Strong and weak relationships
Tie strengths in egocentric leisure networks

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1. Introduction

Focussing on the global coherence of personal leisure networks is the aim of a survey project conducted by ETH Zurich and TU Berlin. Employing the name generator approach the study collects data on egocentric leisure networks. This method is combined with snowball sampling to get an idea of the global network structure beyond isolated respondents’ horizons. The paper focuses on the surveyed personal networks’ structures in terms of tie strength. It briefly introduces both survey instrument and strategy. Secondly, it summarizes the theory of tie strength. ‘Strong’ and ‘weak’ relations are assumed to be important as both types of contacts offer different kinds of support. In order to be well connected, a person needs both kinds of contacts. Thus, the unequal availability of both kinds of contacts is a source of social inequality. Because tie strength has impacts for a society’s coherence, this topic is also of interest for the analysis of social conflicts. The paper analyses personal networks’ composition along traditional dimensions of social inequality analysis such as sex, age, level of education and income. It also checks the shares of kin and non-kin contacts included in strong and weak ties. In addition, it focuses on the spatial distances between interaction partners, relation durations and contact frequencies, which are known to be related to tie strength. Finally, a multilevel logistic regression model is estimated to predict whether a social contact is strongly or weakly related.

2. Surveying connected egocentric networks: A brief introduction

The field of transport planning uses the methods of social networks analysis to approach and explain leisure travel (see Larsen et al., 2006; Carrasco 2006; Frei and Axhausen 2007; van den Berg et al., 2009). Most of these network studies used random samples to recruit their
respondents. Given large target populations this made overlaps between egocentric structures unlikely. So, these projects exclusively focussed on isolated respondents’ horizons without being able to capture the coherence between the egocentric structures. Surveying data on connected personal networks aims to look beyond respondents’ horizon and allows inferences on network’s coherence on a macroscopic level. Collecting these information and impute social networks in large agent based travel demand simulations is the primary aim of the present survey project.

The survey instrument contains four topics: First it asks for respondents’ characteristics. This is followed by two name generator questions offering several stimuli to focus respondents on their leisure contacts. Literature on name generators recommends the use of at least two questions to support respondents’ memory processes and survey the network of interest as completely as possible (Marin, 2004; Marin and Hampton, 2007). The questions of the present name generators are:

1) Please list the people with whom you make plans to spend free time (Examples: errands, sports, club or organized activities, cultural events, cooking together or going out to eat, taking holidays or excursions together).

2) If there are other people with whom you discuss important problems, please list them here.

The questionnaire allows respondents, also referred to as egos, to write down 40 social contacts, referred to as alters. In case they wanted to report more names, respondents were asked to write them down on an extra sheet of paper, so that in principle the number of contacts was unlimited. However, only the first forty names were considered for analysis. Egos were not asked to mention alters which fit in both categories twice. Therefore multi-relational analyses are not possible. The third part of the survey instrument is a name interpreter asking egos to provide details like e.g. socio-demographics on each contact mentioned in the name generator. Finally, a sociogram asks respondents to report groups of alters making plans to spend free time together. This information enriches the ego – alter
relations reported in the name generator as they can be used as a proxy for alter – alter relations. In terms of graph theory each of the reported groups is considered as a clique, a fully connected sub-graph. This form of a sociogram allows an easy participation for respondents without resulting in high response burden or needing the help of an interviewer. It will, on the other side, result in an overestimation of alter – alter relationships. The sociogram provided space for 20 groups at maximum (for more details on the survey instrument see Kowald et al., 2009).

Applying snowball sampling aims to survey connected rather than isolated personal networks. In comparison to studies using name generators to exclusively collect information on certain kinds of contacts the present study enlarges this aim and uses egos’ information on alters as the basis for further recruitment. All alters mentioned are checked for re-identification and asked for participation. Snowball chains were started with 40 ego-seeds found with the help of a stratified random sample of the Canton Zurich population. For 20 seeds chains were continued up to iteration 2 egos mentioning iteration 3 alters. The remaining 20 chains passed iteration 3 and will be continued up to iteration 4 egos mentioning their iteration 5 alters. Data collection for these additional iterations is in the field currently. From researchers side the chains are neither limited geographically, nor by any institutional setting or contact mode. An illustrative example for a component resulting from a snowball chain is given in figure 1.

