COLLECTING SOCIAL NETWORK DATA TO STUDY SOCIAL ACTIVITY-TRAVEL BEHAVIOUR: AN EGOCENTRIC APPROACH

By

Juan-Antonio Carrasco*
Department of Civil Engineering
University of Toronto
35 St. George St
Toronto, ON M5S1A4, Canada
Tel: +1 416 978 5049
Fax: +1 416 978 5054
E-mail: j.carrasco@utoronto.ca

Bernie Hogan
Department of Sociology
University of Toronto
725 Spadina Avenue
Toronto, ON M5S 2J4, Canada
Phone: +1 416 946 5889
Fax: +1 416 978 3963
Email: bernie.hogan@utoronto.ca

Barry Wellman
Centre for Urban and Community Studies
University of Toronto
455 Spadina Avenue, Fourth Floor
Toronto, ON M5S 2G8, Canada
Fax: +1 416 978 7162
Email: wellman@chass.utoronto.ca

Eric J. Miller
Department of Civil Engineering
University of Toronto
35 St. George St
Toronto, ON M5S1A4, Canada
Tel: +1 416 978 4076
Fax: +1 416 978 5054
E-mail: miller@ecf.utoronto.ca

Presented at the 85th Transportation Research Board Meeting, Washington DC, January 22-26, 2006.

*) Corresponding author

ABSTRACT

This paper presents a data collection effort designed to incorporate the social dimension in social activity-travel behaviour, explicitly studying the link between individuals' social activities and their social networks. Using survey and interview instruments, the data collects the respondents' social networks using an egocentric approach, constituted by the interplay between their individual social structure and their social activity-behaviour. More explicitly, individuals' networks are studied in their relationship with social activity-travel generation, spatial distribution, and information communication technology use (ICT). The resultant data set links in novel ways aspects that have been rarely studied together, providing a sound base of theory and method to study and hopefully give new insights about social activity-travel behaviour.

1. INTRODUCTION

Within the study of travel demand using the activity-based approach (*1*), there is an increasing interest in the effect of social interactions in activity-travel decisions (*2*). Complementarily, there is a growing interest in the study of social activities, recognizing their importance in the overall travel patterns, and their behavioural difference with more studied purposes, such as work and shopping (*3*). Despite this interest, the study of these two aspects has been limited so far due to the lack of data collection efforts that explicitly link social travel behaviour and social interactions. Moreover, although data collection and modelling techniques have gone very far towards understanding individual activity-travel decision making processes in time and space (*4*), very little is known about the linkages between social and spatial interactions.

Axhausen (*5*) explicitly discusses this need to incorporate the "social dimension" in travel behavior:

"*Transport planning and even more so transport modelling has ignored the social dimension of travel in the past. There is therefore no empirical literature to fall back on. The general lack of detailed address geocoding of previous travel diary data makes these large data sets less useful then they could be, as they cannot be used to trace the development of the spatial visiting and meeting patterns in detail*" (p.3)

A major aspect in the incorporation of the social dimension is recognizing the need to understand the *specific characteristics of the individuals' interactions*, namely their *social networks*. In fact, although "with whom activities are performed" now constitute a standard question in transportation data collection (*6*, *7*), and questions about "for whom activities are performed" (*8*) have been made, more information is needed to capture the overall importance of the social dimension in activity-travel patterns. In fact, asking *with whom* the activity was performed does not necessarily reflect the relevance of those individuals in the overall activity-travel behaviour, since the interaction with a specific person is collected only if the occurred within the specific time frame the instrument covers. This issue is particularly relevant considering that in general the set of activities collected is very limited, and that activity variety seeking is present over long time spans, especially for social activities (*9*). As a consequence, time-space fixity and recurrence in social activity-travel become difficult to study. Even more importantly, collecting only with whom the activity was performed conceptually implies conceiving the social dimension as a mere *attribute* of the social activity (at the same level as destination or time of the day, for example), rather than the *cause* of the social activity. This approach may hide behavioural processes, such as the propensity to interact with some people rather than with others, and more importantly, it can hide the potential importance in frequency, spatial location, and other activity-travel attributes that the "with whom" dimension implies. I visit an old lady once a week, traveling one hour not only because she is a nice lady and my trade-off costs, but *because* she is my grandmother and she lives there; that is, my travel behaviour is *caused* by the social dimension (my social network).

This paper presents a data collection effort designed to address some of these challenges, linking social activity-travel behaviour and social interactions. The instruments designed explicitly collect the individuals' social networks using an egocentric scheme, constituted

by the social structure of specific individuals (egos), and the interplay between their social activities and social networks. More explicitly, the objective of the data collection is providing a data set that could help study the effect of social networks in the following aspects of social activities: i) their generation, ii) their spatial distribution, and iii) their relationship with information communication technology use (ICT). Regarding the generation and spatial distribution of social activities, the major interest of the social network approach resides in the explanation that it can provide to understand individuals' social patterns, testing whether the "with whom" dimension constitutes a relevant *cause* of individuals' activity-travel patterns. In the case of the relationship between social activity travel and ICT, social networks constitute a privileged way of studying the effect of different media in social interactions and activity-travel, considering that new technologies are increasingly embedded in ordinary life (*10*).

Also, as a background motivation, the interest of this work is studying the general usefulness of social networks to understand travel behaviour, considering Axhausen's remarks about "the need to underpin our travel models with a better understanding of the social structures of daily life … as we implicitly forecast/speculate about them when we predict travel behaviour over long time horizons, anyway…" (*11*: p.3). This study of social networks and travel behaviour is in early stages, and research has concentrated mainly on social influence aspects (*12*, *13*). In addition, an overall interest in this work is informing and enriching with the social network perspective the behavioural components of operational activity-travel demand models, such as TASHA (*14*, *15*), and integrated transportation and land-use models, such as ILUTE (*16*). The motivation of studying social networks is also based on the general interest in studying not only outcomes, but behavioural processes (*4*), echoing the long-discussed need of incorporating complementary explanations to the dominant microeconomic paradigm (*17*, *18*). From a data collection perspective, the method employed here also responds to the interest in exploring mixed quantitative and qualitative data collection in travel behaviour research (*19*).

