
	Active recreation	Count	89	25
		% within Activity Group	25.6%	74.4%
	Entertainment	Count	1115	20
		% within Activity Group	84.4%	15.6%

Note: χ^2 test significant at the 0.000 level.

Table 5 Results of Kruskal-Wallis H test for differences in distribution of activity attributes by specific activity types within each activity group

	Temporal flexibility indicator		Spatial flexibility		Duration fixity indicator		Involved persons (average)		Average Duration (minutes)		Frequency per week (average)	
Activity Group and specific type	N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank
Basic needs												
Night sleep	400	284	400	*481*	397	550	400	*497*	400	732	400	620
Wash/dress/pack/snacks	495	632	495	*463*	476	396	495	*451*	495	271	495	385
Other basic needs	42	310	46	*473*	44	317	49	*491*	49	387	49	152
Total	937		941		917		944		944		944	
Meals												
In-home meal	435	436	435	257	398	363	435	340	435	326	435	478
Bagged lunch	28	227	25	318	18	159	28	241	28	223	28	278
Restaurants	196	206	181	548	186	308	196	459	196	528	196	164
Coffee/snack shop	57	354	58	446	59	239	65	275	65	168	65	224
Total	716		699		661		724		724		724	
Work/School												
At work	70	155	366	330	355	298	366	324	366	460	366	419
Telework	49	202	49	282	49	456	49	287	49	260	49	367
Volunteer work	21	167	25	414	26	386	29	415	29	250	29	235
At School	14	82	49	276	43	295	49	366	49	314	49	294
Schoolwork	50	158	61	328	62	448	64	350	64	203	64	371
Training/special classes	16	133	18	307	18	204	25	431	25	216	25	171
Other work/school	98	156	108	414	108	339	118	418	118	198	118	211
Total	318		676		661		700		700		700	
Household Obligations												
Cleaning/Maintenance	317	672	317	529	210	570	317	492	317	697	317	544
Meal preparation	301	605	301	542	286	468	301	555	301	438	301	619
Attending to children	122	127	122	534	101	528	122	824	122	627	122	731
Other household obligations	236	339	279	538	260	356	279	490	279	491	279	326
Attending to pets	59	769	59	603	57	325	59	360	59	261	59	724
Total	1035		1078		914		1078		1078		1078	
Drop-off/Pick-up												
People	244	222	276	264	232	*232*	297	323	297	264	297	335
Meal	86	248	78	303	66	*204*	86	258	86	358	86	298
Snacks/drinks	22	271	22	243	21	*208*	22	263	22	327	22	303
Video rental	37	306	36	258	18	*189*	37	254	37	289	37	176
Other items (Dry cleaning, Mail, et	108	288	105	217	93	*190*	128	230	128	277	128	191
Total	497		517		430		570		570		570	
Shopping												
Minor groceries (<10 items)	133	517	40	*199*	50	340	133	347	133	295	133	572
Major groceries (10+ items)	210	325	50	*188*	192	306	210	409	210	483	210	441
Housewares	66	374	37	*177*	58	365	66	419	66	435	66	335
Clothing/personal items	124	324	37	*229*	113	377	124	486	124	557	124	417
Drug store	41	559	10	*171*	40	333	41	302	41	195	41	375
Other shopping	244	451	198	*178*	202	308	244	421	244	363	244	316
Total	818		372		655		818		818		818	
Services												
Medical/professional	108	153	108	174	99	*178*	108	260	108	286	108	198
Barber/salon/beauty	37	205	38	188	38	*162*	39	200	39	314	39	169
Banking	90	324	81	225	35	*187*	90	192	90	159	90	290
Religious	82	126	71	184	74	*150*	82	300	82	325	82	312
Gas	63	370	15	340	17	*171*	63	208	63	88	63	280
Other service	78	234	81	192	79	*181*	100	256	100	268	100	191
Total	458		394		342		482		482		482	
Active recreation												
Hobbies	66	*178*	70	*146*	69	208	71	*170*	71	218	71	*170*
Exercise or active sports	215	*147*	231	*172*	234	151	243	*175*	243	169	243	*185*
Playing/parks	29	*170*	31	*173*	31	202	38	*199*	38	149	38	*136*
Total	310		332		334		352		352		352	
Entertainment												
Spectator Events/Theatre	88	345	79	959	78	293	88	974	88	1018	88	219
Regular TV programs	320	252	320	581	303	631	320	718	320	691	320	831
Unspecific TV	88	897	88	588	85	682	88	681	88	610	88	771
Watching video	113	769	113	565	104	333	113	867	113	895	113	355
Relaxing/napping/reading	430	846	430	590	337	661	430	567	430	643	430	760
Email/internet	169	1020	96	592	165	712	169	402	169	350	169	745
Other recreation/entertainment	102	449	110	696	110	473	122	819	122	688	122	320
Total	1310		1236		1182		1330		1330		1330	
Social												
Hosting visitors	154	486	154	238	139	415	154	594	154	548	154	410
Visiting	272	342	247	426	247	424	272	481	272	496	272	444
Planned social events	65	204	64	416	71	247	122	486	122	641	122	286
Cultural/recreational/special clubs	72	211	74	406	73	294	74	489	74	554	74	486
Telephone >10 minutes	163	683	80	255	151	489	163	248	163	164	163	666
Other social	99	335	106	416	107	331	126	455	126	398	126	415
Total	825		725		788		911		911		911	

