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THE GEOGRAPHY OF SOCIAL LINKS AMONG A YOUNG COHORT IN SWITZERLAND

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Abstract

Small world theories and modern communication facilities convey the impression of a connected world where geographical boundaries have lost their importance and where everyone can reach everyone else in just a few steps, overcoming large geographical distances apparently with ease. Most studies on network processes, like, for instance, the accumulation of (dis)advantage in network clusters, focus on topological factors only, ignoring geography, while work on network geography often does not attempt to explain the large variance in link distance. This article analyses the geography of everyday links of a young cohort in Switzerland, integrating several levels of analysis: individual characteristics (micro-level), extended ego networks (intermediate level), and functional regions (aggregate or macro level). Our results show that everyday links are very close, and, for our young sample, get larger with age. Residential mobility shows an effect limited in time. However, distance of links is not only a personal, but also a network characteristic; some individual characteristics only have an effect when cumulated at the network level. An analysis of cross-regional links showed that social links among young people in Switzerland are heavily segregated by language and structured along canton borders, but also determined by the type of region of residence. Thus, while it is crucial to take geography into account when analyzing real-world social networks, link distance alone is not sufficient to render the complexity of social ties.

Keywords

Social networks | Frequent contact networks | Network spatial dispersion |Geographical distance

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1. Introduction

The ever increasing presence of fast and cheap air travel and modern communication facilities, as well as the small world concept (Milgram, 1967) which has become common-sense knowledge, convey the idea of a geography-free world where even large geographical distances are no obstacle. The discussion about the end of geography as a constraint for social interaction is ongoing since more than three decades, more moderate voices predicted radical changes in both the societal imperative of flexibility referring more or less explicitly to the concept of time-space compression (Graham, 1998; Kaufmann, Bergman, & Joye, 2004; Morgan, 2004), but also the individual needs for mobility in the sense of accessibility of all types of resources (job market, leisure travel) (Kaufmann, 2005; Schuler, Lepori, Kaufmann, & Joye, 1997). Mobility – the access to it, and thus, the option to have geographically dispersed contacts, becomes a form of capital which is unequally distributed over the population (Kaufmann et al., 2004). Geographically distant contacts are more likely to act as bridges between two otherwise unconnected network clusters ("bridging ties") (Granovetter, 1973, 1983; Viry, 2012), which, on the one hand, convey structural advantages to the individuals who are involved in them, and, on the other hand, are crucial for system-wide processes like the diffusion of information or social pressure (Centola & Macy, 2007).

However, it appears from recent studies that most social ties are still heavily constrained by space (Lambiotte et al., 2008; Onnela, Arbesman, González, Barabási, & Christakis, 2011; Preciado, Snijders, Burk, Stattin, & Kerr, 2012) even for online contacts (Liben-Nowell, Novak, Kumar, Raghavan, & Tomkins, 2005; Mislove, Viswanath, Gummadi, & Druschel, 2010; Volkovich, Scellato, Laniado, Mascolo, & Kaltenbrunner, 2012). Our potential contacts are most likely the people who live near us, not the whole population as it is often implicitly assumed in models which do not take geographical location into account. Thus, "local network neighborhoods", term which is often used in a topological sense to describe network clusters where members have direct links, are more often than not local also in a geographical sense.

Despite the overwhelming evidence for the impact of space on social ties, research on social networks in social sciences has often focused on network topology and structural characteristics, leaving aside geography and using the term "local" in two different and often confusing ways: Mostly, the concept of "local network neighborhood" refers to topological neighborhoods, neighbors being individuals with a social tie, no matter their geographical location. In the same manner, "context" is mostly understood as a mainly social – rather than a spatial - concept.

The recent developments in communication facilities which, on the one hand, seem to minimize the impact of geographical distance on communication, create new differences on the other hand: Not only social class and economic capital, as suggested above, but also birth cohort might play a role in the access to and proficiency in the use of the technical resources. Recent cohorts who grew up surrounded by smartphones and internet might have another relationship to distance than earlier cohorts who were not socialized in the digital age. Carrasco et al. (2008) suggest that older individuals in their study were somewhat disadvantaged regarding the opportunity to communicate with distant contact due to unfamiliarity with new communication techniques. The present study explores data from a cohort in Switzerland which can be associated to this "virtual generation", addressing the question of the geographical patterns of their frequent contacts on several levels of analysis. Firstly, we analyze the length of social ties, modeling them as a function of individual variables (socio-demographic and biographical), network composition and characteristics of the context. Secondly, we analyze cross-regional links in order to understand how individuals are connected at a level which exceeds the local level. This second part addresses the question whether the social ties of the "virtual" generation remain constrained to "local" environments determined by labor market and commuting behavior (Spatial Mobility regions) developed in the 1980's (PNR 5).

1.1 Spatial patterns of social networks

Despite the fast increase of communication and travel facilities, social ties are still far from being geography-free. The results of studies examining the length of social ties are consensual: Most dyads live relatively close to each other, no matter data type and type of link (Carrasco, Miller, & Wellman, 2008; Frei & Axhausen, 2007; Lambiotte et al., 2008; Liben-Nowell et al., 2005; Onnela et al., 2011; Preciado et al., 2012; Viry, 2012). All studies report a heavily right skewed distance distribution, with an exponential decay being the best approximation (Frei & Axhausen, 2007; Lambiotte et al., 2008; Liben-Nowell et al., 2005; Onnela et al., 2011). The factor that varies according to the study context, the population and the link definition is the scale: Baybeck and Huckfeldt's (2002) analysis on the spatial dispersion of alters with whom ego discusses important matters in a representative sample for the population of two American metropoles showed that about three quarters of the dyads were separated by less than 10 km. Frei and Axhausen (2007), based on a name generator of people with whom participants spend leisure time, find that two thirds of the dyads in their non-representative study on mobility in Zurich (Switzerland) live less than 25 km from each other. Viry's (2012) results using a survey from Switzerland with a sample which is representative for the Swiss population are similar to the distances reported Frei and Axhausen. The people with whom participants discuss important matters live at a mean distance of about 22 km. Most measures of network span are based on dyadic measures. However, there is evidence that this process is not linear – network geography doesn't follow the same rules as distance between dyads and the span of the networks increases suddenly when a threshold of about 30 network members is reached (Onnela et al., 2011).

1.2 Network geography: opportunity of contact and individual trajectories

The spatial closeness of links is caused at least partly by the fact that we are more probably exposed to people living near us; in some cases it is difficult to avoid contact with people around us, even if we don't choose these people, for example our neighbors; inversely, it may be difficult to create contacts with geographically remote people due to the lack of opportunity. Nahemow & Lawton's (1975) study on friendships in a housing project showed that residential proximity fosters cross-age and cross-race links, but only in a very short range. Spatial closeness is thus likely to provide some stability of the link - it is most likely easier to maintain a friendship with someone at walking distance, than on the other side of the world. Viry's (2012) results showed that distant ties tend to be "strong" ties, mostly family links, while friendship ties tend to be more local, and also more transitory in the case of mobility.

Also, geographically bounded social institutions, like school and workplace provide the opportunity to create social links (McPherson, Smith-Lovin, & Cook, 2001; e.g Preciado et al., 2012). While the place of work tends to be reasonably close to individuals' home, these settings may regroup people from different neighborhoods or even regions and be less influenced by administrative structure than, for instance, schools. Individual history, like, for instance, residential mobility and changes in the place of education of work also impacts the structure of our social ties (Axhausen, 2007; Coulter, Van Ham, & Findlay, 2015; Viry, 2012). Viry (2012) reports that residential mobility fosters spatially dispersed networks. His study also showed that the composition of geographically mobile people's networks presents more family tie, which tend to be transitive, and less ties to friends.