Figure 1: An illustration of a three-iteration snowball chain.
Offering the advantage of collecting information on connected personal networks is in case of snowball sampling countered by the disadvantage of several sources of bias. Basically there are three issues (for a detailed overview see Erickson, 1979): Snowball samples do not fit the criterions of random samples as all alters and with that all potential egos on the iteration levels are mentioned selectively by earlier egos (Coleman, 1958). Secondly, snowball sampling gives persons with many social contacts a better chance of becoming part of the sample as each social contact is a potential communication channel for recruitment. Finally, there is the danger of being captured in a homogeneous cluster of respondents. Status homophily in terms of e.g. socio-demographics is a well documented phenomenon in network studies (see e.g. McPherson et al., 2001). In case this similarity resulted in an attribute dominating the sample, it would not reflect a population’s heterogeneity.

Employing arrangements to establish trust between respondents and the research team and to increase the response rate, e.g. a 20 CHF incentive was given to all potential respondents with the survey instrument and egos were asked to sign greeting cards for their alters, which then were send by the research team (for more details see Kowald et al., 2009), a response rate of 27% was achieved and is considered as satisfying (calculated following the COOP4 cooperation rate as suggested by AAPOR (2009)). Depending on the amount of response burden implied in a question and the number of reported social contacts the data contain some
fatigue effects. However, the share of missing values is low, around 3% for egos’ and 13% for alters’ characteristics (for details see Kowald, 2010). Although there were no geographical limits for the snowball chains, the sample is highly clustered in Switzerland, and more precisely, in its German speaking part. In all, the sample matches the Swiss population’s surprisingly well. However, there is some bias and post-stratification will be done once the survey is completed.

3. Of network sizes, core contacts, and weak connections

Considering the microscopic level of isolated personal leisure networks a network size equals the number of social contacts an ego reported in the name generator. These contacts can be distinguished into ‘strong’ and ‘weak’ connections and both have different impacts for an ego. Although there are different definitions for tie strength (for an overview see Wellman and Wortley, 1990) they all mention similar characteristics:

In terms of relational distance strong ties are closely related to each other. They meet frequently, exchange ideas, and want their feelings to be congruent. Strong contacts are emotionally important for egos as they are a source of support and help in crises. These contacts are also called an ego’s core discussion network (Marsden, 1987). The stronger the relationship between two persons, the larger is their emotional support for, and their mutual influence on each other (McPherson et al., 2006). Egos and their strong contacts are likely to be densely interconnected and from a group, whereby news, information, or ideas circulate in this group. It is often assumed that relational distance is connected to social distance. According to the phenomenon of homophily, describing an often observed similarity between egos and alters in a network structure, persons with similar socio-demographics and kinds of behaviours often flock together (see Mc. Phearson et al., 2001). Persons with similar
characteristics are often strong contacts. Because of their similarity they offer access to similar kinds of resources.

In case of weak ties the need of cognitive balance is less crucial. Persons, that are weakly connected, meet less frequently, are less emotionally important for each other, and are often sparsely interconnected within an ego’s network. Also, social distance between them is larger. In terms of socio-demographics and behaviour they are dissimilar to ego and one another. So they offer access to a wider range of resources than strongly related persons. Weak ties ‘bridge’ egos to persons who are different in terms of news, information, or ideas. A (local) bridge is a tie that (indirectly) connects many persons to each other and is a crucial part of the shortest paths between them (e.g. imagine a tie between the ego-seed in figure 1 and another ego-seed). Thus, weak ties are of importance on both the microscopic as well as the macroscopic level. They act as a form of social capital by linking the ego to different spheres of society and transmit information from beyond egos’ personal network horizon. In addition, weak ties are of importance for macroscopic network structures as they connect between different groups. Removing an average weak tie from a ‘global’ network results potentially in more problems than removing an average strong tie (see Granovetter, 1973). So, weak connections are of importance for societies’ coherence and might play a role in situations of social conflict.

In summary, persons with only few or no strong contacts have the risk of lacking emotional support and altruistic help. However, they might be able to hold large numbers of weak connections by having access to large amounts of social capital in terms of fresh information.Persons with many strong and only few weak contacts, on the other side, experience lots of emotional- and altruistic support. For weak ties they might be less attractive as they themselves have access to only small amounts of social capital. The advantage of emotional shelter is than counterbalanced by low information diffusion rates. Thus, networks’
composition in terms of strong and weak ties is a source for social inequality particularly in cases where these differences are related to egos’ socio-demographics.