Note: Values in italics are not significantly different for each other (i.e. $p>0.01$ for associated χ^2 test)

Table 6 PCA factor loadings for activity attributes using all activity types (n=5888)

	Component			
	1	2	3	4
Eigenvalues	2.19	1.24	1.12	0.93
% of Variance	27.4	15.5	14.0	11.6
	Factor Loadings			
Temporal flexibility indicator	**-0.40**	**0.60**	-0.11	0.22
Spatial flexibility	**0.55**	**0.45**	-0.03	**0.54**
Duration fixity indicator	-0.13	**0.74**	0.09	-0.21
Interpersonal flexibility	**-0.62**	-0.13	-0.33	0.35
Involved persons (average)	**0.54**	0.22	0.38	-0.37
Average Duration (minutes)	-0.02	-0.22	**0.81**	**0.44**
Frequency per week (average)	**-0.66**	0.15	0.39	0.05
Location	**0.77**	-0.03	-0.20	0.29

Note: Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.651 ($p<0.000$)

Table 7 PCA factor loadings for activity attributes using only out-of-home activities (n=2360)

	Component			
	1	2	3	4
Eigenvalues	1.49	1.45	1.08	0.87
% of Variance	21.3	20.7	15.5	12.4
	Factor Loadings			
Temporal flexibility indicator	**0.65**	0.32	-0.22	0.33
Spatial flexibility	**0.71**	-0.21	0.02	0.32
Duration fixity indicator	**0.66**	0.13	0.11	**-0.45**
Interpersonal flexibility	-0.11	**0.71**	-0.01	0.42
Involved persons (average)	0.25	**-0.67**	-0.21	-0.04
Average Duration (minutes)	-0.09	**-0.49**	**0.60**	**0.48**
Frequency per week (average)	0.21	0.29	**0.78**	-0.23

Notes: Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.554 ($p<0.000$)

Table 8 Mean PCA factor loading scores by activity group and specific type (all activities model)