Viry (2012) argues that people with spatially dispersed networks access to more non-redundant resources (e.g. information), and are more likely to occupy bridge ties, putting them into the position of intermediary between their contacts. This position conveys the advantage, for instance, to control the flux of information. The access to geographically remote contacts, the possibility of creating and maintaining a socially dispersed network can be considered as a form of capital, where individual resources – economic, educational and related to social status – determine the access to mobility (Carrasco, Hogan, Wellman, & Miller, 2008; Cass, Shove, & Urry, 2005; Kaufmann et al., 2004; Urry, 2007). Study results also suggest that, for mobile individuals, short ties are often ties with neighbors or co-workers, which are usually less durable than links with friends and family, which are maintained even over large geographical distances, but are also associated with more efforts invested into maintaining the link (Carrasco, Hogan, et al., 2008; Viry, 2012; Wellman, Wong, Tindall, & Nazer, 1997). Höllinger and Haller (1990) argue that individuals in contemporary urban societies, individuals have more freedom regarding the choice of their personal networks for both kin and non-kin ties, the former no longer being a lifelong commitment. On the other hand, geographic mobility increased, also for economic reasons, thus leading to growing distance between individuals and their family of origin. Adolescence and young adulthood is a time of multiple transitions, where also the social network changes, away from home and school towards more diversified people and places (Cotterell, 2013).

However, while geography is important, geographical proximity alone is not enough to explain creation of social ties (Daraganova et al., 2012; Liben-Nowell et al., 2005). The creation of links has been proven to be guided by homophily. Individual characteristics – starting with unchangeable attributes like gender, age and race, but also other socio-demographic attributes, like for example occupation, social class and religion, as well as attitudes and opinions, are creators of homophily. People associate with others who are similar along a wide range of dimensions (McPherson et al., 2001; Wimmer & Lewis, 2010). Homophily can lead to cumulative effects, forming homogenous social circles, leading to the accumulation of advantages or disadvantages in network clusters, exacerbating already existing inequality when, as an example, individuals with low socio-economic resources preferentially attach to similar peers.

Geographical proximity is a powerful mechanism of baseline homophily. We will much more likely meet a person who lives near to our home than someone whose place of residence is hundreds of kilometers away. Also, it is likely that spatial and social contexts overlap, e.g. the concentration of low-income populations in neighborhoods with low rents, or the common membership in geographically bounded institutions like schools (Preciado et al., 2012). Yet, space as a creator of homophily is often under-estimated, which leads, in turn, to the over-estimation of individuals' options to choose (McPherson et al., 2001; Wong, Pattison, & Robins, 2006).

1.3 Network geography and pre-existing structures

Characteristics of the region of residence are susceptible to change people's everyday life, their access to services and resources; different regions are associated with different potential for the access to mobility (Kaufmann, 2004).For example, access to all types of services, ranging from shopping opportunities to access to public transportation, and also to a large pool of potential peers, is different in densely populated areas like metropolitan centers compared to thinly populated zones (e.g. Liben-Nowell et al., 2005). As Levy (2001) states, urban areas are not easy to delimit and cannot be reduced to territorial continuity, but have to be analyzed by taking into account functional links between territorial units. The author uses the concept of "conurbation" to describe how "the local character of society is deduced neither from surface area, nor from the size of the population, but from the 'everyday' characters of its space" (Lévy, 2011, p. 235), which is shaped by the interaction between social relations, geography, economy and history.

Not only the type of regions, but also administrative boundaries affect the structure of interaction networks. Ratti et al. (2010), based on an analysis of a telecommunication database with 20.8 millions of nodes from Great Britain show that administrative boundaries powerfully structure patterns of communication. Using different partitioning algorithms to detect community structure in the network, where the links are calls and text messages, they were able to constitute a map, which was strikingly similar, but not identical to the existing administrative regions in the country. The authors explain these results with the conjoint development of administrative units and interaction between individuals.

While the maximal distance between two points in Switzerland is relatively small, the country has several particularities likely to hinder some of the cross-regional links. In the first place, Switzerland is a federalist state with relatively autonomous regions (cantons) which enjoy large autonomy of decision in domains like education and tax system. Centralization is relatively weak when compared to neighboring countries like Italy, France or Great Britain, and many decisions are taken at the cantonal level, leading to sometimes important differences between the cantons. Further and importantly, there is the language barrier, due to three[1] official languages corresponding to different geographical regions. Broadly speaking, French dominates in the West of the country, while German is the official language in the regions of Northern, Eastern and Central Switzerland and Italian is spoken in the South (Ticino). Most cantons and municipalities can be attributed to one single official language. The cantons of Bern, Fribourg and Valais are exceptions; both French and German are present as main language in these cantons.

Additionally, natural characteristics like mountain chains have an impact on the formation of social ties – people are not uniformly distributed over space (Butts, Acton, Hipp, & Nagle, 2012; Parisi, Cecconi, & Natale, 2003). Several mountain chains cross the country, separating the regions and, most importantly, the North from the South (Alps). The Eastern part of Switzerland (namely, the canton of Grisons) is very mountainous, as well as Valais in the South-West of the country.

To sum up, there is a large consensus on the fact that personal networks are mostly local – close in terms of absolute distance, and more likely to be contained within administrative boundaries -, even in the times of fast communication possibilities. Access to remote contacts – in terms of the ability and resources to create and maintain them (e.g. access to transportation facilities, as well as the opportunities to initiate the contact) is often seen a form of capital related to already existing capital.

1.4 Aims and hypotheses

While the spatial dependence of social ties is well documented, many studies are based on online networks (Liben-Nowell, Novak, Kumar, Raghavan, & Tomkins, 2005; Mislove, Viswanath, Gummadi, & Druschel, 2010; Volkovich, Scellato, Laniado, Mascolo, & Kaltenbrunner, 2012), mobile phone data (Lambiotte et al., 2008; Onnela, Arbesman, González, Barabási, & Christakis, 2011) or data assessing children's school friends (Hipp, Faris, & Boessen, 2012; Mouw & Entwisle, 2006; Preciado et al., 2012). Work based on phone records and online data provide detailed accounts for the best-fitting function to model the decay of tie probability with distance, but usually does not provide information on any other characteristics of the individuals or the networks. Studies using school-based networks give interesting insights into differential effects of distance in the presence of common institutional affiliation. However, studies using survey data from a more or less representative sample of the general population remain scarce (for exceptions, see for example Carrasco, Hogan, Wellman, & Miller, 2008; Carrasco, Miller, & Wellman, 2008; Viry, 2012).

This paper aims at exploring the spatial patterns of frequent interaction networks of young adults in Switzerland. Since modern communication facilities help to maintain, but not necessarily create new contacts, we expect the length of ties follow a similar distribution as generally described in the literature. In order to explain the length of the ties, we suggest to take into account characteristics of the individual, as well as aspects of the life course and the network level, addressing the following hypotheses:

H1: We expect tie distance to vary across networks: Social networks are characterized by densely knit clusters composed by individuals similar on at least some – but mostly many – characteristics. Adopting a multilevel-framework, we expect to find network-level effects on tie distance.

H2: Since longer links are harder to maintain, we expect the average size of contacts of the network members to be negatively related to spatial dispersion of the network. However, to our knowledge, there is no empirical evidence on the effect of network composition on link distance. In order to explore possible effects of homogenous network composition, we introduce the deviation from random mixing of gender, as well as age-related homogeneity of the network into the model. Finally, we test the impact of nationality of the network members, computed as the percentage of network members who do not have Swiss nationality.

