

Electronic and Face-to-face Communication in Maintaining Social Relationships

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Abstract

Although the spectacular spread of wired and wireless communication technologies such as the Internet and mobile phone have been discussed extensively in the academic literature, knowledge of the interactions among face-to-face (F2F) and electronic communication modes and their implications for travel behavior is rather limited. The same is true for knowledge about factors influencing the choice for these types of communication. Using survey data collected among 662 respondents, this paper aims to gain more insight into (i) the interaction between F2F and electronic contacts, (ii) the influence of information content and relational distance on the choice of the communication mode/service, and (iii) the influence of relational and geographical distance, in addition to various other factors, on the frequency of F2F and electronically mediated contacts with relatives and friends. Bivariate correlation analysis indicates that the frequency of F2F contacts is positively correlated with that for electronic communication, which points at a generation effect. With respect to the impact of information content and relational distance, we find that such synchronous modes/services as F2F and telephone conversations are used more for urgent matters and that asynchronous modes (especially e-mail) become more influential as the relational distance in the social network increases. Finally, ordered probit analyses confirm that both F2F and electronic communication frequencies decline with increasing physical and relational distance to the social network members.

Samenvatting

Hoewel de spectaculaire groei en verspreiding van draadloze en verbonden communicatietechnologieën, zoals Internet en de mobiele telefoon, uitgebreid worden besproken in de (wetenschappelijke) literatuur, is de kennis over de interacties tussen face-to-face (F2F) en elektronische communicaties en de bijbehorende implicaties voor het reisgedrag betrekkelijk beperkt. Datzelfde geldt ook voor de beïnvloedende factoren voor F2F en elektronische communicaties. Dit paper heeft tot doel om, op basis van empirische data verzameld onder 662 respondenten, meer inzicht te verkrijgen in (i) de interactie tussen F2F en elektronische contacten, (ii) de invloed van de inhoud van de informatie en de relationele afstand op de keuze van de communicatiewijze/-service en (iii) de invloed van relationele en geografische afstand, naast verscheidene andere factoren, op de F2F en elektronische communicatiefrequenties met familieleden en vrienden. Uit een bivariate correlatieanalyse is naar voren gekomen dat de F2F en elektronische communicatiefrequentie positief zijn gecorreleerd. Dit duidt op een communicatie-generatie-effect. Verder is gebleken dat meer synchrone communicatiewijzen/-services, zoals een persoonlijke ontmoeting of een telefoongesprek, vaker worden gebruikt om dringende zaken te bespreken en dat asynchrone vormen (in het bijzonder e-mail) belangrijker worden wanneer de relationele afstand toeneemt. Ordered probit analyses hebben tenslotte nader bevestigd dat F2F en elektronische communicatiefrequenties afnemen met toenemende geografische en relationele afstand tot leden van het sociale netwerk.

1. Introduction

Although the relationship between ICT and social networks has been described in the literature (see, e.g., Boden and Molotoch, 1994; Putnam, 2000; Dijst, 2006), our knowledge of how people use electronic communication modes and face-to-face (F2F) contacts involving corporeal travel to maintain their social network is limited. This is equally true of the extent to which the interactions between communication mode use and maintaining social networks depend on the characteristics of those networks. The current paper aims to provide more insight into these issues on the basis of a questionnaire study. Specifically, it first explores how and to what extent F2F and electronic contacts interact: are both modes regarded as substitutes or complements? Secondly, the aim is to determine the influence of information content/urgency and relational distance or closeness in one's social network on the choice of the communication mode. The main emphasis in this paper, however, will be put on gaining more insight into the influence of relational and geographical distance (straight-line distance between residences) in addition to various other factors on the frequency of F2F and electronically mediated contacts with relatives and friends. In so doing, we build on and extend recent work on the role of recent Information and Communication Technologies and social interactions (e.g., Larsen *et al.*, 2006; Carrasco *et al.*, 2006; Licoppe and Smoreda, 2005). However, the results may also be valuable for transportation researchers. In order to physically see another person (F2F) travel is needed. Therefore, insights into (i) the extent to which electronic and F2F contacts interact, and into (ii) the extent to which F2F contacts are influenced by physical distance to relatives and friends may have important implications for (especially leisure and social-related) travel.

The outline of this paper is as follows. Section 2 outlines a theoretical framework for analyzing the interactions between F2F and electronic communications for maintaining social networks and reviews the literature about communication behavior and geographical, relational distance and communication. Section 3 describes the empirical data, which are used for descriptive and ordered probit analyses of the use of communication modes in sections 4 and 5, respectively. Conclusions are presented in section 6.

