Legend
• location contacts
• home location

Investigating the Relationship between Individuals' Social Networks, Mobility Behaviour, and Social Capital – Survey Method and First Results

Sergio Guidon, ISTP, ETH Zurich
Michael Wicki, ISTP, ETH Zurich
Prof. Dr. Kay Axhausen, IVT, ETH Zurich
Prof. Dr. Thomas Bernauer, CIS, ETH Zurich

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Sergio Guidon
ISTP
ETH Zürich

Michael Wicki
ISTP
ETH Zürich

Prof. Dr. Kay Axhausen
IVT
ETH Zürich

Prof. Dr. Thomas Bernauer
CIS
ETH Zürich

email:
sergio.guidon@ivt.
baug.ethz.ch:

email:
michael.wicki@is
tp.ethz.ch

email:
axhausen@ivt.baug.ethz.
ch

email:
thbe0520@ethz.ch

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Abstract

Decreasing costs of travel and communication have led to increased mobility, which enabled a large fraction of society to maintain a geographically wide spread social network. The maintenance of an individual's social network requires physical travel and is responsible for the largest share of leisure travel. Individuals' social networks are also a core component of social capital. However, an investigation connecting the social network geography and travel behavior with individuals' social capital has yet to be conducted.

A survey with the goal to investigate these issues is presented. Data about individuals' mobility behavior is collected and combined with an analysis of their egocentric social network. This allows for an investigation of the link between the spatial distribution of contacts in individuals' social networks and their travel behavior. In addition, specific questions about the contacts allow for an estimation of the network component of social capital at the local, regional and supraregional level. The data collected in the survey leads to a better understanding of the relationship between individuals' social networks and their travel behavior. Simultaneously, collecting data on the core components of social capital aims at evaluating the impact of the size of the social network geography on social capital.

Keywords

Social Capital – Mobility Behavior – Social Network

1. Introduction

Daily travel distance per person and day has continued to increase. This led to an increased spatial mobility as well as a growing activity space. At the same time, travelling can be understood as a means to an end as it allows participating in activities, which in turn provide individuals with social capital (Kowald, Axhausen, et al., 2015; Kowald, Arentze, et al., 2015). Social capital can broadly be defined as values derived from resources embedded in social ties with others (Lin, 2005). The concept of social capital was first used to characterize the structure of opportunity and action in communities (Coleman, 1988, 1990). But the idea has been adapted to transportation in a number of studies. Putnam (2000) i.e. already mentions travel behaviour as he argues that the increased time and distance of commuting, which in two thirds of trips involves 'driving alone', is one of the reasons for the decline of social capital in the USA as additional commuting time cuts involvement in the community for commuters and non-commuters.

Social capital is thought of being constituted of three components: networks, trust, and social norms and values. It can be divided into the cultural and structural parts: Cultural social capital is defined as generalised trust, while structural social capital are formal and informal networks (Freitag, 2001, 2004). The network component includes civic engagement in associations, voluntary work, and contact to family, friends, neighbors, as well as colleagues. Trust and reciprocity are the cultural components of social capital and form the basis for cooperation in society (Freitag, 2014). One form of structural social capital is civic engagement. This can be divided into informal civic engagement such as neighbourly help as well as formal civic engagement such as voluntary associations (Freitag, 2014; Freitag et al., 2016; Putnam, 2000).

Individuals' social networks are thus a core component of their social capital. Maintaining a social network requires travel. The geographic size of individuals' social networks is therefore connected with their ability to travel. Impeded or reduced access to mobility tools might therefore negatively affect social capital and was even deemed a dimension of social exclusion (Cass et al., 2005). In its relationship, the tenets of geography relate to the ideas of social capital in the family, community, and in the use of social networks. Seeing social capital as a geographical subject, Putnam (2000) argued to classify it as a geographical concept due to the fact that the relationships of people are shaped and molded by the areas in which they live (Mohan and Mohan, 2002).