At the *individual level,* we expect effects of age, occupation and residential mobility. H3: A part of our sample is still rather young, which means, many of them do not have access to a car and did not leave parental home yet. Consequently, we expect older individuals in the sample to have longer links than younger participants.

H4: Mobility is a form of capital which has been argued is related to other forms of capital, namely economic capital; maintaining long-distance links can be costly. We thus expect the financial situation of the household to impact tie length: We expect financial difficulties to have a negative impact on tie length.

H5: Since many contacts are originated at the workplace, which is likely to be less spatially bound than school districts, we expect people who have a full time job to have a longer average tie length than participants still going to school or following other occupations.

H6: Finally, since spatial mobility over the life course, for instance, moving house, provides the opportunity of meeting new people, we expect residential mobility to be related with longer tie distance.

The second part of this article investigates the impact of structural characteristics (micro-regions based on commuting – Spatial Mobility regions, see section 2, and administrative boundaries) on network geographies. Using average link distance from ego's home address gives a good insight in spatial dispersion of social networks. However, equal distance between two points is not associated with equal probability of interaction. We expect administrative boundaries (cantons) and language barriers to structure links over and above geographical distance.

H7: At equal distance, within-canton links are more likely than links across canton.

H8: At equal distance, links are more often between individuals who share the same first language than between peers with different languages.

Further, we dress a typology of network geographies ranging from “local” to “national” and relate them to people’s individual characteristic and trajectories and their place of residence. Finally, we discuss the existence of bridging ties in the different types of network geographies.

2. Data and Methods

2.1 Sample

The Lives COHORT panel study is a longitudinal study on young adults Switzerland, with the aim of analyzing their transition to adulthood. The study population was 15 to 24 years old at the first wave (2014), officially living in Switzerland and been to school in Switzerland since their 10th birthday at latest. Second-generation immigrants were over-sampled in the study. This over-representation is controlled for by population weights. The calculation of the weights, consist of two parts, one specific to the network sampling and another, more “standard” procedure which is the same as used in the Swiss Household panel. Some more details on the weighting can be found in the technical appendix. The study tests an innovative sampling design, combining a stratified random sample with two iterations of controlled network sampling, with random selection within the personal networks. This randomness eliminates some of the problems related to link-tracing sampling designs (Chow & Thompson, 2003; Goodman, 1961; St Clair & O’Connell, 2012; Thompson & Frank, 2000).

An initial sample served as starter sample for two iterations of network sampling. This sample is a stratified random sample drawn by the Federal Statistical Office, based on several criteria: Place of residence, nationality, place of birth and type of residence permit (for non-Swiss citizens). The starter sample (”iteration 0”) consists of 839 individuals. 813 of them answered the network questionnaire, resulting in a total of 4947 contacts from which the respondents for iteration 1 were sampled. The link was defined based on regular, non-professional interaction (face to face or other), at least once a week on average over the last three months. Participants were asked to mention all the contacts for whom this condition is true, and who are aged between 15 and 24 years. Alters were then selected randomly within the personal networks. Contact information was asked only for the selected persons.

The final sample contains 1631 individuals. Among them, 1136 participants form part of at least one dyad, resulting in a total of 792 dyads. Table 1 provides an overview of gender, age and nationality in the sample, grouped by sampling iteration, for participants who are part of at least one dyad (N = 1136).

The data from the LIVES Cohort Panel study (COHORT) provides data on “extended ego networks”: Up to four randomly selected contacts from each participants’ network are interviewed and provide their own network, from which, again, up to two randomly selected contacts are interviewed. Exact geocoding for the addresses of all participants is available. Distance in km was computed as the great circle distance between the home addresses of each dyad.

Table 1: Sample characteristics (participants with at least one dyad)

		Sampling iteration			
		seeds	i1	i2	Total
Gender	F	185	299	129	613
	M	160	237	126	523
Age: *mean(sd)*		19.89(2.78)	19.82(2.67)	19.70(2.59)	19.82(2.68)
Nationality	CH only	102	270	129	501
	CH + other	62	136	75	273
	Other	181	130	51	362
	Total	345	536	255	1136

Additionally, the region of residence for all mentioned alters is available (in contrast to participants, which are the peers who were selected and answered the survey). The regions of residence assessed for the non-sampled contacts are the so-called spatial mobility regions (Spatial Mobility regions)[2] , a set of analytical or functional regions (rather than administrative entities) created by a National Research Pool (PNR5, 1982) on spatial analysis in Switzerland (1982). The 106 regions are spatially relatively homogenous and centered around small-scale labor markets and daily mobility (commuting). These regions, which do not follow administrative boundaries, can be understood as a relatively local “living space” and have often been used as units of analysis and planning. They are further subdivided in 14 region types, again grouped in three hierarchical levels (Schuler, Dessemontet, & Joye, 2005). For the analyses, we classified the types in 4 categories: Metropolitan centers (central agglomerations; more commuting inwards than outwards); metropolitan areas (suburban, peri-urban and agglomerations around metropolitan centers with a negative commuting score); non-metropolitan agglomerations (agglomerations in tertiary and industrial regions which are situated outside of metropolitan areas) and rural regions (agro-industrial, industrial, agro-touristic or agrarian regions). Further, the canton (administrative unit) is available for all participants. Finally, geographical information is also represented on a more macro-level by „Large Regions“, as defined by the Federal office of Statistics[3] . These regions are equivalent to the Spatial Mobility regions at a macro–/inter-cantonal level and group several cantons (a single canton in the case of ZH and TI).

2.2 Variables

The dependent variable is the log of the great circle distance (in km) between each pair of respondents. The variance is much larger than the mean, suggesting that a negative binomial distribution is the best approximation to the empirical distribution in Figure 1a. We used log-transformed distance in order to symmetrize and approximate normal distribution. In line with findings in the literature, tie distance follows a power-law function. This assumption can be modelled using a logarithmic transformation of linear distance (Sohn, Christopoulous, & Koskinen, 2013). In order to analyze the impact of individual characteristics, the following socio-demographic indicators were taken into account: Age (centered at the mean), gender and nationality (computed as a categorical variable: Swiss only; Swiss and other; other only) and first language (German, French, Italian, other). Age ranges from 15 to 26 years. Financial difficulties of the household were assessed based an items from the Swiss Household Panel questionnaire to assess household finances, asking the following question: “When you think of all the expenses your household has during a year, would you say that your household... can save money (0), spends what it earns (1), eats into its assets and savings (2) or gets into debts (3). Further, two life course variables, occupation and residential mobility history, were taken into account. Occupation is factorized into three categories: Full time education (reference category), full time employment, other (comprising all other occupations, including, among others, part time work, unemployed and staying at home).

Residential mobility was assessed using a Life History Calendar (LHC). The variable “residential mobility” was computed counting the number of entries in the “residence” column of the calendar. We computed the time since the last time the participant moved. In order to categorize residential mobility experience, we conducted separate regressions, which showed a change in the coefficient at 3 years after moving house the last time. Thus, a factor with three categories was computed: “Never moved”, “moved more than three years ago”, “moved in the last three years”. The reference category is “never moved”.

The following *network characteristics* were taken into account: Age-related homogeneity, which was computed as a continuous variable, using the sum of age differences between each dyad in the network, divided by the number of network members. Gender-related homogeneity, which expresses the deviance from random mixing (50% of each gender). The variable was categorized to facilitate interpretation. Finally, nationality status of network members was computed by calculating the percentage of network members who do not have Swiss nationality (vs Swiss only and double nationality, including Swiss).