The rest of the paper is divided as follows. Section two reviews the key background concepts; section three describes the survey and interview instruments of the data collection; and finally section four presents some discussion and conclusions.

2. KEY CONCEPTS

This section presents the conceptual background that motivated and guided the design of the data collection. After a brief review of the social networks approach, the key hypotheses and concepts of the interplay between social networks and activity-travel behaviour are described. Finally, the main characteristics, issues, and challenges in social network data collection are discussed, setting the context of the specific design chosen for this study.

2.1. The social networks approach

The social networks approach of this work is more than metaphorical, and draws from a long tradition in Sociology; for a further revision of the paradigm and techniques, see for

example (*20*, *21*, *22*, *23*). Tindall and Wellman (*24*) define the social network approach in the following way:

"*Social network analysis is the study of social structure and its effects. It conceives social structure as a social network, that is, a set of actors (nodes) and a set of relationships connecting pairs of these actors*" (p.1-2).

Thus, two key components define this paradigm: **actors,** who represent different entities, such as groups, organizations, nations, as well as persons; and relationships **and ties,** which represent flows of resources that can be related with aspects such as control, dependence, cooperation, information interchange, and competition.

The core concern of the social network paradigm is "to understand how social structures facilitate and constrain opportunities, behaviors, and cognitions". Social network analysis conceives the overall behaviour as more than the sum of individual behaviors, and contrasts with "explanations that treat individuals as independent units of analysis", as those traditionally used in travel behaviour research. Thus, behaviour is explained not only through personal attributes, but by using social structure attributes that incorporate the interaction among the different social network members. This vision assumes that *the whole is more than the sum of its parts*, that is, social phenomena cannot be understood solely by individual characteristics (such as socioeconomic attributes), but also by the social structure emerging from the interaction among individuals.

2.2. Social networks and activity-travel behaviour

The main hypothesis in this work is that communication and activity-travel patterns *emerge* from the individuals' social networks or, in other words, they can be inferred in part from knowing the individuals' social network characteristics. This hypothesis has consequences in the understanding of the generation and spatial distribution of social activities, and the communication media behaviour among individuals.

The *generation* of (or decision to perform) social episodes can be explained by the individual's propensity and opportunity to engage in a social activity (*25*, *26*). Propensity not only depends on the individual's socioeconomic and lifestyle attributes (*27*), but also on *with whom* individuals perform social activities, who constitute the individual's social network characteristics, and also on their related communication patterns (e.g. frequency and type of media used). As a consequence, ties or links between the individual and other people in the network represent a flow of potential activity-travel *generated* by the interaction between those "nodes" of individuals. The opportunities to engage in social activities are represented by individuals' time and space prisms (*26*), which in part depend on the spatial distribution of individuals' social networks, is fixed in the short time horizon.

Furthermore, in the case of the *spatial distribution*, the above hypothesis implies studying activity destinations from another, complementary perspective, which views the observed people's activity patterns as a direct consequence of not only people's preferences and restrictions, but also of the *spatial location* of their social network. The concept of *social anchor points* can be used, which describes the main places where the individuals "move around" when they interact with other network members. Several anchor points are

defined by the individual's social network, either directly, such as the social network's homes, or indirectly, such as pubs or restaurants in part defined by the network members' home or workplace. These anchor points are hypothesized as key pivotal places defining the social *activity space* (*28*).

Finally, regarding communication patterns, the previous hypothesis conceives interpersonal relationships as the focal element from which different communication interaction media emerge, incorporating in the same framework face-to-face, telephone, and Internet based socializing episodes. This focus of communication subjected to individuals' social networks sets an intuitive and consistent conceptual framework about the way individuals satisfy their interaction needs, conceiving social activity-travel as only one of the possible ways of interaction.

2.3. Social networks data collection

There is a long tradition concerning the techniques and issues of collecting social network data; for an in-depth review, see Marsden (*29*, *30*). Overall, some of key challenges in this kind of data collection are:

- Network boundaries are difficult to define.
- People do not easily recall their network members, and need appropriate "prompts" to elicit them. In addition, networks are very large in general, and different social network members may have different importance depending on the phenomenon studied.
- Information about the network members needs to balance detail and interviewee's burden.

Each of these three challenges was considered in specific social network data collection techniques, as is described below.

2.3.1. Whole versus egocentric networks

Most social network data collection can be divided into "whole" and "egocentric" networks. Whole network studies examine actors "that are regarded for analytical purposes as bounded social collectives" (*30*: p.8); actors in these studies are named in closed lists, usually pre-defined, and known *a priori*. Since these boundaries are very difficult to define in urban settings with large populations ("close lists" are not known in advance), whole network studies are unpractical, making egocentric data collection the only feasible method. Egocentric network studies concentrate in specific actors or **egos** and those who have relations with them, called **alters**. That is, from the participant's perspective, egocentric networks constitute a "network of me" or a network of actors (alters) with whom the participant has some relationship. Egocentric network data is thus composed by two levels: i) an ego-network level, constituted by the ego's characteristics and overall network features; and ii) an ego-alter level, constituted by the characteristics of each alter and alter-ego ties.

2.3.2. Name generators

As was discussed before, defining the network's boundary is a crucial challenge. For egocentric networks, the problem is twofold: choosing appropriate egos, and selecting

appropriate network members. In the first case, egos must be representative of the context studied (urban setting in this case). In the second case, eliciting "appropriate" network members is difficult due to the large size of networks, and the need to sample adequate network members for the phenomenon of interest. In egocentric methods, the most used technique to elicit network members is the *name generator*, which consists of free recall questions that elicit alters from an ego's network (*30, 31*).

Name generating questions elicit "a fraction of respondents' social contacts" (*30*: p.12). The key decision then is choosing the appropriate specific question(s) that will elicit the network members relevant for specific phenomenon of interest, constrained by the available time, and the desired level of complexity of the data collection instrument. Also, the number of alters elicited can be limited by a specific number (*32*) or unlimited (as here). There is an extensive literature that compares different name generators, discussing aspects such as their influence in network size, the number of "core" and extended network members that each elicit, the importance of the instrument's context, the relevance of the order and wording of questions, and the forgetting phenomena (for further review, see (*30*) and the references therein). Finally, name generators are also important to measure **tie strength** between egos and each alter, and between alter-alter pairs. As before, the chosen indicator will impact on the reliability of tie strength measures, being emotional closeness the most usual and accepted (*33*). In the case of egocentric networks, tie strength is in general measured only *from the ego perspective*, for both ego-alter pairs and alter-alter pairs.