Regarding leisure activities, social capital can be seen as the consequence of investment in and cultivation of social relationships that allow individuals to access resources that would otherwise be unavailable (Glover and Hemingway, 2005). Specific forms of leisure activity contribute to the development of social capital: The more an individual participates in social

activities, the more autonomy the individual experiences. This helps to develop individual skills and abilities. The more social capital an individual accumulates and experiences, the more likely it is that this transfers to other leisure activities as well as personal social role and other relationships within a social structure (Hemingway, 1999).

The maintenance of an individual's social network requires physical travel and is responsible for the largest share of leisure travel (Götz, 2004). Hemingway (1999) found a significant correlation between social capital and leisure. Leisure travel in turn accounts for the highest share of personal travel by frequency and distance in developed countries and should therefore not be neglected if one seeks to understand and predict individual travel (Frei, 2012).

It has been theorized that maintaining a geographically wider spread social network might have a negative impact on the spatial density of contacts as people become more selective with their contacts. This also entails a lower density of local social contacts, which might negatively affect local social capital (Axhausen, 2007). Moreover, the growing size of social network geographies might adversely affect local social capital (Kowald, Arentze, et al., 2015).

2. Methods

2.1   Survey Instrument

A survey in the Canton of Zürich (Switzerland) is conducted in two waves. The survey includes traditional elements of travel surveys, which are combined with information on the egocentric social network of the participants and the locations of the alters in these networks. In addition, questions about political attitudes, the personality and lifestyle of the participants, and the acceptance of specific transport policies are included.

The target population consists of a probability-based sample of 12'500 addresses from residents of the Canton of Zurich (18+), which were registered in one of the 168 municipalities by 1st of January 2017. The Department for Economic Affairs of the Canton of Zürich collected and provided these addresses. It is a stratified sample based on the municipality size. Thus, four times 3125 addresses were received for municipality-categories with 0-2'999, 3'000-9'999, 10'000-29'999 and above 30'000. The sample will be biased due to non-response errors, which will occur due to i.e. refusal, illness, non-contact (outdated address) as well as no internet access. In order to convert the prospective respondents, an unconditional incentive (pen) will be attached to the invitation letters. The non-response constitute a problem since they are probably not missing at random but rather due to lack of internet access, lack of computer skills or the lack of German language skills. This will have an effect on the inferential population on which the conclusions of the research can be drawn since the realized sample will be biased.

The individuals of the target population will all receive an invitation letter for an online survey including the incentive. In this letter, they receive an invitation to take part in the survey via a web address as well as an access code, which they have to enter in the first question of the survey. Thus, access is controlled and only people from the probability sample will be able to start the questionnaire. Others will not have access to the survey. To make sure that these are the same individuals of the probability-based sample, there will be a control for gender and age. We received these two socio-demographics from the statistical office. After two weeks, the subjects who then have not completed the survey will receive a reminder letter.

In the first questionnaire, respondents are asked to participate in a second survey. Additionally, they are asked to provide their phone number in order to be able to recruit them. If they are willing to do so, they will receive a letter with the invitation to the second part of the survey about social networks. As an incentive, 10 Swiss Francs are enclosed to the letter. After two weeks, the subjects who have not completed the second survey again will receive a reminder letter. If they still did not participate in the survey, the respondents will be recruited by phone another two weeks later.

The survey will be conducted as an online survey. Nevertheless, mixed mode with paper-and-pencil would probably be most suitable since the internet penetration rate in Switzerland is 87% and therefore with a pure online questionnaire one would exclude approximately 13% of the population of interest and run into coverage issues. Moreover, even the ones who are connected to the internet might lack computer skills, which might make it impossible to them to participate.

2.2   Measurement of Social Capital

There is no widely held consensus on how to measure social capital: quantitative measuring has proven somewhat complicated. This has resulted in different metrics for different functions. In order to measure individuals' social capital, the survey includes four questions to measure generalized trust, reciprocity, and fairness as well as the perceived helpfulness of others. For this purpose, 11-Point-Likert scales were used (0-10). The questions have been used by several authors (Frings, 2010; Glaeser et al., 2000; Holm and Danielson, 2005; Uslaner, 2015) and are also included in several social science surveys such as the World Values Survey, the European Value Survey and the European Social Survey. The four concepts are operationalized as follows:

Q8.1 Generalized trust: The concept of social trust is measured with the following standard survey question (European Social Survey, 2014): „Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?"