In the multilevel model, we inserted population density as a control variable, computed on the individual level, for the following reason: The variance explained by the region as a grouping variable (higher level variable) in the Multilevel Model is tiny and non-significant. Introducing the level anyway and in a next step adding population density on the region level reduces the variance to zero.

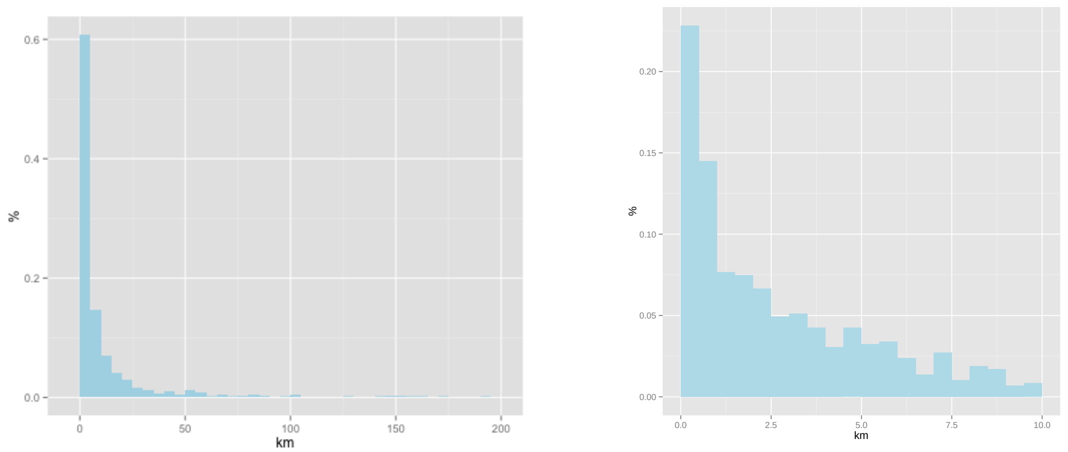
On the *contextual* level, we consider Spatial Mobility region of residence, as well as canton and large region of residence. In order to analyze the patterns of the cross-regional links, we aggregated the individual data. The "human connection" between Spatial Mobility regions A and B is computed using the weighted frequencies of links between individuals from these regions. The geographical distance between the regions has been computed calculating the great circle distance of the centroids of each region[4].

2.3 Data analysis

The COHORT data present a dependent structure due to the sampling strategy. Multilevel models are suitable to deal with this nested structure, since they allow for distinct sources of variability (Gelman & Hill, 2006; Louch, 2000; Van Duijn, Van Busschbach, & Snijders, 1999). In order to test hypotheses 1 to 5, we will model individuals nested in networks using multilevel models with random intercept models[5] . The multilevel model is a generalization of the classical regression model to allow for varying coefficients across groups (Gelman & Hill, 2006). Moreover, adding random slopes to the model allows to test whether the effect of one or several variables varies across networks.

To test hypotheses 6 and 7, we conduct a negative binomial regression, using the aggregated database with the weighted number of links between each micro-region, step-wise introducing the predictor variables (canton, language, distance). Negative binomial models, similar to Poisson models, allow to model count variables. Negative binomial models have an additional parameter which adjusts the variance independently from the mean, thus allowing to model over-dispersion – this is the case when the observed variance of a variable is greater than the mean.

Network typologies were explored using a K-mean cluster analysis. The method partitions the observations into a pre-determined number of groups, starting at randomly selected centroids and, subsequently updating group membership based on squared Euclidean distances on updated centroids of each cluster.



a) Percent of ties (binned) by distance in km. Bars = 5 km (N = 792 dyads)

b) Percent of ties (binned) by distance in km, max. distance truncated at 10 km. Bars = 0.5 km (N = 578 dyads)

Figure 1: Distance between dyads

3. Results

3.1 Individual and Network characteristics

3.1.1 Everyday links are short

The mean distance between dyads is 11.03km (SD=23.25). Strikingly, most of the links span less than 10 km distance[6] : The third quartile lies at 9.62 km, the median is 3.32 and 25% of the dyads live less than 820 m away from each other (Figure 1a). Figure 1b represents the distribution of distances between dyads who live within a range of 10 km. Among the dyads living at a maximal distance of 10 km away from each other, the home addresses of 25% are separated by a distance of less than 600 m; 50% live closer than 2 km (median = 1.84), and 75% live within 4.3 km.

3.1.2 Link distance depends on individual history and network composition

While most links are rather close, the question arises if the distances are randomly distributed over individuals, or if link distance is associated to some individual, network, or regional characteristic. The results of the multilevel models are presented in Table 2. The model was built in three steps after the empty null model (variance partitioning): First, adding fixed individual level variables (socio-demographic and biographical variables, models 1 and 2). The second step introduces network level variables (model 3), controlling for population density (model 4) and in the third step, slopes were allowed to vary (models 5 and 6).

Variance partitioning

When introduced to the model separately, the network, Spatial Mobility region and canton as grouping variables explain a significant part of the variance. However, the network, which explains 36% of the variance is the only grouping variable that remains meaningful when adding several levels (networks, Spatial Mobility regions or administrative regions, cantons). This suggests that, in line with H1, link distance is not exclusively an individual characteristic, but varies between networks. We retain the model with network as grouping variable[7]. After introducing the covariates, the remaining unexplained variance of the network level is 23.7%. Figure 2 depicts the network effects (residuals) for the null model. The significant share of the variance at the network level indicates that individuals who are part of small distance dyads tend to be part of networks with members who also present short links. Thus, link distance is not only an individual, but a network characteristic. This means that participants with short "personal" links are likely to be part of networks which span smaller distances – they need more intermediaries to span larger geographical distances, "the world is larger" for them than for individuals in networks with longer ties. Table 2 provides an overview over the coefficients of the models presented in this section. Table 3 presents variance partitioning and model fit statistics for each model, while table 4 contains the fit statistics for random slopes.

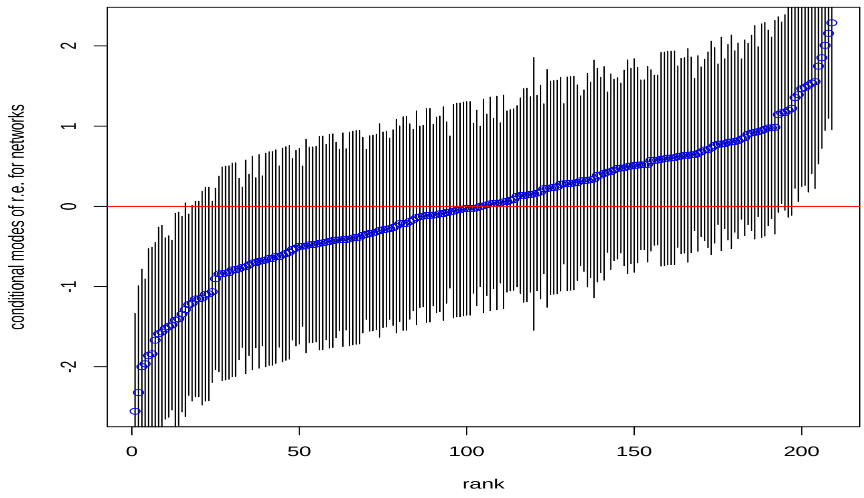


Figure 2: Network effects (residuals) with 95% confidence intervals

Individual and household characteristics (models 1 and 2)

Introducing age, sex and nationality (CH, CH + other, other only) into the model improves the model fit. Only the coefficient for age attains statistical significance, indicating that older individuals tend to have longer mean distances, confirming H3 predicting a positive relationship between age, which varied between 15 and 26 in the sample, and average tie distance. We did not find evidence for H4 predicting a negative impact of financial difficulties of the household on the spatial extension of links.