The present survey’s name interpreter employed two proxy questions to measure tie strengths. Respondents were asked whether they discuss important problems with their alters and whether they ask them for help when in trouble. In cases egos shared with an alter both concerns the relation was considered as strong, otherwise as weak. In Otnes (2009) critique on Granovetter’s work one of his major points concerns the segregation of ties in strong and weak ones with the help of proxies as not all methods are reliable. Addressing this argumentation we first present some information on the reliability of the survey project’s proxy questions.

Overall 565 egos participated so far (all data are as of September 2010). Around 6% did not report any social contacts. Excluding those, 531 egos mentioned 10,836 alters in the name generator. For 13.5% of the ego – alter relations no information about tie strength are available. This amount of item non-response seems high, but it has to be considered that the instrument implied a high overall amount of response burden and that the two proxy questions were at last position in the name interpreter, which made them susceptible to fatigue effects.

The 531 egos reported around 19 leisure contacts on average, of which 32% are strongly and 68% are weakly related. Focussing on the median, there are 5 strong and 12 weak social contacts in the average network (for some alters no information on tie strength are available). The numbers are comparable to those mentioned in literature: In terms of active network sizes, defined as personal relationship over the last two years, Roberts et al. (2009) found the number of emotionally close alters being 5, the size of on egos’ sympathy group being between 12 and 15. Concerning the core discussion network of Americans, Marsden (1987) reports an average network size of 3, a number which decreased in the following years (McPherson et al., 2006). Providing a network-based explanation for language, to replace grooming and allow a larger number of emotionally close contacts, Dunbar (2003) estimated
the number of a core discussion network being around 4, including the ego. The numbers of the present survey nearly match these results.

Furthermore, literature on tie strength reports the nuclear family as being often used as strong ties, whereas weak relations often imply non-kin contacts (see Marsden, 1987; McPherson et al., 2006; Roberts et al., 2009). Again, this relation is confirmed by the snowball data, were 69% of all nuclear family contacts are labelled as strong, whereas only 24% of the remaining contacts are strongly connected.

It is assumed that core contacts are well remembered and listed first in name generator lists (see Brewer, 1995; Marsden, 2005), which also is observed in the present data. Focussing on different positions of the name generator shows the share of strong contacts clearly decreasing with names’ position increasing. From position 1 to 5 more than every second alter is strongly connected whilst only around 20% of the alters at position 31 to 40 are considered as emotionally close ties.

Although different name generators result in different social contacts and comparisons are rather limited (see e.g. Campbell and Lee, 1991; Marsden, 2005) the surveys’ two proxy questions for tie strength seem to be valid.

4. Egos’ characteristics and tie strength

Persons with similarities in socio-demographics and behaviour are likely to form ties and flock together. They are often strongly connected and offer emotional support for each other. On the other side, the more socio-demographic heterogeneity an ego is connected to, the better this ego is linked to different spheres of society, which is important for e.g. information gathering (see Marsden, 1987). The present data allows focussing on tie heterogeneity in terms of sex, age, education level, and civil status, which are rather weak indicators for social spheres. Since the definition of categories influences the degree of homophily they have to be mentioned: Sex is used dichotomous. Age similarity is defined as egos’ age plus/minus 10 years. Civil status uses five categories: single, married, divorced, widowed, and living
Education is categorized in three classes: primary (elementary school), secondary (high school), and higher education (any kind of university degree). Degrees of status-homophily were calculated for each egocentric network, either for weak and strong contacts twice: once by including ties between egos and their relatives and the second time by excluding all kin contacts.

The distinction between relatives and non-relatives is important. Whilst relatives are often strongly connected, the graph clearly shows that they are a substantial source of heterogeneity in both kinds of ties: strong and weak ones. Excluding kin contacts shows character similarity increasing rapidly for strong and moderately for weak ties. So, homogeneity is stronger in contacts that are chosen and not present as a matter of birth. When relatives are excluded, weak tie characteristics are more heterogeneous and potentially offer wider access to different social spheres than strong tie contacts. When relatives are included, the differences in strong- and weak ties heterogeneity are rather small. So, weak ties might bridge egos to different spheres of society but relatives might, even when they are frequently labelled as strong contacts, too. On the other side, it has to be mentioned, that heterogeneity for relatives in some characteristics usually comes together with high amounts of homophily in other characteristics, e.g. religion, race and ethnicity (see McPherson et al., 2001), which is not necessarily the case for non-kin contacts.
Figure 2: Degrees of status similarity in strong and weak contacts.