Q8.2 Fairness: To measure the perceived fairness of society, the following question was asked (European Social Survey, 2014): „Do you think that most people would try to take advantage of you if they got the chance, or would they try to be fair?"

Q8.3 Cooperativeness: To measure the perceived helpfulness of others, the following question was asked (European Social Survey, 2014): „Would you say that most of the time people try to be helpful or that they are mostly looking out for themselves?"

Q8.4 Reciprocity: The concept of reciprocity can be divided into positive and negative reciprocity. Positive reciprocity occurs when a single individual commits an action that has a positive effect on others is returned with an action that has a positive effect as well. To measure positive reciprocity, respondents were asked whether they agree or disagree with the following statement (SOEP Group, 2017): *"I am ready to undergo personal costs to help somebody who helped me before."*

Another method of measuring trust is to measure an individual's activity in civic society. The theoretical argumentation is based on the idea that more civic engagement leads to higher levels

of trust within the society. Hence, activity and memberships in voluntary associations should be a good indicator of trust (Putnam et al., 1994). The network component of social capital is measured in two ways: In the first part of the survey, respondents are asked whether or not they were civically engaged within the last four weeks as well as how much time they spent with civic engagement. These two questions were combined into a categorical variable where the amount of time spent over the last four weeks is displayed in four hour steps (0, 0-4, 4-8, etc.).

In the second part, respondents name social contacts with the following characteristics: They discuss important problems, are in regular contact, meet for leisure activities, or they can ask them for help. They indicate which of the previous characteristics is true for a given contact in a further question. Together with the type of the relationship and the frequency of contact with different modes of communication, this serves as an approximation of social closeness. Respondents are asked to indicate the home location of their contacts, which allows determining where their individual social capital (that comes from the contacts in their networks) is located. This serves as one type of quantitative social capital measure that uses name generators to construct social networks and to measure the level of social capital. These networks are constructed by asking participants to name people that they interact with (Marsden, 1987). The exact measurement of these networks will be explained in the next section.

2.3   Measurement of the Geography of Social Networks

The geography of a social network can be described in terms of its static and dynamic elements. Static elements are the home locations of the members and dynamic elements are the locations where members of the network meet. For the purpose of further analysis, the patterns of spatial distribution of locations have to be reduced to a small set of indicators that can be compared (Axhausen, 2007).

Describing the spatial distribution of locations in an egocentric social network is related to the more general problem in geography of describing areal point data. Yuill (1971) points out that areal point data has usually been described by three measures: average location, dispersion, and orientation or arrangement in space. The author discusses the standard deviational ellipse as a measure and updates the approach that was first devised by Lefever (1926). In contrast to other measures, the standard deviational ellipse is able to capture the orientation of the data. The confidence ellipse has been used as a measure to describe activity spaces, for example by Saxena and Mokhtarian (1997). Schönfelder and Axhausen (2004) suggest several measures to capture individual activity spaces: minimum spanning trees, kernel densities, and the confidence ellipse. However, Axhausen (2007) points out that the confidence ellipse is easily computable and strongly correlated with more complex approaches, which seems to make them redundant for the purpose of measuring activity spaces.

In this study, the confidence ellipse is used to describe the social network geography. The addresses of the contacts that the subject has met within the last year were geocoded using the ggmap package for R and the Google Maps API (Kahle and Wickham, 2013). To construct the confidence ellipses, a similar approach as Frei (2012) was chosen. Each location was included as many times as the subject met the contact in the last year in order to give contacts that have been met more often more weight and to avoid constructing overly large ellipses when spatially more distant contacts were named that the subjects rarely meet in person. Each point therefore represents a meeting with the contact living at the given location (although the points will be concentrated at the home locations of the contacts).