In a next step, we introduced characteristics of the individual trajectories: the current occupation (reference category is full time training) residential mobility (reference category is zero events of residential mobility). These variables again improve the model and the coefficients suggest that having another occupation than being in full time training or a full time job (e.g. being unemployed or staying at home) decreases the average link distance. Our results partially confirm H5, which predicts longer average ties for those of our young adults who already have a job: While the difference between individuals in any kind of full time occupation and persons in other situations is significant, our results do not show any difference between types of full time occupation; tie lenght does not differ between participants in either full time education or work). H6 predicts the increase of link distance with residential mobility. Our findings confirm the hypothesis, providing a further precision on the temporality of the effect: Having moved less than four years ago increases the mean distance of a person's link while after this period, the effect of residential mobility disappears. The individual level and life course variables explain 13% of the residual variance.

Table 2: Multilevel models. Individual and network level effects on distance

	Null model		M1		M2		M3		M4	
	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
(Intercept)	1.12	0.09	1.6	0.56	1.6	0.56	2.7	1.5	1.61	0.62
Individual level										
Age (centered at the mean)			0.1	0.03	0.11	0.03	0.07	0.03	0.1	**0.03**
Sex: male			-0.14	0.13	-0.14	0.13	-0.18	0.13	-0.22	*0.13*
Nationality: CH + other(s)[a]			-0.54	0.55	-0.58	0.54	-0.49	0.54	-0.57	0.53
Nationality: Other(s)[a]			-0.42	0.54	-0.46	0.54	-0.43	0.53	-0.55	0.54
First language: French[b]			0.09	0.17	0.11	0.18	0.19	0.18	0.13	0.19
First language: Italian[b]			-0.11	0.33	-0.08	0.32	-0.19	0.31	-0.27	0.32
First language: Other[b]			-0.38	0.37	-0.39	0.37	-0.07	0.38	-0.07	0.38
Household financial situation										
income = expenses			0.18	0.15	0.19	0.15	0.16	0.15	0.21	0.15
income < expenses			0.09	0.14	0.04	0.14	0.02	0.14	0.08	0.14
Life course variables										
Occupation: Full time job[c]					0.01	0.2	0.03	0.21	0.03	**0.2**
Occupation: other[c]					-0.57	0.2	-0.59	0.21	-0.56	**0.2**
Moved less than 4 years ago[d]					0.51	0.18	0.59	0.19	0.59	**0.18**
Moved 4 or more years ago[d]					0.15	0.14	0.21	0.18	0.21	*0.14*
Pop. Density: Intermediate[f]									0.39	**0.14**
Pop. density: Thin[f]									0.81	**0.2**
Network level										
Mean number of contacts							-0.08	0.03	-0.07	**0.03**
Age homogeneity							-0.23	0.21		
Sex homogeneity: high[e]							-0.7	0.23	-0.67	**0.23**
Sex homogeneity: intermediate[e]							-0.28	0.19	-0.26	0.19
Mean % of non-Swiss members							-1.32	0.57	-1.13	**0.55**

M1: Socio-demographic characteristics and household economic situation; M2: Biographical variables, M3: Network level variables; M4: Control for population density.
Reference categories: [a] Swiss only; [b] German; [c] Income > expenses; [d]Full time education; [e] Never moved. [f]Random mixing,
Bold characters: p <.05; italics p<.1

Network composition variables (model 3)

Introducing variables describing the network composition again increases the model fit and reduces the variance of the higher-level variable "network" from 0.95 to 0.77. The results show that link distance slightly decreases with the increase of the average number of peers with whom network members interact frequently. A higher percentage of network members without Swiss nationality is associated with a smaller average link distance. Sex homogeneity of the network reduces the average distance of the links. These variables explain 30% of the network-level variance.

Table 3: Multilevel models. Variance decomposition and model fits

		Null model		**M1**		**M2**		**M3**		**M4**	
Variance decomposition		Var	SD	Var	SD	Var	SD	**Var**	**SD**	**Var**	**SD**
	Network (intercept)	1.1	1.05	0.99	0.99	0.95	0.97	0.77	0.84	0.71	0.85
	Residual	2.39	1.55	2.10	1.45	2.06	1.43	2.08	1.44	2.04	1.43
% of variance explained											
	Network (intercept)							30.0		35.4	
	Residual			12.1		13.8		12.9		14.6	
Model fit	AIC	3359.2		3016.1		3006.0		2922.2		2907.8	
	BIC	3373.4		3072.0		3080.5		3019.5		3009.7	
	deviance	3353.2		2292.1		2974.0		2880.2		2863.8	
	LR (d.f)			**361.0 (9)**		**18.3 (4)**		**93.8 (5)**		16.4 (1)	

M1: Socio-demographic characteristics; M2: Biographical variables, M3: Network level variables; M4: Control for population density.

Controlling for population density (model 4)

Model 4 in Table 2 presents the full model, additionally controlling for population density. The variable significantly increases model fit but does not alter the other coefficients of the other variables in the model.

Random slopes (models 5 and 6)

We tested for random slopes for all significant individual-level coefficients. (Table 4). The effect of age (LR = 11.61, d.f. = 2, p<.01) and occupation status (LR = 14.29, d.f. = 5, p<.05) differs across networks. The positive correlation between the slope for age and the intercept indicates that higher levels of baseline distance are associated with a stronger effect of age. In other words, for individuals in networks with shorter link distance, the gain in the span of their links is smaller than for individuals embedded in networks with longer average link distance, thus showing a cumulative effect of network distance. The effect of occupation also varies across networks.

Table 4: Random slopes for significant individual coefficients

	M5		M6			M7			
Variance decomposition	**Var**	**SD**	**Var**	**SD**	**Corr**	**Var**	**SD**	**Corr**	
Network (intercept)	0.69	0.83	0.56	0.74		0.69	0.83		
age	0.05	0.23	0.05	0.22	0.39				
Occupation: full time job						0.01	0.11	-0.94	
Occupation: other						2.03	1.42	-0.05	-0.30
Residual	2.04	1.43	1.93	1.39		1.87	1.36		
Model fit AIC	2900.5		2894.4			2894.4			
BIC	2993.2		2996.3			3010.2			
deviance	2860.5		2850.4			2844.4			

M5: Network effects + Controlling for population density; M6: Random slope for age; M7: Random slope for occupation

3.2 Administrative structure and context

3.2.1 Human connections across micro-regions

Figure 3 represents a global-level view on network patterns in Switzerland, depicting cross-regional links. A link exists in the graph if any two individuals from region A and region B are connected by frequent interaction. Node colors represent the type of Spatial Mobility region. The graph has to be interpreted with care since inexistent links are inexistent only in our sample but not likely in reality. However, since the sample is representative for the studied cohort of young adults and their social ties to peers in the same cohort, the depicted network links are also representative for the cross-MS region connections between pairs in our population of young adults. In the graphic, the effect of linguistic barriers and natural obstacles (mountains) appears clearly. The French-speaking regions of western Switzerland are connected to the more central part (namely, the capital Bern) only by indirect links passing through smaller towns with (more or less) bilingual culture, while Ticino, which is the only Italian-speaking canton and separated from the rest of the country by the Alps remains disconnected.