2.3.3. Name interpreters

After eliciting network members, a second set of questions is usually performed to obtain more information about the characteristics of each alter (e.g. socioeconomics, relationship with the ego), and ego-alter relationship (e.g. frequency and characteristics of interaction). From a practical point of view, a key challenge here is gathering an adequate amount of information in a non-tedious, relatively short, and reliable way; these issues are especially critical when the number of alters is not defined beforehand, as in this study. In general, a *sampling* strategy is usually performed (*30*), although no firm guidelines can be found from the literature about this issue.

3. THE CONNECTED LIVES STUDY

This section describes the overall study and specific instruments used to capture the link between social networks and social activity-travel behaviour. After a brief presentation of the overall study, the survey and interview instruments are described in detail.

3.1. The study

The data were gathered in the East York area of Toronto, Canada, between May 2004 and April 2005 as part of the "Connected Lives Study", a broader study composed of surveys, interviews, and observations about people's communication patterns. The first author conducted the study in conjunction with sociologists (among them, the second author) and social workers of the NetLab, part of the Centre of Urban and Community Studies at the University of Toronto, and lead by the third author, Barry Wellman. The multidisciplinary setting allowed for a rich crossed-fertilization in data collection techniques, and a broad set of information collected. The study consisted of two stages: surveys of a random sample of 350 people from the East York area in Toronto, and interviews and observations of a sub-sample of 87 people. The East York area is located in the East side of downtown Toronto, and is fairly representative of the overall inner city characteristics regarding sociodemographics and general transportation level of service. For a further overview of the study, see (*34*).

3.2. Name generator

The name generator in both the survey and interview instruments concentrated on the individual's *affective network* or a network of people the respondent defines as *emotionally close*, an approach that seems to be useful for understanding communication and social activity-travel patterns. Concretely, respondents were asked to name the people who live outside their household, with whom they felt ***very close*** and ***somewhat close***. Very close people consisted of "people with whom you discuss important matters with, *or* regularly keep in touch with, *or* they are for you if you need help". Somewhat people consisted of "more than just casual acquaintances, but not very close". This "closeness" approach defines two aspects. First, closeness becomes a tie strength measure: strong (very close), and weak (somewhat close). Second, closeness defines the social network "boundary" – and thus the sociable activity-travel patters captured in the data – which excludes people who are only casual acquaintances.

3.3. Survey

The survey instrument covered a variety of aspects about people's communication patterns (*34*); the focus here is on the social network composition section. Table 1 shows the specific items prompted. The summation method was used (*35*), which consists of asking respondents *how many* strong and weak tie people lives outside their households in each of the following roles: immediate family, other relatives, neighbors, work or student mates, known only online, from organizations, other friends, and others not previously included. As an aid, respondents were provided with a sheet that helped them to write the names of the people in each category. After prompting the number of network members in each role, further questions included the number of strong and weak

tie network members in each gender, with different ethnic heritages, living outside Canada, and living in Canada at more than one hour's travel. Finally, a set of questions about frequency and media of interaction were asked. Concretely, respondents were asked the number of strong and weak tie network members they typically: i) call by cell phone, ii) call by regular phone, iii) send an email, iv) send an instant message, v) talk with face to face, vi) meet at restaurants or bars, and vii) visit or host them as a visitor. Each of the previous questions differentiated between two time horizons: i) at least once a week, and ii) between once a week and once a month. Figure 1 shows the overall number of network members by ego in selected categories, illustrating that the method captures a broad set of social networks, and social activity-travel and communication patterns.

The approach adopted in the survey could be defined as a "meso" approach, since it captures structural features, such as size of the network, approximate density, and aggregated composition by aspects such as role and gender, and also the ego's characteristics. This approach contrasts with a "micro" approach (adopted in the interview) that also captures *more* disaggregated characteristics, such as each alter's characteristics (e.g. gender, spatial location), and each interaction between alters and the respondent. Yet, the "meso" approach constitutes a quick way of prompting structural features, without the use of more complex instruments such as those used in the following interview section.

A key overall assumption is the record of "usual" communication and activity-travel patterns to capture the *overall* communication and social activity-travel behaviour, rather than observed or stated patterns. This approach was adopted due to: i) the need of capturing realized patterns in social activities over long time spans (*9*), ii) lowering the risk of more interviewee burden, and iii) cost restrictions. Further research is needed to assess whether this approach involves biases with respect to the actual respondent's patterns, and whether it constitutes a reasonably adequate proxy of the actual respondent's behaviour. However, no other technical issues than the previous enunciated prevent future studies including more detailed activity-travel aspects in conjunction with social network data.

3.3. Interview

The interview took on average two and a half hours, generally at the home of the individuals, conducted by graduate students. The sections of interest for this paper are: i) name generator, ii) name interpreter, and iii) social episodes.

Name generator

The name generator had three goals: i) creating a participant-aided *sociogram*, ii) maximizing the size and richness of the egocentric network, and iii) facilitating the record of the network's connectivity. A sociogram can be intuitively defined as a drawing that permits visualizing the respondents' social network, containing each alter's name and the ties among them. The sociogram was represented in the study as series of four concentric circles, where the ego is at the centre, and the alters are situated around it (see Figure 2). The importance of the sociogram is threefold. First, it helps collect network data in an intuitive and easy way for respondents, lowering their burden – especially in the case of senior and less educated people – and facilitating the incorporation of the highest possible

number of network members of interest. Second, it makes connectivity recording easier, more reliable, and more complete. Finally, it serves as a cognitive aid to prompt the posterior questions about communication and social activity-travel patterns.