The concentration or dispersion of locations can be described by the area enclosed by the ellipse. A small area indicates a high concentration of locations while a large area indicates a wide dispersion of locations. The number of locations inside the ellipse serves as another measure of concentration.

3. Pre-Test Results

This section describes the results obtained in the pre-test of the survey.

3.1 Summary Statistics

3.1.1 Response rate

The pretest was run between 10th of March and the 20th of April. Therefore, a random sample of 500 addresses was drawn from the full sample. The access to the first online survey was sent by a postal letter on 10th of March with a reminder letter two weeks later to those respondents who did not answer the questionnaire at that time. The invitation to the second part of the survey was conducted in three waves depending on when the respondents finished the first questionnaire. The first wave was sent on the 30th of March, the second one week and the third three weeks later. Again, a reminder letter was sent two weeks later.

As expected due to the source of the addressees, the contact rate of 99.6% (CON1) was high. The response rate was 16.7% (RR3), including partial answers even 19.1% (RR4). For the second part, 57 respondents from the first part agreed to take part in a second survey. This equals a recruitment rate of 68.7%. For this second part, the contact rate was 100% (CON1). Due to the cash incentive, the response rates of 73.7% (RR3) and 75.4% (RR4) are rather high, which was expectable.[1]

3.1.2 Social Capital Measures

Regarding the three social capital measures, they all have a rather high overall outcome on the 11-Point-Likert Scale. While the differences among the measurements do not differ too much, reciprocity scores highest. This does not surprise as it is the only question that directly asks about the respondents behaviour to be willing to help, which might lead to a social desirability bias. All in all, the problem of a social desirability bias occurs for all measures as the lower bounds of the scale were chosen rarely or even never. Still, there is enough variance among and

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[1] The outcome rates were calculated according to the definitions provided by The American Association for Public Opinion Research (2016)

within the four measures in order to get valid and reliable results. The results are as well in line with previous studies using the same or similair measurements conducted in Switzerland.

Figure 1   Boxplots Social Capital Measures
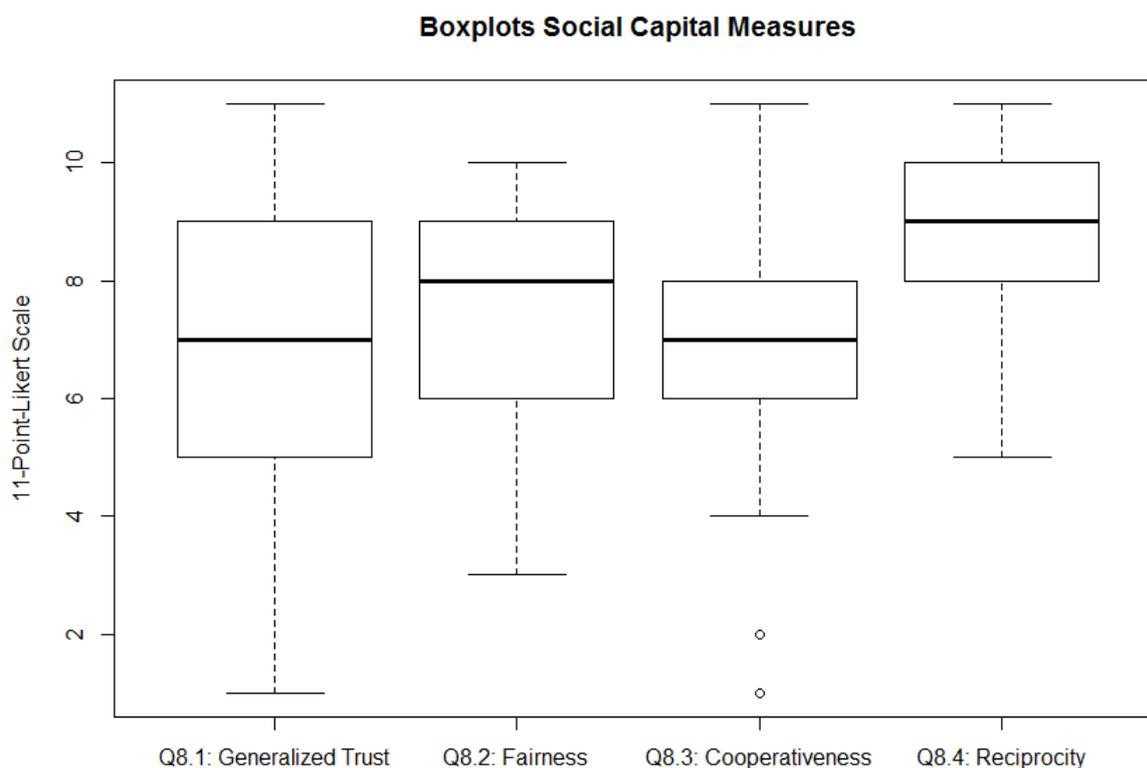
Expectedly, the correlation between the different measures are mainly positive. Only reciprocity and cooperativeness show a negative but not significant correlation. Generalized trust and fairness correlate the highest. Nevertheless, the correlation with cooperativeness to both of the other measures is not significantly lower. Still, this might be explained by strength of the argument: to expect that other people help is probably less likely compared to fair behaviour or trust towards others.