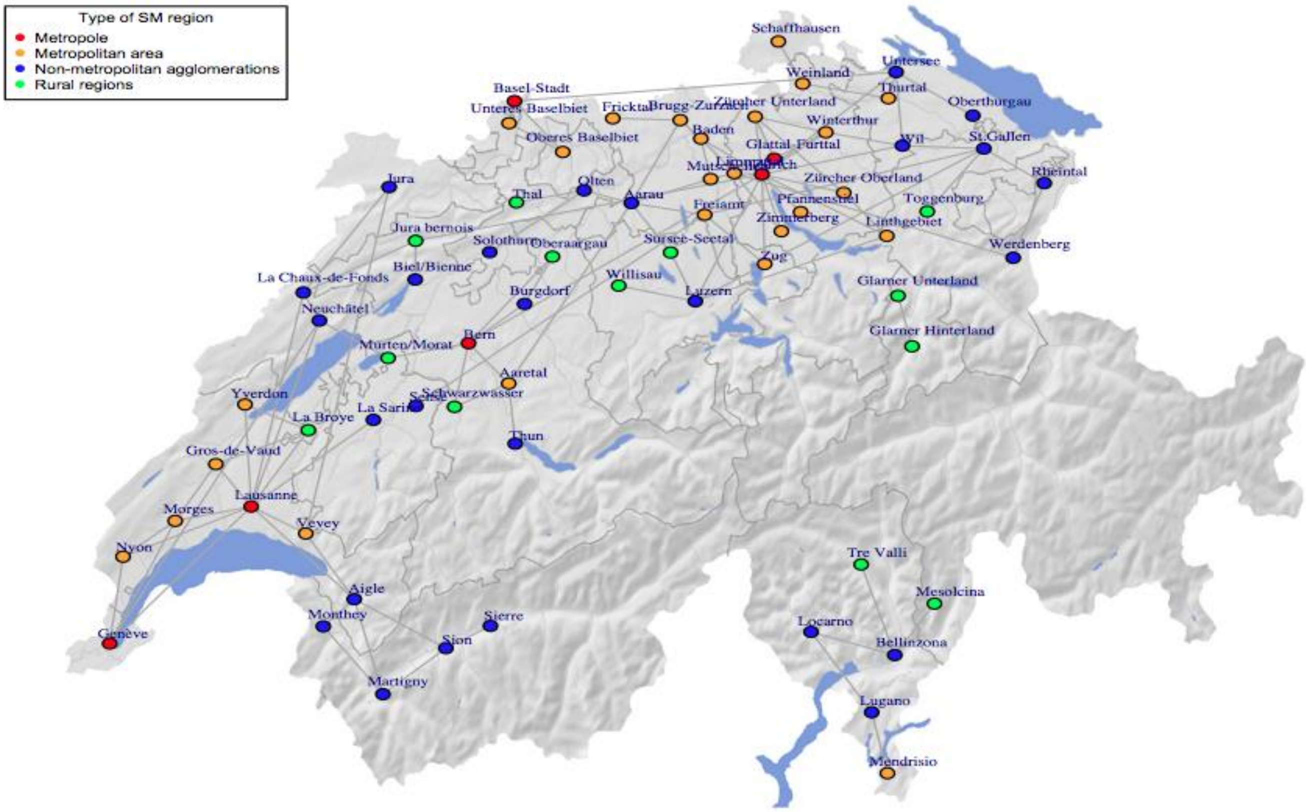


Figure 3: Spatial Mobility regions, connected by links of frequent interactions between individuals. *A link is depicted if at least three dyads exist between two regions.*

In order to analyze the structuring factors of the cross-regional links, we use a negative binomial[8] regression to model link frequency. The results are presented in Table 5. The results suggest that intra-cantonal links are more likely than cross-cantonal links even when distance between the regions is controlled for (OR = 3.35, p<.05). Also, unsurprisingly, people associate more likely with other people from the same linguistic region, independently of distance (OR = 2.3, p <.001). These findings are in line with hypotheses 6 and 7.

Table 5: Negative binomial regression: Predicting the number of links

	Model 1: Canton and language					Model 2: Controlling for distance				
				Confidence Intervals (OR)					Confidence Intervals (OR)	
	Est.	SE	OR	2.5 %	97.5%	Est.	SE	OR	2.5%	97.5%
(Intercept)	3.42	0.18				9.51	1.23			
Same canton	2.28	0.53	9.75	3.85	33.92	1.21	0.58	3.35	1.18	12.15
Same official language	2.20	0.25	9.02	5.41	14.9	0.83	0.29	2.30	1.16	4.53
Log(Distance)*						-1.23	0.25	0.29	0.18	0.45

*Distance between region centroids

3.2.2 Local or global? A typology of network geographies

Given the definition of Spatial Mobility region as a micro-analytical space, links within the same SM can be considered as being “local” links. We consider links beyond the Spatial Mobility region, but within the canton as “cantonal”; links going beyond the canton, but staying within the same large region (cf section 2) as “macro-regional” and links reaching beyond the large region as “national”.

Computed on the ego network level, 68.5% of all links are local, while only 7.8% of the links are national. In 43% of the ego networks, all links are local, while 15% of the ego networks don’t present any local (within Spatial Mobility region) link. Inversely, 78% of the networks do not present any “national” tie (going beyond the large region).

A cluster analysis (K-means cluster) showed that network types are best represented by a four-cluster solution. Figure 4 shows that the majority (60.1%) of the networks can be considered “local”, with most links within MS region (95.2%) and very few links at the cantonal, regional or national level. A second cluster is constituted by “cantonal” networks (12.5%), with 87.3% of the links in this cluster at the cantonal level. About 5% of the networks are characterized by a majority of “national”, thus long(er) distance links – these links form “bridges” between remote regions. The “national” networks are composed by 82% long links, 8.9% local links and 4.2% and 2.8% of cantonal and regional links respectively. The fourth cluster contains “mixed” networks, where 45.8% of the links are local and the other half is composed by cantonal (22.8%), regional (15.8%) and some national (9.4%) links.

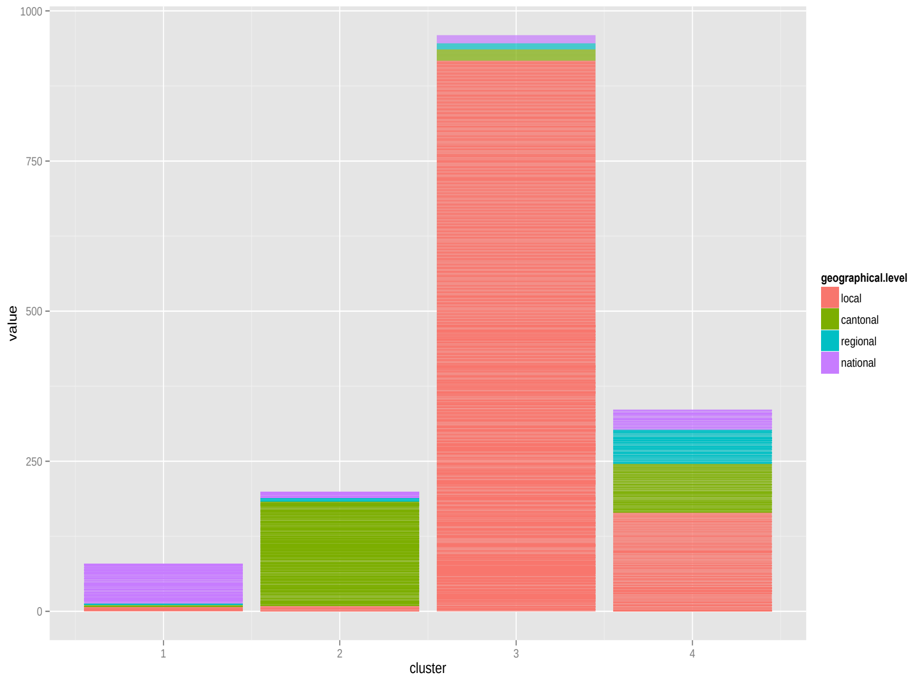


Figure 4: Types of networks (K-means cluster analysis)

Individual variables and cluster membership

In accordance with the results presented in the previous section, participants in clusters 1 (national networks) and 4 (mixed networks) are older[9] than participants in the other clusters. This difference is significant, as an ANOVA showed ($F = 7.55$, $df = 1$, $p < .01$). Further, participants with "national" networks are more likely to have experienced residential mobility in the last four years ($\chi2 = 34.8$, $df=6$, $p>.001$. Std.Res = 3.78). Inversely, in cluster 3 ("local networks"), participants who reported at least one residential mobility in their lives longer than four years ago are over-represented (Std. Res = 3.35), while participants who moved recently are under-represented (Std. Res = -5.17). In the local cluster, individuals who are in full-time education are over-represented (Std. Res = 3.3), while persons in full time jobs are under-represented (Std. Res = -3.65).