The sociogram was built in three steps:

1. Respondents were asked to write on post-it papers, in a free recall order, their strong and weak tie network members in a "name template" (see Figure 3), using the previously mentioned very close and somewhat close definitions. After the list is done, each individual's role is recorded; alter's roles can be multiple: e.g. a workmate can also be a friend, a phenomenon called *multiplexity*, which is explicitly allowed for and encouraged to be recorded. At this stage, two kinds of numbers record information about each alter: a *rank* number, representing the order in which each alter is elicited (the smaller number, the higher the rank); and *role* number(s), representing each alter's role.
2. In the second step, respondents were asked to situate each post-it paper (representing each alter) in one of four concentric circles, according to how "close" they felt about them. The closer they felt, the closer the ring from the centre, starting with the strong tie people, and followed by weak tie people. This closeness measure was kept ambiguous, and is not necessarily linked with tie strength, adding a second and possibly complementary measure of emotional proximity. This step was entirely left to the respondent; the only instruction was placing people who know each other nearby, in order to help the following step.
3. The third and final step consisted in recording the connectivity among alters. Respondents were asked to draw circles, representing groups of people who they thought were all very close, groups who were all somewhat close among them, and lines among pairs of very close or somewhat close alters.

The final result of the name generator section can be seen in the left down image in Figure 2. The respondent has: i) generated each social network name and their role, differentiating by tie strength, ii) located each alter in the sociogram according to a loosely defined emotional closeness, and iii) recorded ties among all social network members, differentiated by tie strength. The method provides a "step-by-step" procedure to gather the participants' social network, which is base information to capture their subsequent communication and activity patterns.

Name interpreter

Name interpreter questions recorded communication and social activity patterns between the participant and a selected number of network members (see Table 1). Pre-tests showed the necessity of sampling network members for whom to retrieve the information. This sampling strategy contemplated choosing fifteen alters, representing a compromise between the need for a representative number of people, and keeping the interview's length at a reasonable level. Overall, the sampling scheme elicits names from all the rings on the sociogram, from both strong and weak ties, "covering" the overall network in the best possible way, but at the same time giving higher priority to emotionally closer alters (i.e. those in the inner rings). From the communication and travel patterns point of view, this sampling scheme balances two objectives: on the one hand, eliciting representative alters of the overall network, and thus overall ego's patterns; and on the other hand, capturing a high proportion of the more "relevant"

communication and activity patterns of the respondent, assuming that those are the emotionally closer people (see Figure 2).

Two sets of name interpreting questions were asked for this sample:

1. Information about each alter's characteristics, including age, relationship, job, and ethnic heritage. Two spatial locations were recorded: the alter's home location, and the most frequent place of interaction with the respondent, both at the level of the intersection, to facilitate posterior geocoding.
2. Information about the ego's communication and interaction patterns with each alter, considering face to face, socializing, telephone, email, and instant messaging interaction. Face to face and socializing were explicitly separated since a main interest is differentiating between instrumental interactions (such as those existing in workplaces) and social interactions (visiting, hosting, going to pubs and restaurants); also capturing the circumstances when face to face interactions are different from socializing. Two additional questions include the "direction" of the interaction, that is, who starts or "triggers" the interaction; and technology use (e.g. cell phone versus landline).

In this section, a paper and pencil "mini-survey" was used to record the information, leaving to the respondent whether they answered the questions on their own, or whether the interviewer helped them. The interview conversation was also recorded, a strategy that proved to be very useful since in general respondents tended to add extra contextual information about their alters and interaction patterns, providing an interesting mix between quantitative / structured data, and qualitative / contextual information.

Social episodes

The last section of interest in the interview involved recording selected social episodes between the participants and some of the alters previously elicited in the name generator and interpreter sections. Social episodes are defined as those involving visiting, hosting visitors, or meeting in restaurants, pubs, or similar places. The already complex design of the study did not leave room for an extensive collection of all the respondent's social episodes, also considering that a complete account of social activities requires collecting data for long time horizons (*9*). Instead, the method used in this section involves a small sample of the ego's social episodes that potentially serves as a proxy to understand their overall respondent social patterns, without a detailed and extensive account of all of them. With that purpose, six social episodes were recorded, using a strategy consistent with the main background assumption ofthe study; that is, communication and social activities emerge from the individuals' social networks.

Specifically, participants were prompted about social episodes with selected six social network members from the fifteen elicited in the name interpreter section, with whom they have socialized in the Greater Toronto Area (the boundaries of the study). These six alters were semi-randomly chosen using a scheme that was biased towards the ego's most frequent social episodes with their network members, and those with emotionally closer alters. The scheme kept the same balance of objectives as in the name interpreter section: sampling the overall network, emphasizing the emotionally closer alters, and maintaining the consistency of alters sampled in each section. For each of the six alters, participants were asked about specific aspects of their last social episode with them: what the activity

was about, when it was (time of the day, day of the week, duration), where it was (detailed spatial location, feasible to be geocoded), who other network members were involved, and which transportation mode was used (see Table 1). Also, other qualitative questions about the activity planning process were included, such as who triggered the episode, what media were used, and how far in advance the episode was planned. Finally, participants were asked about the episode in general, in terms of frequency and fixity in time and space.

As in the name interpreter section, the interview setting allowed respondents to add qualitative information about the behavioral context of each of the social episodes and patterns. Although further analysis is needed, the initial perception of the interviewers is that six social episodes seem to be an adequate number to have a good overview of the individual's social patterns, which is in part reaffirmed by results in Europe that show eight locations capturing 80% of the overall leisure activities (*9*).

4. DISCUSSION AND CONCLUSIONS

A data collection effort designed to incorporate the "social dimension" in travel behaviour has been presented; the background hypothesis of this effort is that the overall individuals' communication and social activity patterns emerge and can be inferred in part from their social networks. With that hypothesis in mind, the data collection instruments are designed to incorporate the key characteristics of the respondent's social networks, remarkably its multilevel structure, which considers the ego-network and ego-alter levels, and the interactions between egos and their alters. The instruments explicitly collect data about the interplay between social networks, the characteristics of social episodes, and their generation and spatial distribution. The study involved a multi-instrument strategy, consisting of a paper and pencil survey, and an interview, balancing aggregated and less in-depth data from a large sample, with more disaggregated and more in-depth data from a sub-sample.