Personal leisure networks’ composition is analysed descriptively along traditional lines of social inequality: sex, age, civil status, parenthood, education, and household income. An overview is provided in table 2. To check whether there are differences in the distribution of weak and strong ties within personal networks, two sample Wilcoxon rank sum tests (Mann-Whitney-tests) were employed. Wherever egos’ characteristics were not dichotomous all attributes were tested against each other. Wherever alters are referred to as relatives this description includes all relatives, not only respondents’ nuclear family.
### Table 1  Tie strength along traditional lines of status-inequality

<table>
<thead>
<tr>
<th>Egos’ characteristic</th>
<th>Share of attribute in sample [%]</th>
<th>Share of strong contacts [%]</th>
<th>Share of relatives [%]</th>
<th>Network size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>62.87</td>
<td>34.77</td>
<td>30.05</td>
<td>19.75</td>
</tr>
<tr>
<td>Male</td>
<td>37.13</td>
<td>38.19</td>
<td>28.76</td>
<td>20.93</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 - 37</td>
<td>12.99</td>
<td>39.91</td>
<td>23.94</td>
<td>18.65</td>
</tr>
<tr>
<td>38 – 45</td>
<td>21.83</td>
<td>35.02</td>
<td>29.88</td>
<td>21.94</td>
</tr>
<tr>
<td>46 – 52</td>
<td>16.25</td>
<td>37.02</td>
<td>30.11</td>
<td>20.16</td>
</tr>
<tr>
<td>53 – 60</td>
<td>20.90</td>
<td>34.61</td>
<td>30.64</td>
<td>22.28</td>
</tr>
<tr>
<td>61 +</td>
<td>28.02</td>
<td>35.69</td>
<td>30.57</td>
<td>19.25</td>
</tr>
<tr>
<td><strong>Civil status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>73.69</td>
<td>34.79</td>
<td>31.55</td>
<td>21.28</td>
</tr>
<tr>
<td>Unmarried</td>
<td>26.31</td>
<td>39.70</td>
<td>24.19</td>
<td>18.47</td>
</tr>
<tr>
<td><strong>Children in household</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>42.44</td>
<td>37.25</td>
<td>30.47</td>
<td>21.66</td>
</tr>
<tr>
<td>No</td>
<td>57.56</td>
<td>34.17</td>
<td>29.50</td>
<td>21.39</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>3.49</td>
<td>29.70</td>
<td>27.51</td>
<td>18.37</td>
</tr>
<tr>
<td>Secondary</td>
<td>49.94</td>
<td>35.36</td>
<td>29.77</td>
<td>19.02</td>
</tr>
<tr>
<td>Higher</td>
<td>46.57</td>
<td>37.19</td>
<td>28.03</td>
<td>22.10</td>
</tr>
<tr>
<td><strong>Household income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 8’000 CHF</td>
<td>32.97</td>
<td>40.99</td>
<td>29.20</td>
<td>17.66</td>
</tr>
<tr>
<td>8’001 – 12’100 CHF</td>
<td>32.36</td>
<td>33.24</td>
<td>30.46</td>
<td>20.56</td>
</tr>
<tr>
<td>12’101 + CHF</td>
<td>34.67</td>
<td>33.41</td>
<td>28.03</td>
<td>24.64</td>
</tr>
</tbody>
</table>

In terms of egos’ sex there are no significant differences in network composition. Males and females have similar shares of strong ties. In addition, their network sizes and the share of relatives in their networks as well as the share of relatives in strong and weak ties are similar.

Egos’ age is categorized in quartiles’ range and an additional class for retirees (61 years and older). Although there is an increased share of strong ties for respondents in age class 1 (under 37 years), around 40%, this difference is not significant when compared to the other
age classes with a share of around 35%. Focussing on kin contacts shows respondents’ younger than 37 years having significantly lower shares of relatives in their networks, 23% on average. All other age classes have a 30% share of relatives. Checking for differences in strong and weak ties’ composition shows these younger respondents also having significantly lower shares of kin contacts within their strong ties, 46% on average. For all other age classes the share of kin contacts within strong ties is dominant, around 55%. Younger respondents’ networks as well as their core network rely less strongly on relatives as the network structures of older persons. To receive emotional support they frequently use non-kin contacts. Network sizes stay relatively constant over all age classes, around 20 persons with a peek for respondents between 53 and 60 years, reporting 22 contacts on average, and 19 contacts for those under 37 years.