Reciprocity shows the lowest correlation with the other three measures. This is not surprising since – as shown in Figure 1– it significantly scores higher overall. Finally yet importantly, all the four social capital measures are positively correlated with civic engagement. This result is

completely in line with results from literature. Whereas the causality is still rather unclear and might be best described with a co-evolution: people with more social capital are more likely to get civically engaged, where they again improve their social capital.

Figure 2   Correlation Table Social Capital Measures
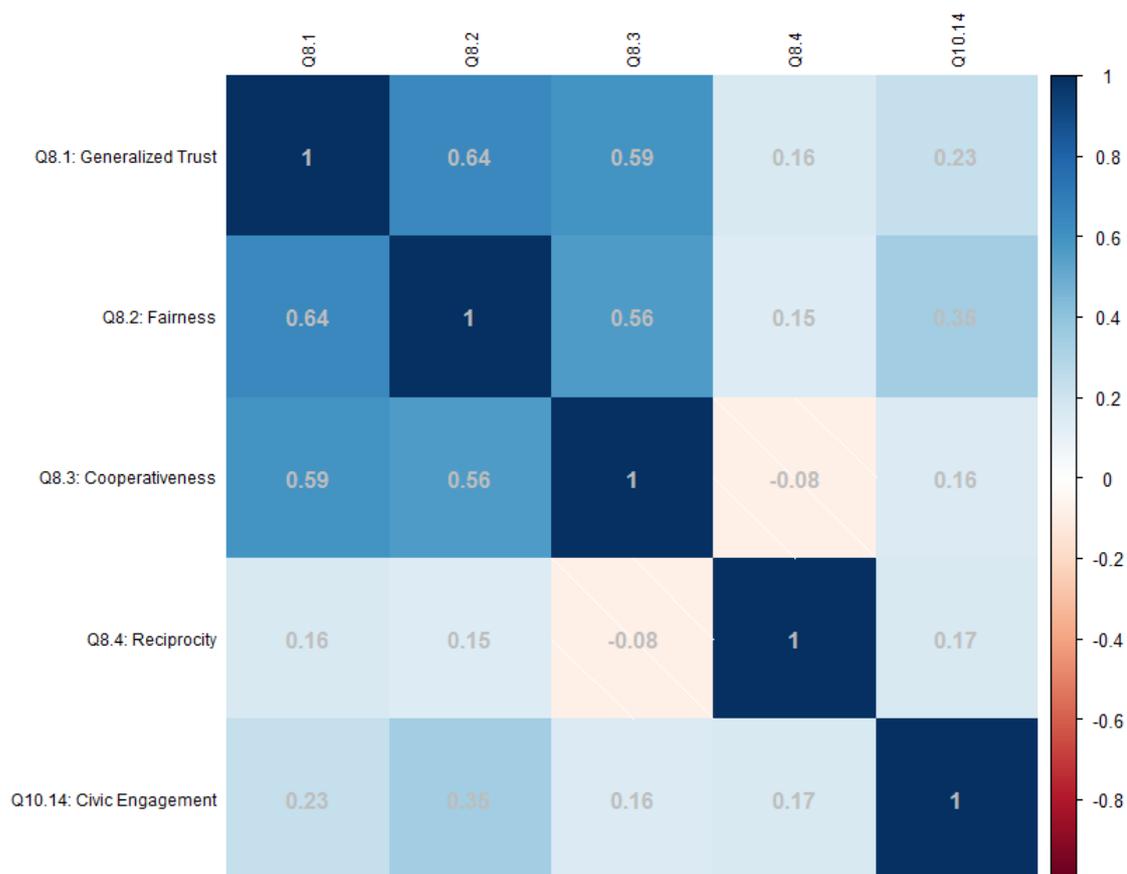
3.1.3   Social Network Geography