The study involved a number of design options to address the intrinsic challenges of social network data collection. The first key design option corresponded to the name generator questions, which defined the way alters are elicited from the respondent. The option of focusing in emotional proximity sets the boundary of each respondent's social network elicited, and the consequent activity-travel behaviour patterns captured. This boundary choice balances previously successful network data collection methods, and seems to be adequate for the social episodes focus. In addition, the use of emotional closeness and role relationships provides a useful way of capturing adequate network sizes for the purposes of the study, addressing issues such as respondent's forgetting and fatigue. The second key design option involved the interview's sampling scheme, which combined multiple objectives, such as: i) gathering consistent samples along the interview, ii) capturing a relevant subset of the participants' network, iii) capturing a relevant set of their activity-travel episodes, and iv) lowering the risk of high respondent's burden.

Besides from those design options, the interview involved another two aspects worth remarking. First, the sociogram used to build the respondents' social networks helped to

increase their comprehension of the questions, and – we believe – also increased their motivation, especially due to the step-by-step procedure. In fact, the sociogram created emotional impact (individuals could "see" their network), and empowerment (they could "build" their networks), both elements that were very useful to prompt the subsequent name interpreter and social episode questions. Not less important, the fact that the sociogram was built in an interview setting (allowing the interviewer's help), and was constituted by simple interfaces (face-to-face and simple elements such as post-it papers) lowered the technical burden on the respondents, helping them to concentrate on their networks and behaviour. Second, the used of semi-structured questions in the interview setting encouraged gathering both systematic quantitative information about the respondents' network and behaviour, and qualitative data about the context where the phenomena studied happen. This design supports the potentially rich insights that mixed qualitative and quantitative techniques potentially give to travel behaviour research.

Still, some issues, challenges, and assumptions inherent to these kinds of data collection need to be explicitly considered. First, the people and patterns that are elicited are highly dependent on the name generator questions, which can be sensitive to aspects difficult to manage, such as the respondent's interpretation of questions. Specifically, the use of "closeness", although one of the most adequate approaches available, is not free from these kinds of potential biases. Second, even with the efforts employed in this survey, the captured network size is always limited, and represents a small portion of the respondent's total social network. As a consequence, capturing most of the overall individual's communication and activity-travel patterns heavily depends on *how many* and *which* network members are prompted. This issue also links with a third aspect, which is the collection of usual rather than observed communication and activity-travel patterns. Although much research is needed to understand the biases involved, usual patterns at the very least give an overview of the individual overall behaviour, since the related questions are rooted in objective experience, namely "with whom" those activities were performed. A final issue worth mentioning is that the complexity of the design and relatively simple interface with the respondent implies that most of the technical burden (and potential bias) is passed to the interviewer; and that the transcription stage can be complex (e.g. coding connectivity between alters) and potentially costly (in terms of time and money).

Although these challenges, the data collection effort presented in this paper constitutes a promising way of incorporating the "social dimension" in travel behaviour, linking in novel ways aspects that have been rarely studied together. The approach taken here of explicitly incorporating social network theory and method, hopefully provides a base of theory and method to give new insights about social activity-travel behaviour.

ACKNOWLEDGEMENTS

The authors would like to thank Jeffrey Boase, Kristen Berg, Rochelle Coté, Dima Dimitrova, Jennifer Kayahara, and Tracy Kennedy, members of the NetLab group at the Centre for Urban and Community Studies, at the University of Toronto, who were also part of the research team who designed and collected the data of the Connected Lives Study. Thanks also to Inna Romanovska, Phuoc Tan, and students who participated in the

survey data collection stage. The authors would also like to acknowledge the financial support received from the Social Sciences and Humanities Research Council of Canada (SSHRC), Major Collaborative Research Initiative (MCRI).

REFERENCES

1. Axhausen, K. W. and T. Gärling (1992), "Activity-based approaches to travel analysis: conceptual frameworks, models, and research problems," *Transport Reviews*, 12 (4), 323-41.
2. Bhat, C. R. and T. K. Lawton (2000), "Transportation in the new millennium: Passenger travel demand forecasting." A1C02: Committee on Passenger Travel Demand Forecasting, Transportation Research Board, U.S.
3. Bhat, C. R. and R. Gossen (2004), "A Mixed Multinomial Logit Model Analysis of Weekend Recreational Episode Type Choice," *Transportation Research B*, 38, 767-87.
4. Doherty, S and E. J. Miller (2000), "A computerized household activity scheduling survey," *Transportation*, 27, 75-97.
5. Axhausen, K. W. (2005), "Social networks and travel: Some hypotheses," in *Social Aspects of Sustainable Transport: Transatlantic Perspectives*, K. Donaghy, Ed. Aldershot: Ashgate.
6. Arentze, T., H. Timmermans, F. Hofman, and N. Kalfs (1997), "Data needs, data collection and data quality requirements of activity-based transport demand models," in *5th International Conference on Travel Survey Methods*. Grainau, Germany.
7. Doherty, S, E. Nemeth, M. Roorda, and E. J. Miller (2004), "Design and Assessment of the Toronto Area Computerized Household Activity Scheduling Survey," *Transportation Research Record*, 1894, 140-49.
8. Goulias, K., T-G. Kim, and M. Patten (2005), "On activity type classification and issues related to the *with whom* and *for whom* questions of an activity diary: Preliminary findings and pattern classification," in H. Timmermans (Ed.): *Progress in Activity-Based Analysis*. New York: Elsevier.
9. Schlich, R., S. Schönfelder, S. Hanson, and K. W. Axhausen (2004), "Structures of Leisure Travel: Temporal and Spatial Variability," *Transport Reviews*, 24 (2), 219-37.
10. Haythornthwaite, C. and B. Wellman (2002), "Introduction," in *The Internet in Everyday Life*, B. Wellman and C. Haythornthwaite, Eds. Malden, MA: Blackwell Pub.
11. Axhausen, K. W. (2002), "A dynamic understanding of travel demand: A sketch," in Arbeitsberichte Verkehrs- und Raumplanung, 119. Institut für Verkehrsplanung, Transporttechnik, Strassenund Eisenbahnbau (IVT), ETH Zurich, Zurich.
12. Dugundji, E. and J. Walker (2005), "Discrete choice with social and spatial network interdependencies: An empirical example using Mixed GEV models with field and “panel” effects," *Transportation Research Record*, forthcoming.
13. Páez, A. and D. Scott (2005), "Social influence on travel behavior: A simulation example of the decision to telecommute," *Environment and Planning A*, forthcoming.
14. Miller, E.J. and M. Roorda (2003), "A prototype model of household activity/travel scheduling," *Transportation Research Record*, 1831, 114-21.
15. Miller, E. J., M. Roorda, and J.A. Carrasco (2005), "A tour-based model of travel mode choice," *Transportation*, 32, 399-422.