2. Theoretical framework

2.1 Interaction between communication modes

For each communication, a person can choose to use (combinations of) four communication modes: F2F conversations, written documents (e.g., a letter or a note) and fixed and mobile telecommunication modes. In this paper, however, we only make the distinction between F2F and electronically mediated contacts (either wired or wireless), because these have the most direct ramifications for activity-travel patterns. In addition to mode choice, people have to select the electronic communication service to be used. Examples of such services are: a phone conversation, e-mail, SMS and MSN/chat.

Communication between people by ICTs does not take place independently of F2F contacts; the different communication modes/services can be regarded as communicating vessels. Following Salomon (1986) and Mokhtarian (1990), we suggest that their interactions can take various forms: substitution (e.g. electronic communication decreases F2F contacts), generation (e.g. electronic communication stimulates F2F contacts), modification or changes in the nature, temporal and spatial locations of F2F and telecommunication contacts, or neutrality (no impact of one mode/service on the other). On the basis of literature, in this section we consider the relationships between F2F contacts and the use of electronic communication modes and services, especially the Internet. We draw a distinction between the frequency of contacts and time spent on communication, because the literature shows different interaction effects for both.

In general, Internet use seems to have a neutral or positive effect on the *number* or *frequency of contacts*. Based on an international web survey, the use of the Internet increased the frequency of contacts with friends and family in the USA and Japan (see, e.g., Ministry of Public Management, Home Affairs, Posts and Telecommunication, Japan, 2004). Some other studies have found mixed effects with respect to contact frequency with different social relations (e.g., Täube, 2004; Katz and Rice, 2002). Not all studies focus, however, on Internet use. Using communication diary data Mokhtarian and Meenakshisundaram (1999), for example, studied relationships between the frequencies of personal meetings (and trips), transfer of an information object (in-house documents, regular mail, and express or overnight mail), and electronic interactions (phone, fax and email) between two points in time.

Significant cross-lagged effects (i.e. the effect of one communication in period 1 on a different type of communication in period 2) were mostly found to be positive, indicating the presence of some generation effects across modes. Yet, relationships between electronic forms of communication and F2F meetings were not found to be significant in either direction.

In contrast with the number of contacts and frequency of F2F encounters, it seems that the impact of Internet use on *time spent* on these contacts is negative or neutral. Studies in, Japan, USA and the UK have suggested a substitution effect of Internet use on time spent physically with family and friends (Nie and Erbring, 2000; Nie *et al.*, 2002). Kestnbaum and colleagues (2002) used time-use diary data for the USA to show that Internet use diminishes the time spent on socializing and visiting non-family members; however, after controlling for socio-demographics, this result was no longer statistically significant.

2.2 Communication mode/service and relational and geographical distance

In the context of the Pew Internet & American Life Project, Wellman's group in Canada studied the association for adults of 18 years and older between ICT use and core ties (family and close friends) and significant ties (colleagues and less close friends) in social networks (Boase *et al.*, 2006). In general, the respondents relied heavily on F2F encounters and mainline phones to contact core and significant members of their network. The mobile phone and e-mail rank third and fourth. All these communication means are used more for core than for significant ties. Instant Messenger (IM) services (e.g. chat) are used much less widely than the other communication modes in maintaining existing contacts.

Other studies have also shown that relational distance affects the choice of communication mode. As in the USA-based study of Boase *et al.* (2006) and the study of Carrasco and Miller (2006) in Toronto, Canada, a personal phone call for maintaining interpersonal relationships also seems more usual in the French case (Rivière and Licoppe, 2004). In Japan, more than in Europe, text messages by mobile phone appear to serve emotional as well as instrumental purposes, and such messages are sent to all contacts, independent of relational distance (Carrasco and Miller, 2006). More generally, sending the indirect communication services liberates the user from relatively strict values and norms in personal contact expressed in, e.g., feelings of embarrassment when one disturbs another person (Rivière and Licoppe, 2004).

The choice of a communication mode and service also seems to depend on the interaction between the geographical distances between network members. Studies in the USA (e.g., Boase *et al.*, 2006) and UK (Larsen *et al.*, 2006) have indicated F2F contacts to diminish with geographical distance. While in the USA phone calls (mainline and mobile phone) show no relationship with geographical distance in the USA, this relationship is negative for the UK-sample. This difference might reflect the operationalization of the variable ‘distance’ in the two studies. In both studies, the frequency of e-mail use increases with geographical distance, because of the relatively low costs. The same result has been found in Japan for e-mails sent by mobile phone (Miyata *et al.*, 2002).