In the pre-test, subjects named 7.1 contacts on average with a standard deviation of 3. Compared with Frei (2012) where 12 contacts where named on average, this number seems too small. The reason for the deviation is that subjects mainly named contacts that were important to them and neglected contacts they only meet for leisure activities but are less important (only 5% of all contacts named in the pre-test were not close contacts of the subjects).

Confidence ellipses for 30 of 38 subjects were calculated. For eight subjects the calculation failed for the following reasons: Only one contact was named or the number of unique locations was smaller than three. Figure 3 shows an example of a confidence ellipse for a subject living in the city Zürich who named 11 contacts that he or she regularly meets in person. Although the subject has contacts in the cantons of Bern and Basel, the frequency of meetings with the contacts closer to the home location in Zürich is much higher, which leads to an ellipses that is centered close to the home location.

Figure 4 shows a histogram of the areas of the weighted confidence ellipses. The mean area of the ellipses is 852 km^2 with a relatively high standard deviation of 879 km^2. The distribution of the areas is strongly positively skewed with a positive kurtosis. After a square root transformation of the ellipse areas, the data comes closer to a normal distribution, which will be important for statistical inference once the full dataset is available.

Figure 3   Example of a 95% Confidence Ellipse

Confidence Ellipse - Subject 2

Legend
- location contacts
- home location
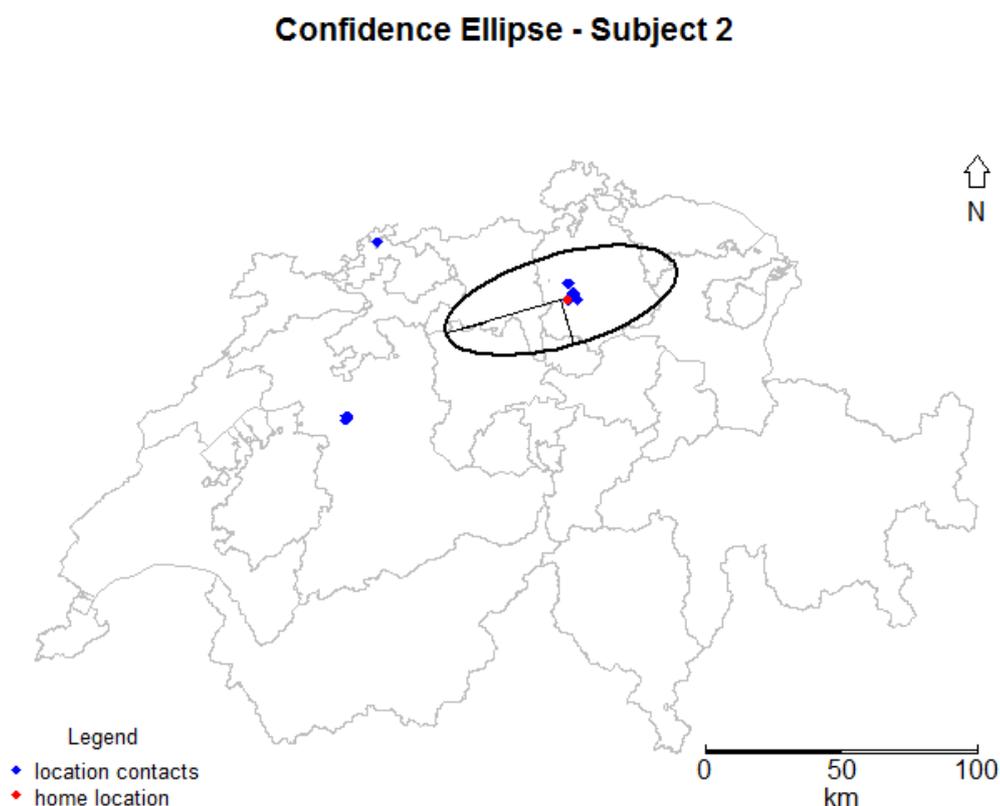
Base map: swissBOUNDARIES3D (swisstopo, 2017)