16. Salvini, P. and E. J. Miller (2005), "ILUTE: An operational prototype of a comprehensive microsimulation model of urban systems," *Networks and Spatial Economics*, 1Vol. 5, pp. 217-234.
17. Gärling, T. (1998), "Behavioural assumptions overlooked in travel choice modelling," in *Travel Behaviour Research: Updating the State of the Play*, J. de D. Ortúzar and D. Hensher and S. Jara-Díaz Eds. Great Britain: Pergamon.
18. Pas, E (1990), "Is travel demand analysis and modelling in the doldrums?," in *Developments in dynamic and activity-based approaches to Travel Analysis*, P Jones (Ed.). Aldreshot, UK: Gower.
19. Clifton, K. and S. Handy (2003), "Qualitative methods in travel behaviour research," in *Transport Survey Quality and Innovation*, P. Stopher and P. Jones, Eds. Amsterdam; Boston: Pergamon.
20. Carrington, P., J. Scott, and S. Wasserman Eds. (2005), *Models and Methods in Social Network Analysis*. New York: Cambridge University Press.
21. Scott, J. (1991), *Social Network Analysis*. London: SAGE Publications.
22. Wasserman, S. and K. Faust (1994), *Social Network Analysis*. New York: Cambridge University Press.
23. Wellman, B. and S. D. Berkowitz (1988), *Social Structures: A Network Approach*. Cambridge [Cambridgeshire]; New York: Cambridge University Press.]
24. Tindall, D. and B. Wellman (2001), "Canada as social structure: Social network analysis and Canadian Sociology," *Canadian Journal of Sociology*, 26 (2), 265-308.
25. Chapin, F. S. (1974), *Human Activity Patterns in the City: Things People Do in Time and in Space*. New York: Wiley.
26. Hägerstrand, T. (1970), "What about people in regional science?" *Papers of the Regional Science Association*, 24 (7), 7-21.
27. Lu, X. and E Pas (1999), "Socio-demographics, activity participation and travel behavior," *Transportation Research A*, 33, 1-18.
28. Horton, F. and D. Reynolds (1971), "Action Space Formation: A Behavioral Approach to Predicting Urban Travel Behavior," *Highway Research Record*, 322, 136-48.
29. Marsden, P. V. (1990), "Networks data and measurement," *American Sociological Review*, 16, 435-63.
30. Marsden, P. V. (2005), "Recent developments in network measurement," in *Models and Methods in Social Network Analysis*, P. Carrington and J. Scott and S. Wasserman, Eds. New York: Cambridge University Press.
31. Burt, R. (1984), "Network items and the General Social Survey," *Social Networks*, 293-339.
32. Marsden, P. V. (1987), "Core discussions networks of Americans," *American Sociological Review*, 52, 122-31.
33. Marsden, P. V. and K. Campbell (1984), "Measuring tie strength," *Social Forces*, 63, 482-501.
34. Hogan, B., B. Wellman, J. Boase, K. Berg, J.A. Carrasco, J. Kayahara, and T. Kennedy (2005), "The making of Connected Lives," in *The Networked Neighborhood*, P. Purcell, Ed. London: Springer.
35. McCarty, C., P.D. Killworth, H.R. Bernard, E.C. Johnsen, and G.A. Shelley (2000), "Comparing two methods for estimating network size," Human Organization, 60, 28-39.

Table 1: Survey and interview questions

<table>
<tr><td colspan="2">SURVEY SECTION</td></tr>
<tr><td>I. Number of strong and weak tie network members who are</td><td rowspan="2">II. Number of strong and weak tie network members with whom the ego usually interacts i) at least once a week and ii) between once a week and once a month:</td></tr>
<tr><td>Immediate family
Other relatives
Neighbors
Work or school mates
People you know only online
People from organizations
Friends not included above
Other people not included above
Men / Women
Live in Canada at more than one hour’s travel away
Live outside Canada</td><td>By cell phone
By regular phone
By email
Using instant message
Meeting face to face
Meeting at a bar or restaurant
Visiting or hosting as a visitor</td></tr>
<tr><td colspan="2">INTERVIEW SECTION</td></tr>
<tr><td>I. Name generator and sociogram building</td><td>II. Name interpreter questions</td></tr>
<tr><td>1. Generating names
1.1. Eliciting strong and weak tie network members:
Very close people (strong ties): discuss important matters with, or regularly keep in touch with, or there for you if you need help
Somewhat close people (weak ties): more than just casual acquaintances, but not ‘very close’
1.2. Roles of each person, allowing for multiple roles (multiplexity)
2. Locating very close and somewhat close names in sociogram
2.1. Locate very close and somewhat close people according to how “close” they feel
2.2. At the same time, locate people that know each other close to each other
3. Tie connectivity
3.1. Draw ties among groups of people who all are very close among each other
3.2. Draw ties among groups of people who all are at least somewhat close among each other
3.3. Draw very close ties between two people
3.4. Draw somewhat close ties between two people</td><td>1. Alter’s characteristics
Age, relationship, job, ethnic heritage, home location, most frequent place of interaction
2. Face-to-face
Frequency (# per year, month, week, day)
On average, how long spend together
Who go to see the other
3. Socializing
Frequency (# per year, month, week, day)
On average, how long spend together
Who invites
4. Telephone contact
Frequency (# per year, month, week, day)
On average, how long conversations are
Who calls (Scale 1 – 5; 1 = “me”, 5 = “him/her”)
Landline or cell phone use (ego and alter)
5. Email contact
Frequency (# per year, month, week, day)
On average, how long emails are (scale 1 – 5; 1 = “short”, 5 = “long”)
Who sends emails to who (Scale 1 – 5; 1 = “me”, 5 = “him/her”)
6. Instant message contact
Frequency (# per year, month, week, day)
On average, how long the conversations are
Who starts the conversation (Scale 1 – 5; 1 means “me”, 5 means “him/her”)</td></tr>
<tr><td colspan="2">III. Social episode questions</td></tr>
<tr><td>1. About the specific social episode
What it was about, when it was (time of the day, day of the week, duration), where it was (detailed spatial location), who else was involved, transportation mode, planning: how it was planned (routine, media), how far in advance</td><td>2. About the episode in general
Frequency
Place fixity / recurrence
Time fixity / recurrence</td></tr>
</table>