2.3 The contribution of this paper

On the basis of sections 2.1 and 2.2 we can conclude that the knowledge about the relationship between ICT and social networks is rather limited. What evidence is available suggests that there might be substantial differences between countries and cultures. This paper seeks to add new knowledge to the current body of literature about interactions between communication modes on the basis of Dutch data. We are inclined to believe that one of its strongholds lies in its combined focus on the influences of both geographical and relational distance on the frequency of communication, while at the same controlling for all kinds of contextual factors. Until now, only few studies did this (e.g., Boase *et al.*, 2006).

While the focus throughout the paper is on the combined influence of geographical and relational distance, we also consider other factors that are likely to influence people’s communication behavior. These include characteristics of the (members of the) social network, such as the size and composition of the social network (i.e., number and types of contacts) and sociodemographic characteristics of the network members. Additionally, we consider respondents’ current use of ICTs and their opinions about using them, as well as their characteristics. The latter include such factors as household type, age, ethnicity, degree of urbanization of the residential location and gender.

3. Data

To gain more insight into the relationship between ICT and social networks a survey was conducted among one and dual-earner households residing in the Utrecht-Amerfoort-Hilversum area in the central part of the Netherlands in February-July 2007. This area was

chosen because we were already familiar with it. First, selection questionnaires were sent to around 13,500 respondents living in different neighborhoods in the research area. We strived for a quasi-experimental design in which neighborhoods were selected on the basis of the average personal income, urban density and the availability of a train station (within 800 meters). We created a combined income, density and accessibility matrix (4 income, 5 density, 3 train accessibility classes) and assigned the neighborhoods in the research area to the different cells. From this matrix 26 areas were selected, covering the income, density and accessibility ranges. Using a criterion of equal marginal totals over income, density and accessibility classes, we determined the number of addresses to be sampled per neighborhood. Addresses within each neighborhood were selected randomly using digital files containing all street addresses. The selection questionnaire asked about general household characteristics (gender, age, employment status, etc.), ICT availability (mobile phone possession, type of Internet connection, etc.), and most importantly, whether or not the respondent and his or her partner were willing to participate in the main part of the research.

The main part of the research consisted of a questionnaire and a 2-day combined activity, travel and communication diary. As this paper only uses the questionnaire, the emphasis will be on that part of the survey here. In total 662 respondents completed the questionnaire, either online or in a mail-out/mail-back paper-and-pencil format. The sample is not representative of the Dutch population, in part because we specifically selected employed households only¹. In addition to questions about socio-demographic background and lifestyle, the main questionnaire contained questions about ICT use in general and for maintaining social contacts in particular. With regard to the latter, respondents were asked to state with which five family members and five friends they communicate most often. More specifically, they had to indicate how often they have contact with each of them via electronic means (i.e. phone, e-mail, SMS, Internet) and F2F. The responses had to be given on a five-point Likert-scale ranging from communicating less than once a month (1) to having contact on a daily basis (5). For privacy reasons, we did not ask for the names and detailed address information

¹ Higher-educated persons are over-represented in our data. Additionally, the average household income is (slightly) higher compared to the Netherlands' average, which may be partly due to the underrepresentation of singles (27% in the sample versus 35% for the total population in 2006; CBSStatline, 2007). Finally, the share of men in the sample (45%) is lower than for the Netherlands in total (49% in 2007) (CBSStatline, 2007). Nonetheless, representativeness in terms of marginal distributions for socio-demographic characteristics is not so critical when the purpose of the study is exploring relationships among multiple variables, as is the case here (Babbie, 1998).

of the family members and friends but rather for their gender, age and place of residence. The information about the place of residence enabled us to determine the geographical distances within people's social network. Thus, the concept of 'geographical distance' is operationalized simply through the actual physical distance (i.e. as the crow flies) between social network members in this paper. This social network question was also used to measure the concept of 'relational distance': it is defined as the relative position in the social network (i.e. firstly mentioned contact in network, secondly mentioned contact, etc.); contacts that were mentioned later on in a sequence of five contacts within the survey are assumed to exhibit a higher relational distance. However, relational distance is also operationalized using two other survey questions. In these questions relational distance is measured through the type of person with whom the respondent has contact (a relative, a good friend, a good colleague, a far friend or acquaintance); in this context relatives or good friends are regarded to be closer to the respondent (i.e., a low relational distance) than far friends or good colleagues. The first question asked respondents about the communication mode (F2F meeting, telephone conversation, SMS, e-mail, chat, or a combination of modes) they would use to discuss something urgent with a relative, a good friend, a far friend/acquaintance, and a good colleague living at a hypothetical travel time of 10 minutes (by car or bicycle). The second was similar but concentrated on discussing something important, but not urgent and thus varied in terms of information content.