Region of residence and cluster membership

Membership in clusters is significantly associated with different types of Spatial Mobility regions ($\chi2 = 117.49$, $df=9$, $p<.001$). Table 6 shows the results of the test, along with standardized residuals. Examination of standardized residuals shows that participants from metropoles are much more likely to be in cluster 3 ("local networks"), and especially few of them have "cantonal" and "national" networks[10] . Participants from metropolitan areas and rural regions are less often than expected in the "local" cluster. Inversely, individuals residing in metropolitan areas are more often involved in "national" and "cantonal" networks. Participants from rural regions are more often members of cluster 2 ("cantonal" networks).

Table 6: Cluster membership, by type of Spatial Mobility region: Standardized Residuals from $\chi 2$ test

		Type of Spatial Mobility region				
cluster		**Metropole**	**Metropolitan area**	**Non-metrop. agglomeration**	**Rural region**	**Total**
1: "national"	Obs	13	38	24	6	81
	Exp	26.7	21.6	27.0	5.7	
	Column %	2.4	8.9	4.5	5.4	5.1%
	Std. Res	**-3.3**	**4.3**	-0.7	0.1	
2: "cantonal"	Obs	28	78	63	31	200
	Exp	66.0	53.3	66.7	14.0	
	Column %	5.3	18.4	11.8	27.7	12.5%
	Std. Res	**-6.1**	**4.2**	-0.6	**5.0**	
3: "local"	Obs	396	207	310	50	963
	Exp	317.6	256.6	321.2	67.6	
	Column %	75.3	48.7	58.2	44.6	60.1%
	Std. Res	**8.5**	**-5.7**	-1.2	**-3.5**	
4: "mixed"	Obs	89	102	135	25	351
	Exp	115.8	93.5	117.1	24.6	
	Column %	16.9	24.0	25.4	22.3	22.3%
	Std. Res	**-3.5**	1.2	2.3	0.08	

Bold characters: poor fit of H_0 in the cell

These results suggest that factors of the region of residence impacts the geographical profile of networks. People living in metropolitan centers, where more potential peers and a wide range of services are available, have mostly local networks, while people from rural regions reach out at the cantonal level. However, even in the latter group, almost half of the networks can be characterized as "local". Participants from metropolitan areas are the only group with more than expected "national" level links – the links who go outside the neighboring Spatial Mobility regions, reach beyond the nearest administrative unit (canton) and even beyond the macro region. Thus, while residents of metropolitan centers are likely to have easier access to direct transportation (e.g. intercity trains, etc), the adolescents in our sample do not seem to use this access.

3.2.3 Local or global? A typology of network geographies

"National" links – the links going beyond the region of residence and its surroundings – can be considered as bridging ties. 340 individuals (21.2%) report at least one link classified as national. About half of them have a few (<20 %) "national" links. However, 11% mentioned exclusively national links, indicating that they are not inserted in a network with local links or links to neighboring regions. Unsurprisingly, individuals with a recent event of residential mobility are more likely to be involved in this kind of links than other participants ($\chi2$ = 14.2, df=2, p<.001, Std. Res = 3.76). However, people with a recent mobility history only make half the individuals with exclusively national links. Participants from the Leman region are significantly less likely to have bridging links in their networks ($\chi2$ = 58.3, df=6, p <.001. Std. Res=-5.49), while individuals from Zurich and Central Switzerland are significantly more likely (Std. Res = 4.11 and 3.66 respectively).

Yet, the "national" cluster in our typology does not represent networks of bridge ties in all cases: Most of these networks are (almost) exclusively composed by long distance ties, thus lacking local insertion. Inversely, individuals with "mixed" clusters are more likely to have ties which span structural holes, connecting otherwise unconnected network clusters.

4. Discussion

Everyday links are mostly local and deeply rooted in the place of residence, suggesting that "local" network neighborhoods are more than a metaphor. Our geographical neighborhood structures our social ties. However, while our results are in line with the results of a study conducted in Zurich (Axhausen & Frei, 2007; Frei & Axhausen, 2007), and with studies on the geography of network links in different countries and using different types of data (Baybeck & Huckfeldt, 2002; Lambiotte et al., 2008; Mislove et al., 2010; Nahemow & Lawton, 1975; Onnela et al., 2011; Scellato, Noulas, Lambiotte, & Mascolo, 2011; Volkovich et al., 2012), the link definition, as well as the young age of the participants in the COHORT study contributed to even shorter links in our survey. Local effects may be especially strong for this young cohort, since many of them did not (yet) experience spatial mobility for professional reasons, for example, and their experience of spatial mobility, if any, is most likely dependent of their parent's decisions. However, one of the aspects addressed in this paper was precisely the question whether spatial boundaries matter to the "virtual generation", familiar with facebook and smartphones from a young age.

The results show network effects on link distance, in line with our hypothesis. Spatial dispersion of social links is not only a personal, but also a network characteristic: Individuals with shorter distance links are part of more locally based networks - lacking long links, their contacts are equally unlikely to have long links. For these individuals, it would thus probably take more steps to reach large geographical distances by travelling on network links. Thus, if we consider that the capacity to build and maintain long links is a form of capital, we found a cumulative network effect for this type of capital.

Our hypotheses on the impact of different personal factors on link distance were partly confirmed. The results show that links tend to become geographically more distant as individuals grow older (our oldest individuals are young adults rather than teenagers). This is especially true for networks with already longer link distances, thus confirming our predictions regarding the effect of age. The “virtual generation” is not born into a connected world, young people do not grow up with connections to distant others – at least not when frequent interactions are concerned. Nevertheless, this effect is likely to be specific to our young population and probably disappears if the study population is a sample of the general population. However, the results presented by Axhausen and Frei (2007), using a slightly broader link definition (“spend free time” rather than frequency of the contact), suggest that most links remain relatively local even at adult age. Carrasco (2008) showed that, at the other end of the life course, age has a negative effect on link distance.

Contrary to our expectations, there were no effects for the economic status of the household. The absence of impact of the economic status of the household on link distance is in line with previous findings in a (non-representative) Swiss survey (Axhausen & Frei, 2007; Frei & Axhausen, 2007) and in contradiction with the hypothesis that ”mobility capital” is correlated with economic capital. However, it is important to bear in mind that most of our young participants still live with their parents and that the variable we used in the model only assesses subjective evaluation of the household’s finances. They are yet to start their own adult life, so the economic status of the household assessed in the study is actually the economic status of their parents/family. Yet, the economic capital of the household – and the access to goods stemming from the availability of this capital – is still likely to be determinant for the individual’s reality.