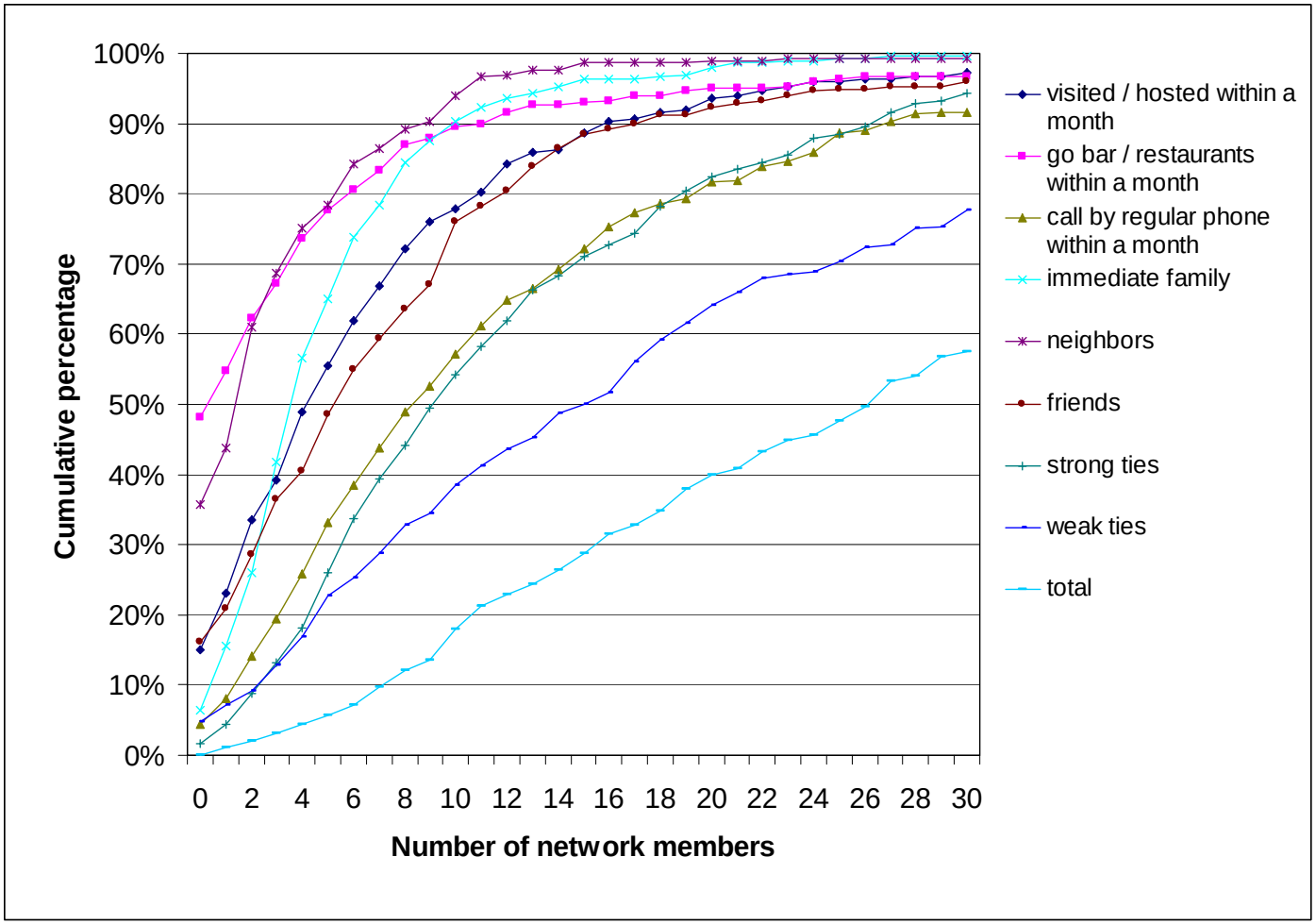


Figure 1: Cumulative percentage of network members by selected categories

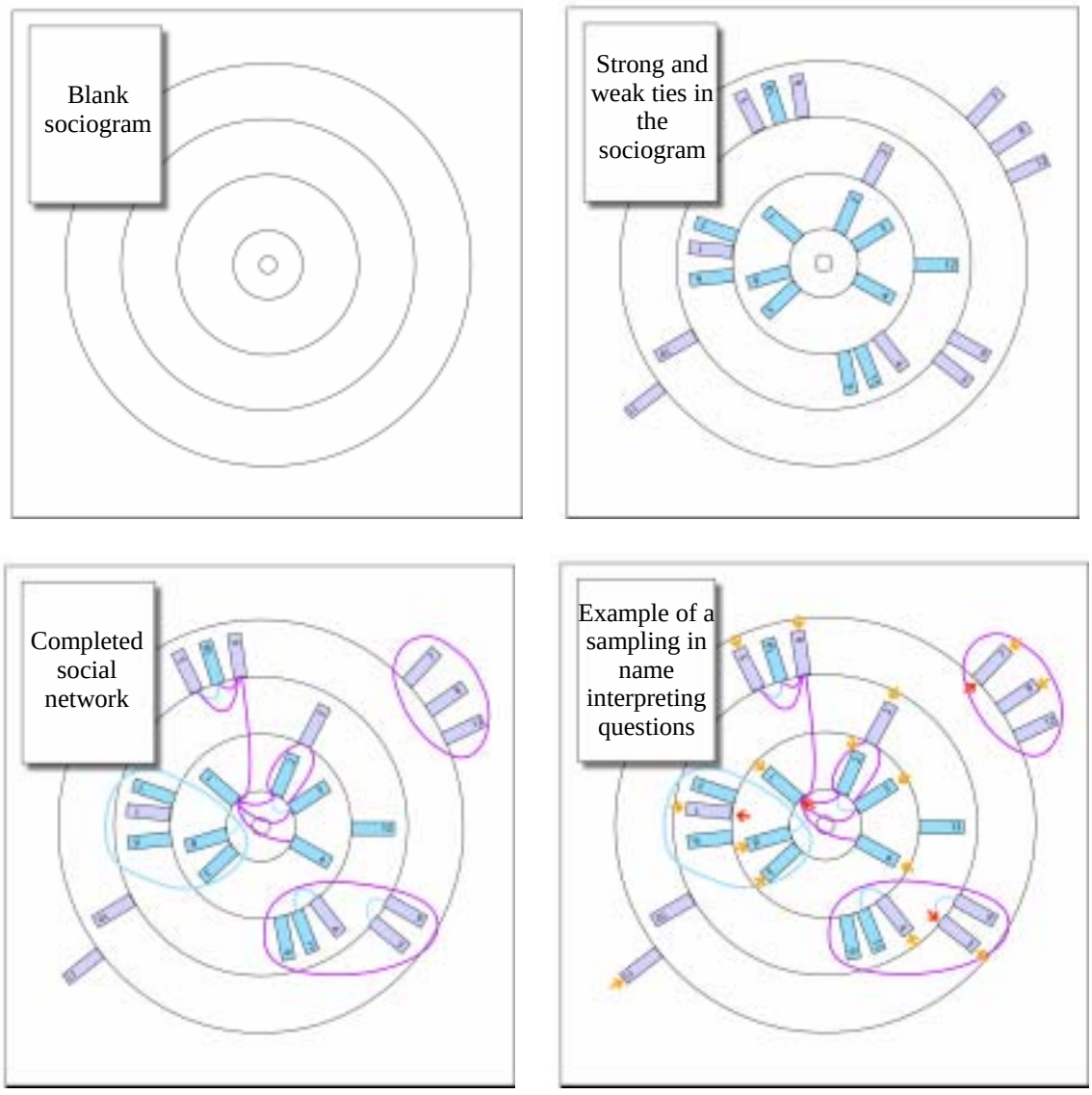
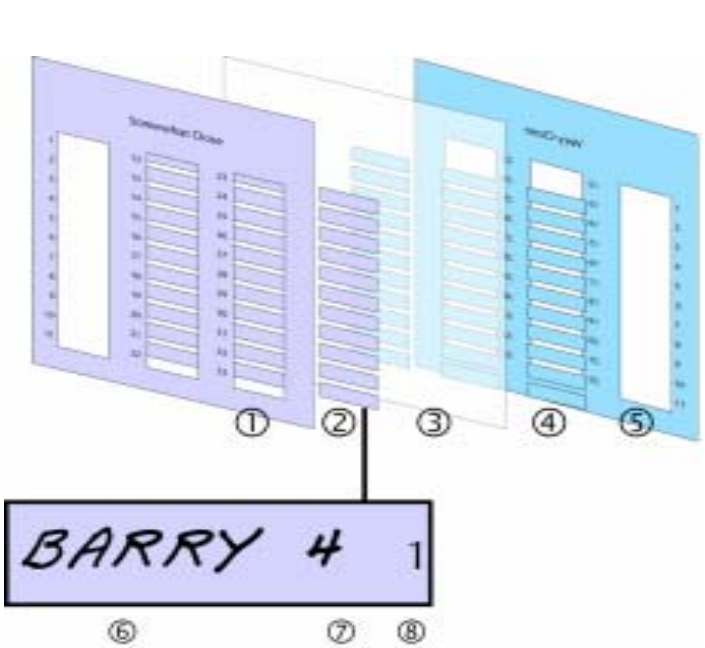
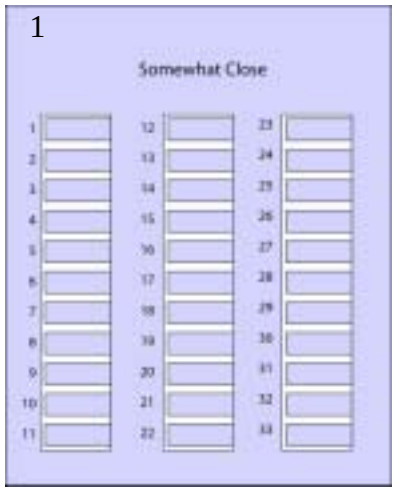


Figure 2: Sociograms in different stages of the interview.
Each post-it rectangle represents an alter (with different colors depending on the tie strength), circles indicate groups of alters with ties among all of them, and lines represents ties between a pair of alters



(1) Cover of weak tie template
(2) Post-it notes for weak tie network members
(3) Sheet to separate both templates,
(4) Post-it notes for strong tie network members
(5) Cover strong tie template,
(6) Alter's name
(7) Alter's role number
(8) Alter's rank number



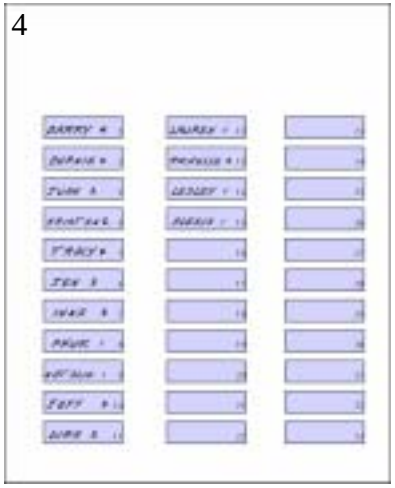


Figure 3: Overview of the name template and the answering process