		PCA 1		PCA 2		PCA 3	
Activity Group		Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
Night sleep, other needs	Night sleep	-1.12	0.39	-0.21	0.53	1.98	0.68
	Wash/dress/pack/snacks	-0.91	0.46	0.09	0.55	-0.34	0.45
	Other basic needs	-0.26	0.60	-0.40	0.74	-0.20	1.09
Meals	In-home meal	-0.75	0.54	0.31	0.52	-0.01	0.47
	Bagged lunch	0.73	0.69	-0.34	0.65	-0.66	0.56
	Restaurants	1.44	0.61	0.71	0.95	-0.19	0.66
	Coffee/snack shop	0.67	0.71	0.41	1.66	-0.81	0.70
Work/School	At work	0.63	0.79	-0.49	1.42	0.56	1.71
	Telework	-0.65	0.37	-0.26	0.75	0.22	0.98
	Volunteer work	0.61	0.80	-0.31	1.15	0.19	1.33
	At School	0.49	0.23	-1.13	1.26	-0.21	0.94
	Schoolwork	-0.29	0.57	-0.26	1.31	-0.03	0.59
	Training/special classes	0.52	0.46	-1.01	0.76	-0.30	0.66
	Other work/school	0.78	0.84	-0.18	1.24	-0.06	0.95
Household Obligations	Cleaning/Maintenance	-0.88	0.32	0.28	0.49	-0.19	0.48
	Meal preparation	-0.74	0.37	0.24	0.69	-0.42	0.42
	Attending to children	0.21	0.56	-0.22	0.70	1.17	0.90
	Other household obligations	-0.30	0.48	-0.31	0.81	-0.46	0.69
	Attending to pets	-0.11	0.50	0.29	0.55	0.04	0.43
Drop-off/Pick-up	People	1.04	0.51	-0.34	0.93	-0.34	0.57
	Meal	0.83	0.65	-0.19	0.98	-0.69	0.75
	Snacks/drinks	0.23	0.54	-0.27	0.80	-0.86	0.48
	Video rental	0.64	0.42	-0.42	0.66	-0.99	0.75
	Other items (Dry cleaning, Mail, etc.)	0.42	0.63	-0.23	1.39	-0.90	0.62
Shopping	Minor groceries (<10 items)	0.50	0.42	0.09	0.78	-1.03	0.36
	Major groceries (10+ items)	0.70	0.47	0.06	0.83	-0.82	0.54
	Housewares	0.58	0.52	0.01	0.80	-0.92	0.60
	Clothing/personal items	0.92	0.54	0.49	1.07	-0.72	0.47
	Drug store	0.49	0.34	-0.01	1.14	-1.31	0.17
	Other shopping	0.72	0.51	0.12	1.00	-0.89	0.76
Services	Medical/professional	0.63	0.32	-0.79	0.88	-0.76	0.55
	Barber/salon/beauty	0.41	0.44	-0.69	0.75	-0.91	0.60
	Banking	0.27	0.45	-0.20	0.89	-1.11	0.79
	Religious	0.60	0.69	-1.05	0.46	-0.34	0.59
	Gas	0.79	0.44	0.41	0.58	-1.31	0.40
	Other service	0.54	0.65	-0.25	1.28	-0.63	0.86
Active recreation	Hobbies	0.01	0.89	-0.28	0.91	0.09	0.95
	Exercise or active sports	0.57	0.72	-0.53	1.03	-0.30	0.82
	Playing/parks	0.75	0.74	-0.15	0.78	-0.13	1.02
Entertainment	Spectator Events/Theatre	1.35	0.63	-0.35	0.82	0.23	0.74
	Regular TV programs	-0.38	0.41	-0.69	0.97	0.24	0.56
	Unspecific TV	-0.68	0.40	0.23	0.75	-0.09	0.64
	Watching video	-0.30	0.47	-0.16	0.48	-0.05	0.52
	Relaxing/napping/reading	-0.75	0.42	0.10	0.59	-0.15	0.47
	Email/internet	-0.86	0.38	0.54	1.36	-0.36	0.52
	Other recreation/entertainment	0.56	0.92	-0.30	0.89	0.04	0.95
Social	Hosting visitors	0.61	0.54	0.73	1.31	1.32	1.10
	Visiting	1.46	0.64	0.82	1.52	0.52	0.90
	Planned social events	1.60	0.67	-0.20	1.04	0.80	1.16
	Cultural/recreational/special clubs	1.59	0.65	0.14	1.11	0.71	0.82
	Telephone >10 minutes	-0.21	0.49	0.90	1.22	-0.11	0.69
	Other social	1.17	0.87	0.48	1.27	0.32	1.02

Table 9 Mean PCA factor loading scores by activity group and specific type (out-of-home activities model)