Aspects of the life course – both present and past - affects the average distance of the links individuals are involved in, as predicted in the hypotheses. Being in some kind of full time occupation (job or education) results in longer mean distances. However, the link distance of students (school and professional training confounded) does not differ from participants who are in a full time job. Residential mobility impacts the length of links, but the effect is temporal and disappears after a few years – 3 years for our young sample. Spatially dispersed social links need more pro-activity and resources to be maintained (Viry, 2012; Carrasco, 2008). Our result that tie length decreases with the average number of contacts cited by each network member is in line with this. As Viry (2012) argued, only the strongest links overcome distances – mostly family links, which were not assessed in our current study.

Some characteristics, which are not important at the individual level, show an effect at the network level: Individual sex did not yield a significant coefficient. However, the degree of gender-related homophily in the network does play a role – networks with mixed gender members are more spatially dispersed. Also, networks with a higher percentage of members who do not have a Swiss nationality present shorter links, suggesting an effect of this status on people's social insertion.

At the macro-level, the results suggest that geographical proximity is a powerful predictor of links, but not the only one. As predicted, administrative and linguistic boundaries seem to structure human interaction over and above distance. At equal distance, within-canton links are more likely. This is not surprising, given the very decentralized nature of Switzerland. Also, all compulsory and even some post-obligatory education ("gymnase") is organized by canton. Thus, for the adolescents and young adults who are still in either the compulsory system or some post-obligatory track which is organized by canton, these administrative constraints coincide with institutional constraints – e.g. the impossibility to choose a geographically nearer school which, is located in another canton.

However, administrative boundaries are not the only "invisible" obstacles for social ties: Language barriers are important in Switzerland. Although national languages are taught in school, the networks – and, consequently, the inter-regional links – are almost perfectly segregated by language. While the high homophily coefficient for Italian-speaking regions might well be caused by the relative geographical isolation of these regions, this is not true for French-speaking regions, which present a similar coefficient, cannot be explained this way. Interestingly, German-speaking regions present a much lower language-related homophily coefficient, which, however, remains highly significant.

Also, rural regions (and, to a lesser extent, non-metropolitan agglomerations), are not well connected to the more central regions. Mountain chains are a natural obstacle for links. Dyads linking peers from both side of the alps are scarce, leaving Ticino mostly isolated when anecdotal links are removed. Grisons, a mountainous region in the East of Switzerland, is relatively isolated too, with only few links between neighboring regions and longer, extra-cantonal ties only from the canton's capital.

Finally, time-based distance – the time it takes, for example, to reach a peer's home, or a the place of common activity, is probably more relevant than distance in km. However, time-distance is modulated by other types of barriers – namely, language. For example, the time distance for both car and train commuting from Lausanne, the most central larger city in French-speaking Switzerland, and Bern on the one side as well as towns in the canton of Valais (Martigny, Sion) is similar and both connections represent cross-cantonal links. However, while virtually no ties can be found in our sample between Lausanne and Bern, Lausanne is very densely connected to Valais. Thus, it matters where we are, not only how far away we are: The same travel time does not imply the same link frequency. For many of our young participants under 18, as well as participants over 18 with no access or limited access to a car, an additional constraint coming from public transportation timetables might apply, especially in more peripheral and rural regions. Thus, their mobility might be further limited by infrequent public transportation connections.

In the light of the results suggesting that the same geographical distance – and even the same time distance, does not imply equal numbers of ties, it seems adequate to re-examine the implicit assumptions of the multilevel model. Using a log transformation of the link distance and fitting a linear model to the data, we imply linear relationships. However, it is reasonable to think that a threshold model might as well be adequate. We are unlikely to interrupt a friendship (or not create/maintain it) due to a few additional kilometers or minutes of travel time. The distribution of the distance suggests a similar conclusion: There are sharp(er) drops at some distance points – e.g. at a distance of about 1km, then again at 2,5 km and finally at about 4km. Between these points and after 4km, the distribution flattens. Thus, additional to immediate spatial proximity, the question of accessibility may play a role: Contacts stay in the immediate surroundings, as close as a couple of hundreds of meters in many cases, which is an easily walkable distance. However, once we cross the boundaries of immediate surroundings, this same distance does not seem to play the same role any more. Additionally, while the log transformation "flattens" high values, there is evidence that spatially close and spatially distant social ties might be of a different type (Viry, 2012) and the meaning of some additional hundred meters – or even some kilometers - distance is relative: while spatially distant ties demand more time and energy to maintain and are often ties linking family members or long term friends, spatially close ties may be easier to maintain, but also more casual and circumstantial. Once we exceed a small distance which can easily be overcome by a short time of travel in everyday life, it is unlikely that a small additional time on top of an already considerable journey will be determinant for the maintenance of the link.

Limitations

One important limitation of the data is the absence of information on clustering at the ego network and extended ego network level. Connections between non-sampled peers have not been assessed due to the excessive burden this would have represented for the respondents. Thus, it is impossible to draw conclusions on the clustering of the local networks, loosing an important structural information.

While the objective link definition based on effective contact (rather than importance or subjective definitions like "being a friend of") turned out to be efficient in producing symmetric links, the presence of a measure for the frequency of interaction (other than "once a week per average") would have been an advantage.

Finally, our sample consists of emerging adults. An important share of the still depend on their parents and are finishing or just finished school. Obviously, these living arrangements and institutional constraints are reflected in the geography of their social links. Also, most of the participants are either still at school or just finishing school. Therefore, the results are limited to the studied cohort which, in the study year 2014, represented about 10% of the total resident population in Switzerland.

5. Conclusion

Not considering geography most likely influences how we understand our results. For instance, it has been argued that geographic closeness as important creator of homophily: people who share a physical space are more likely to form social ties (McPherson et al., 2001; Preciado et al., 2012). However, the effects are not only individual, but present important network effects. It does not only matter who and where we are, but also who our friends are. Most everyday links are situated inside the same Spatial Mobility region, or, in other words, within the same activity space – they are "local". On the other hand, we found a minority of participants who are inserted exclusively in networks with distant ties, reporting no local ties.

While this seems unproblematic for individuals with very recent residential mobility, this type of link geography for individuals without recent mobility suggests a poor integration in their local context. Using solely link distance as a predictor for geography-and mobility related capital, without considering, for example, the composition of networks (e.g. combination of long-distance and local links within the network) might be misleading.

6. Notes

[1] The fourth official language is spoken only by a very small number of persons and will not be taken into account.
[2]http://www.bfs.admin.ch/bfs/portal/de/index/infothek/nomenklaturen/blank/blank/msreg/01.html
[3] http://www.bfs.admin.ch/bfs/portal/fr/index/regionen/11/geo/analyse_regionen/02a.html
[4] The centroid is a region's geographical center and may not correspond to any particular locality
[5] Another interesting option, proposed by Van Duijn et al. (1999) is to model ties (instead of individuals) within networks, in order to understand the impact of tie characteristics, like strength, type of transaction, etc.
[6] Calculated as the great circle distance between the addresses of both dyad members
[7] Inserting Spatial Mobility region as a second grouping variable does not alter the coefficients. Population density, which could conceptually be considered as a contextual variable, is computed at individual level and inserted as such in the model without altering the results.
[8] The results remained robust when fitting a quasi-poisson model and a logistic regression.
[9] Reminder: the age range of the sample is between 15 and 26.
[10] For the interpretation of the residuals, we followed Agresti (2007) who suggests that a standardized residual of +/-3 or more indicates poor fit of H0 in the cell.

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