Figure 4   Histogram of weighted 95% confidence ellipse areas, a) original data, b) square
root transformed data

a)

b)
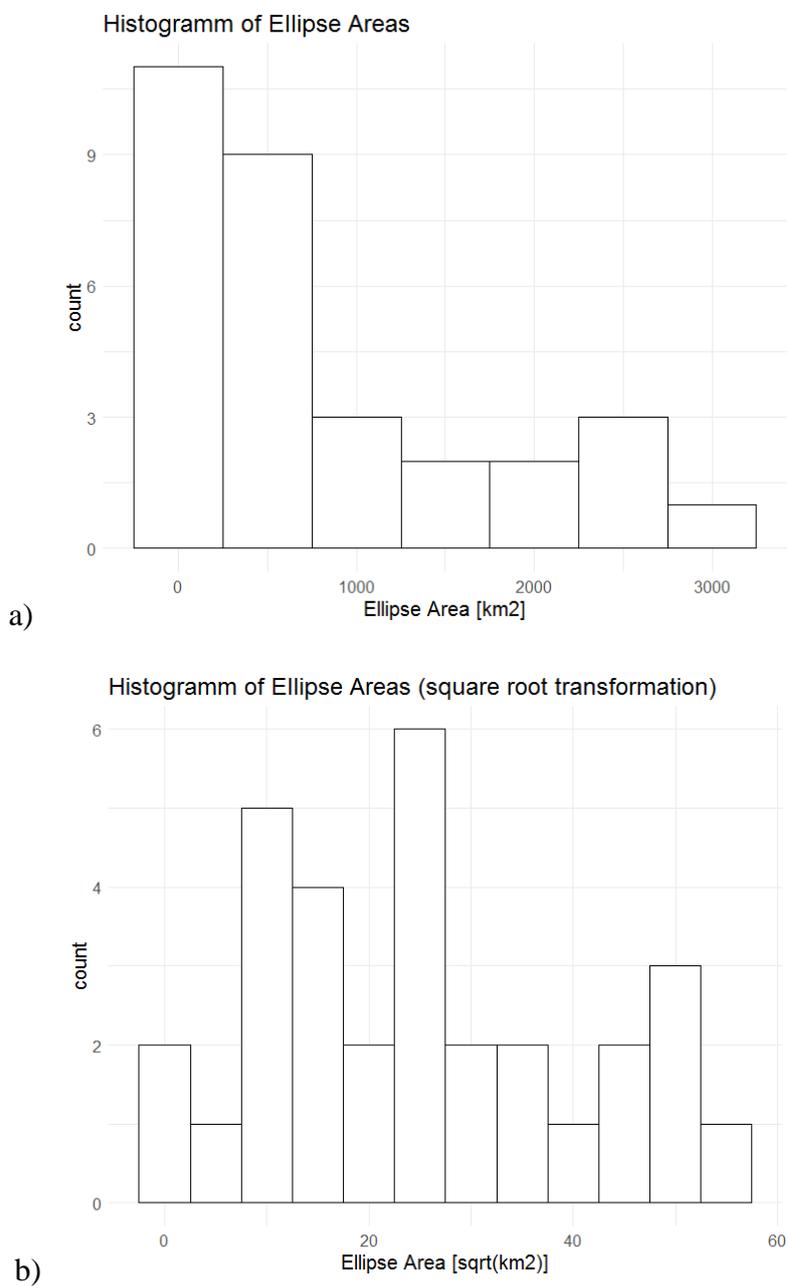
3.2   Social Capital and the Social Network Geography