Civil status is summarized in two classes: unmarried persons, containing singles, divorced, widowed, as well as respondents living separately from their spouses, and married ones. Between these two categories a significant difference in network composition exists. Whilst married respondents report lower shares of strong contacts within their network structures, 35%, unmarried persons have higher proportions of strong ties, 40%. In addition, married respondents report significantly higher shares of relatives in their networks. Focussing on strong tie composition shows married persons implying significantly more kin contacts within their strong ties, around 58%, compared to unmarried persons, where strong ties only have a 42% share of kin-contacts. In combination with a significantly increased network size for married respondents this shows couples as sharing their formally separated networks. This increase in network size might cause managing problems, e.g. in terms of marginal costs and efforts to maintain relations. So, couples have smaller shares of strong contacts, which demand higher efforts to be maintained, and tend to focus stronger on kin-contacts in both, their overall leisure networks as well as their core network. This might, on the one hand, be due to social norms like “blood is thicker than water”, idealizing the assumed long-term
reciprocity of kin ties and promoting family welfare, or, on the other hand, be simply influenced by relatives’ position in the kinship system rather than being related to their support (see Wellman and Wortley, 1990). However, people put more efforts in maintaining kin-contacts.

Respondents with children in the household have significantly higher shares of strong ties, around 37%, then those without children, around 34%. There are no further differences observed. Persons with children might depend on strong contacts for some kinds of help, like e.g. babysitting or they might have an increased demand for emotional support as parenthood might, at least some times, go together with sorrows. There is no hint, that parents commonly mention their children as strong contacts as the share of relatives does not increase.

Levels of education were summarized in three categories: primary, secondary, higher educated persons. These rather wide ranging categories have advantages since some respondents are Non-Swiss and the survey collected information on various types of education. On average, the share of strong ties within personal networks increases with the educational level. However, these differences, as well as the differences in network size and the shares of relatives are not significant. The only significant difference is a decrease in networks’ density.

Household income is summarized in three categories: 8’000 CHF per month and lower, a class that contains the Swiss average household income of around 7’000 CHF (see ARE/BFS, 2007), households with an income above average, and an additional class for very high household incomes. Comparing the first income class to the later two shows the share of strong contacts within personal leisure networks decreasing significantly from around 41% to around 33%. The share of relatives stays nearly constant. Network size, on the other hand, increases significantly from 18 to 21 to 25 alters on average. This causes a significant decrease in network density. Contrarily, the share of relatives within strong contacts increases from 49% for the lowest income class to 53% for the highest one. Persons in higher income classes seem
to be more attractive to others than those with an average income level. The larger network sizes result in decreasing shares of strong contacts and a decrease in density. In addition, richer persons are more likely to use kin contacts for emotional support compared to respondents with an average income level.

In summary, there are differences in leisure networks’ compositions along at least some traditional dimensions of social inequality analyses. Some findings, e.g. in civil status and household income, suggest that larger networks go hand in hand with an increased number of weak contacts. Comparing reported network sizes with the share of strong contacts shows that an increase in size is related with a decrease in strong ties’ shares. The correlation is highly significant and negative, -0.293 (tested with a two-sided Pearson test; p-value = 0.000). This finding is confirmed by other studies, which showed that larger networks are not simply scaled up versions of smaller networks but that their increase in size is mainly caused by a larger number of weak contacts (see Roberts et al., 2009).

5. Tie strength and geographical distances

Another important factor that influences networks’ composition is the spatial spread of social contacts. Because strongly related persons want their feelings to be congruent they have to stay in contact, which needs coordination and opportunities. Certainly there are the various modes of electronic communication technologies (ICT) available today, which allow to stay in contact over large distances at relatively low costs. Still, face-to-face meetings are known for being of high importance as they are assumed to be more intensive by e.g. forcing interaction partners to share the same environment and allowing non-verbal communication (Mokhtarian and Salomon, 2002).

In general, communication frequency is known to decrease with increasing geographical distance, a trend that is also present in leisure networks (see Larsen at al., 2006; Carrasco, 2006; Frei and Axhausen, 2007). Whilst there are only few studies focussing on the relation between networks’ composition, contact frequencies and physical distance, these projects
showed that strong ties heavily rely on face-to-face meetings and phone contacts (see Tillema et al., 2007). In addition, Latanè et al. (1995) report that influential ties, defined as persons with whom memorable activities were performed, are characterized by and strongly decrease with spatial distance.