		PCA 1		PCA 2		PCA 3	
Activity Group		Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
Night sleep, other needs	Night sleep	0.46	0.40	0.62	0.56	3.76	0.45
	Wash/dress/pack/snacks	0.34	0.67	1.41	0.67	1.42	1.34
	Other basic needs	-0.19	0.94	0.17	1.33	0.47	1.08
Meals	Bagged lunch	-0.24	0.57	0.43	0.88	-0.03	0.49
	Restaurants	0.70	0.86	-0.34	0.82	-0.22	0.62
	Coffee/snack shop	0.39	1.34	0.63	0.91	-0.10	0.82
Work/School	At work	-0.43	0.99	-0.24	1.14	1.20	1.73
	Telework	0.05	0.70	0.88	0.37	1.32	0.78
	Volunteer work	-0.41	0.96	-0.21	0.83	0.41	0.70
	At School	-0.90	0.93	0.35	0.50	0.73	0.82
	Schoolwork	-0.12	0.86	0.44	1.01	0.82	1.09
	Training/special classes	-0.78	0.65	0.24	0.62	0.18	0.83
	Other work/school	0.00	1.14	-0.19	0.91	0.22	1.02
Household Obligations	Attending to children	0.35	0.06	-0.13	0.82	2.69	1.81
	Other household obligations	-0.20	0.60	0.73	0.72	0.13	1.00
	Attending to pets	0.30	0.63	0.71	0.45	1.12	1.15
Drop-off/Pick-up	People	-0.32	0.82	-0.07	0.70	-0.01	0.85
	Meal	-0.13	0.89	0.35	0.96	-0.08	0.61
	Snacks/drinks	-0.08	0.77	0.73	0.45	-0.50	0.57
	Video rental	-0.40	0.56	0.51	0.74	-0.61	0.53
	Other items (Dry cleaning, Mail, etc.)	-0.34	0.81	0.57	0.61	-0.66	0.57
Shopping	Minor groceries (<10 items)	0.10	0.71	0.80	0.56	-0.25	0.69
	Major groceries (10+ items)	0.05	0.72	0.47	0.70	-0.47	0.55
	Housewares	0.04	0.67	0.60	0.68	-0.54	0.59
	Clothing/personal items	0.43	0.91	0.30	0.59	-0.47	0.52
	Drug store	-0.05	0.97	0.89	0.37	-0.65	0.38
	Other shopping	0.09	0.86	0.46	0.75	-0.59	0.62
Services	Medical/professional	-0.74	0.70	0.39	0.48	-0.31	0.54
	Barber/salon/beauty	-0.62	0.61	0.58	0.58	-0.45	0.37
	Banking	-0.06	0.75	0.90	0.55	-0.44	0.85
	Religious	-0.95	0.36	-0.08	0.64	-0.10	0.65
	Gas	0.35	0.52	0.71	0.52	-0.78	0.28
	Other service	-0.39	0.71	0.29	0.82	-0.50	0.71
Active recreation	Hobbies	-0.24	0.77	-0.27	1.03	0.10	0.65
	Exercise or active sports	-0.38	0.91	0.19	0.99	0.31	0.85
	Playing/parks	-0.15	0.66	-0.13	1.12	-0.10	0.68
Entertainment	Spectator Events/Theatre	-0.22	0.76	-0.69	0.82	-0.02	0.63
	Regular TV programs	0.13	2.26	0.61	0.98	1.65	1.08
	Unspecific TV	1.12	0.04	1.85	0.61	2.10	2.48
	Watching video	-0.10	0.13	0.18	0.36	-0.35	0.33
	Relaxing/napping/reading	0.43	0.56	0.98	0.48	0.77	0.70
	Email/internet	0.33	0.68	0.69	0.74	-0.10	0.77
	Other recreation/entertainment	-0.24	0.83	-0.56	0.97	-0.13	0.73
Social	Hosting visitors	0.46	0.28	-1.35	0.30	0.22	0.76
	Visiting	0.68	1.22	-0.81	0.90	-0.01	0.71
	Planned social events	-0.14	0.86	-1.15	1.03	0.03	0.82
	Cultural/recreational/special clubs	0.20	1.00	-1.10	0.87	0.12	0.63
	Telephone >10 minutes	0.96	1.09	0.70	0.80	0.33	0.71
	Other social	0.29	1.08	-0.71	1.03	-0.17	0.83