The area of the 95% confidence ellipse shows no correlation with fairness, cooperativeness, reciprocity or civic engagement. The correlation between the ellipse area and generalized trust is weak (see Table 1). None of the correlations was significant, but the signs are positive as expected. A square root transformation did not significantly change the correlations.

Table 1   Correlations between 95% confidence ellipse area and social capital measures; N= 30.

	Variable	Correlation
95% confidence ellipse area	Q8.1: Generalized Trust	0.23
	Q8.2: Fairness	0.04
	Q8.3: Cooperativeness	0.09
	Q8.4: Reciprocity	0.07
	Q10.14: Civic Engagement:	0.06

3.3   Mobility Behaviour and the Social Network Geography

The area of the 95% confidence ellipse is weakly correlated with the number of public transport trips per week and the number of flights per year. There is a very weak negative correlation between the ellipse area and the estimated kilometres driven by car (see Table 2). The calculated correlations should be interpreted with reserve as the data from the pre-test only exhibited 20-30 pairwise complete observations for the considered variables and none of the correlations was significant. However, the signs of the correlations can still reveal tendencies in the data that can be used to adapt the main survey.

Table 2   Correlations between 95% confidence ellipse area and mobility measures

	Variable	Correlation
95% confidence ellipse area	Q4.5: Kilometers by car	-0.14
	Q4.11: PT trips	0.22
	Q4.16: Number of flights	0.29

4. Discussion

Given that the presented data are based on the results of the survey pre-test and that there are only 38 observations in the second part, conclusions associated with the social network geography cannot yet be drawn and are not definite. However, tendencies might be visible. A coarse analysis of the data has shown that most of the measures of social capital do not correlate with the size of the confidence ellipse that was chosen as a proxy of the geography of the social network. Only generalized trust exhibits a weak correlation. It is conceivable that a larger social network geography is associated with higher levels of trust depending on which persons subjects include mentally when they are asked about 'people in general'. If subjects tend to include all people of society, it is reasonable to assume that the level of trust is higher when subjects know people from different geographical regions. Knowing people makes their behaviour more predictable and therefore expectations about behaviour are met more often, which leads to a higher level of trust. However, it would be an interesting result if this did not extent to fairness, cooperativeness, and reciprocity.

The number of flights per year and the number of public transport trips per week are weakly correlated with the size of the confidence ellipse. The kilometres driven by car in a year is very weakly negatively correlated with the area of the ellipse. This would be surprising as meeting social contacts necessarily requires travel and there would be no conceivable reason why the car would be used less by people with a larger social network geography. However, the surveyed mobility characteristics are not limited to social activity travel. The car is most likely also used for other activities and the influence of meeting social contacts by car on the total kilometres driven could simply be too small (and the estimation by the subjects too inaccurate). For the main study, a question about public transport trips, flights per year, and kilometres driven by car with the purpose of meeting social contacts will be included in the second part of the survey. In addition, the number and types of contacts that are named by subjects highly depends on the name generator that is employed. The name generator used in the pre-test tends to neglect contacts with whom subjects are less close but still meet for leisure activities. This leads to an underestimation of the social network geography and to less variation of the number of contacts (as larger social networks do not tend to have more core contacts but rather a higher number of casual contacts). The name generator will thus be adapted for the main study.

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