Figure 2 provides an overview on shares of leisure contacts living at certain great circle distances from egos’ home locations. Distance class 1 are local contacts living less than 1 km away from egos’ home location. It contains 19% of all leisure contacts. This confirms findings reported by Wellman (1996), which showed nearly 20% of all active ties being persons from respondents’ neighbourhoods. In the present data, nearly 35% of these alters are strongly related to ego and the chance that one of these close contacts is a kin is high with around 52%. 35% of all alters live in the second distance class from 1 and 10 km distance. They can be labelled as regional contacts. The share of strong contacts within this class decreases smoothly and the share of kin contacts within the strongly related alters decreases substantially. Distance class three from 10 to 100 km, can, at least in the Swiss context, be labelled as nationwide and contains around 38% of the alters. The share of strong contacts is similar to distance class two. The share of kin contacts within strongly related alters decreases further to around 30%. Only 6.2% of all leisure contacts are European-wide, living at distances between 100 and 1’000 km. The share of core contacts is increasing again. In addition, the share of relatives increases. The last distance class, containing 1% of all alters, the international ties, who live more than 1’000 km away, have the highest share of strongly related alters of all distance classes, and, in addition, these strongly related persons are in nearly 47% of all cases relatives.

In summary, there is a relation between geographical and relational distance. Contacts living very close and those living at long distances from the egos are often of high emotional importance for them. In addition there is an increased chance, nearly 50:50, that they are kin contacts. In contrast, most contacts live between 1 and 100 km away. The share of strong
contacts decreases for both classes and these closely connected persons are often non-kin contacts. There are two further distance related trends in the data, which have to be mentioned. The farther away an alter lives, the longer the relation is on average. Keeping the lowest 95% of all reported distances and the lowest 95% of all durations, to avoid bias from outliers, shows them being weekly but significantly correlated (two sided Persons test = 0.122; p-value = 0.000). This can be interpreted as a proxy for networks’ history. Persons accept large efforts to maintain relationships with others they have known for a long time even over large distances. Often they do not only stay in contact but there is a fair chance of keeping this contact as a strong relationship alive. Not surprisingly this holds for relatives especially. By comparing annual face-to-face meeting frequencies to ICT-contacts, here telephone, e-mail, SMS, and chat, shows contact frequencies not only clearly decreasing with increasing distance, but, in addition, that there are substantially higher contact frequencies with strongly connected persons for both face-to-face and ICT contacts at all distance classes than with weak contacts.

Figure 3: The spatial spread of social contacts by tie strength.
6. Predicting tie strength: Who is strongly and who is weakly connected?

Focussing on social inequality in terms of tie strength is related to the probabilities for egos’ to label certain alters as weakly or strongly connected. Considering the primary aim of the present survey project, to impute leisure networks in agent based travel demand simulations, this question is relevant too, as strongly related persons are more densely interconnected and meet more frequently than weakly connected partners. Resulting from this there is a higher probability for closed triangles for some network structures. On the other side, weak ties might bridge between groups which results in a lower global clustering coefficient for the overall snowball graph.

Employing a multilevel logistic regression model with a random intercept allows to model the nested data structure and the dichotomous character of the dependent variable. So, the probability of a connection to be strong or weak is predicted by both: level 1 variables, representing the individual level of personal leisure relations, and level 2 variables, representing egos’ socio-demographics and network characteristics (for an introduction in multilevel regression analysis see Snijders and Bosker, 1999; Goldstein, 1995). Basically, multilevel models take into account that variables at level 1 might vary within an egocentric network and their means might change between the personal network structures whilst, on the other side, variables at level two only vary between the networks. A random intercept model reflects that in some networks there might be higher probabilities for certain alters to be strongly connected to ego than in others. Table 2 shows the logistic regression model including certain level 1 and 2 effects.

Focussing on level 1 shows that an increasing number of annual contacts, face-to-face as well as ICT-contacts, and an increasing relationship duration affects the probability of being chosen as a strong contact positively. The largest positive effect was found for a dummy variable indicating whether an alter is a relative. In addition, a dummy for sex homophily showed an large positive effect too. No further level 1 variables, whether dealing with alters’
socio-demographics, indices of homophily or the geographical distance, used as distance in kilometers and its logarithm, were estimated as being of significant influence.

The model fit improved significantly by adding certain level 2 variables. A rather large significant and positive effect was found for the number of children in an ego’s household. The more children in a household, the higher the probability that contacts become strongly connected. A negative effect was found for network size. This was expected as larger networks usually imply more weak contacts, so that the overall probability of strong ties decreases. The residual variance, related to level 2, proves that there is significant variability in the chances for certain alters to be strongly connected between different network structures.

Table 2  Multilevel logistic regression model on tie strength

<table>
<thead>
<tr>
<th>Effects</th>
<th>Coefficient</th>
<th>t-value</th>
<th>Odds ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>3.031</td>
<td>10.445</td>
<td></td>
</tr>
<tr>
<td>Effects on level 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relation duration [years]</td>
<td>0.054</td>
<td>12.712</td>
<td>1.055</td>
</tr>
<tr>
<td>Face-to-face contacts [annual meetings]</td>
<td>0.007</td>
<td>4.339</td>
<td>1.007</td>
</tr>
<tr>
<td>ICT contacts [annual meetings]</td>
<td>0.013</td>
<td>11.570</td>
<td>1.013</td>
</tr>
<tr>
<td>Sex homophily [y/n]</td>
<td>0.236</td>
<td>2.895</td>
<td>1.266</td>
</tr>
<tr>
<td>Reference = different sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alter is a kin contact [y/n]</td>
<td>0.758</td>
<td>5.760</td>
<td>2.135</td>
</tr>
<tr>
<td>Reference = non-kin contacts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effects on level 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children in household [number]</td>
<td>0.342</td>
<td>3.784</td>
<td></td>
</tr>
<tr>
<td>Egos’ degree [number of alters]</td>
<td>-0.028</td>
<td>-2.946</td>
<td></td>
</tr>
<tr>
<td>Residual variance</td>
<td>2.470</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

The model was estimated with the Mplus software (see Muthen and Muthen, 2007).

7. Conclusions

Personal leisure networks were analysed in terms of tie strength. Distinguishing between strongly and weakly related persons is important as theoretically both kinds of contacts offer
different kinds of support. Thus, systematically different shares of strong and weak ties are a source of social inequality. They also have different impacts for the global coherence of societies and for which they are also related to social conflicts.

No clear answer was found to the question whether weak ties are more appropriate to connect a person to different spheres of society. Focussing on non-kin contacts the answer is ‘yes’, but for relatives in the networks the answer is ‘no’.

In terms of respondents socio-demographics we found large differences in networks’ composition along some dimensions of social inequality. The strongest effects were found for civil status and household income. Both variables are related to personal networks’ sizes: married persons share the network of their partners and richer persons are more attractive to others. However, focussing on tie strength by distinguishing between personal attributes showed relatives being frequently used as leisure contacts and often involved in emotional support. People seem to put much effort in maintaining relationships to relatives. Because social contacts are not only socially diverse but also spread in space, this dimension was descriptively analysed too. There is a correlation between spatial distance and tie strength. In addition, spatial distance and tie strength are correlated with the duration of persons’ relations.

Finally, a multilevel logistic regression model was presented, analysing the probabilities for ties to be labeled as ‘strong’ or ‘weak’. It showed that the probabilities for contacts to be strong or weak are influenced by alters’ and ties’ characteristics. Furthermore, there are significant differences in the networks’ structures and in egos’ socio-demographics influencing the probabilities for relations to be considered as ‘strong’ or ‘weak’.

A part of the survey is still in the field and will be finished in the first months of 2011. Future research will particularly focus on advanced multilevel models. As the data result from snowball sampling they contain a third hierarchical level: the connected personal networks, each started by a ego-seed, which is not considered in the model presented above. In addition,
we will focus on persons’ positions in the overall snowball graph in terms of different shares of strongly and weakly related persons. Checking for centrality and betweenness indices by focussing on different shares of strong and weak ties allows to investigate whose network structure is more central in the overall graph and who holds powerful positions, which can be of interest in both fields: social inequality analyses and the analyses of social conflicts. Furthermore we plan to conduct spatial analyses, e.g. to see how often weak or strong ties connect between different language regions within Switzerland.

8. Literature

Erickson, B.H. (1979) Some problems of inference from chain data, Sociological methodology, 10(1) 276-302.


Otnes, P. (2009) A tie is not just a tie. From ‘weak ties’ to ‘social capital’, a critique, Sosiologisk Arbok, 3 120-146.