4. Communications within people's social networks: a general insight

4.1 Communication frequency and correlations between F2F and electronic communications

As section 3 described, respondents were asked to indicate the frequency of contact with the five relatives and five friends they communicate most often with via electronic means (phone, e-mail, SMS, Internet) and F2F. Answers were given on five-point scales ranging from less than once a month (1) to daily (5). Table 1 shows the communication frequencies for both communication modes as reported by the respondents. Based on details for about 2700 network members, we found that the electronic communication frequencies with both relatives and friends are on average higher than the frequencies of F2F contacts. This may be due to a possibly lower effort to communicate electronically, especially with regard to time and costs (e.g., no physical travel). Table 1 also shows the mean frequency values (i.e. the

mean over the five classes) because they facilitate easy comparison of results across the different modes and social relations. The mean value for the electronic communication frequency with relatives amounts to 2.6 (i.e., in between the categories ‘at least once a month’ and ‘on a weekly basis’). For friends Table 1 shows a lower value (2.4). However, we found a slightly higher frequency for F2F contact for friends compared to relatives.

Table 1: The F2F and electronic communication frequencies with relatives and friends

Communication frequency	Descriptives (% of total network relations per frequency class)			
	F2f with relatives (2756 relations)	Electr. with relatives (2747 relations)	F2f with friends (2711 relations)	Electr. with friends (2700 relations)
1: less than 1x per month	42.6	22.2	37.3	25.4
2: at least 1x per month	32.2	29.7	29.4	33.9
3: weekly	15.2	25.3	21.1	23.3
4: more than 1x per week	7.0	16.9	9.8	13.3
5: daily	2.9	5.9	2.5	4.1
Mean value (over class 1-5)	2.0	2.6	2.1	2.4

Correlation analysis was used to investigate the interactions between F2F and electronic contacts within the social network (Table 2). All coefficients are positive and statistically significant. The highest correlations occur for the interaction between the frequency of F2F and electronic contacts for either relatives or friends: respondents that more often visit their friends also more frequently communicate via electronic means; the same seems to be relevant for communications with relatives. Correlations between contacts with relatives and friends are lower but still significant. This finding of a generation effect between communication modes aligns with the results from Boase *et al.* (2006). Finally, weighting the communication frequencies for the size of the total social network resulted in even higher correlation effects compared to Table 2.

Table 2: Interactions between f2f and electr. communication frequencies with relatives and friends

Spearman's rho	F2f with relatives	Electr. with relatives	F2f with friends	Electr. with friends
F2f with relatives	X	0.592**	0.170**	0.174**
Electr. with relatives		X	0.142**	0.291**
F2f with friends			X	0.533**
Electr. with friends				X

** $p < 0.05$

4.2 The influence of geographical distance

Table 1 showed that the mean F2F frequency with friends is slightly higher than for relatives, which may be due to a higher mean distance to relatives. In our sample, the mean distance to relatives within the Netherlands amounts to 38 kilometers, which is roughly 1.5 to 2 times higher than the average distance to friends. In contrast, the mean international distance to friends is higher than the distance to relatives. However, the number of international contacts

is far smaller in size and therefore has less influence on the average communication frequencies.

The relationship between physical distance and the average communication frequency is evaluated more directly in Table 3², which shows a negative association for both F2F and electronic modes. This ‘distance decay’ effects seems to be stronger for contacts with relatives than for friends and for F2F than for electronic contacts. The decreasing communication frequency with geographical distance may be explained by the increasing financial and temporal costs when distances get larger. It may also reflect a ‘from the eye from the heart’ effect.

Table 3: Mean communication freq. dependent on the geographical distance to network members

Mean communication frequency (scale 1-5)	F2f with relatives	Electr. with relatives	F2f with friends	Electr. with friends
1 0-5 km	2.93 ^{(2,3,4)*}	2.96 ^(2,3,4)	2.64 ^(2,3,4)	2.53 ⁽⁴⁾
2 5-10 km	2.24 ^(1,4)	2.71 ^(1,4)	2.13 ^(1,4)	2.47 ⁽⁴⁾
3 10-20 km	2.05 ^(1,4)	2.58 ^(1,4)	2.10 ^(1,4)	2.46 ⁽⁴⁾
4 20+ km	1.51 ^(1,2,3)	2.35 ^(1,2,3)	1.53 ^(1,2,3)	2.16 ^(1,2,3)

*The numbers between brackets indicate the distance classes for which the average communication frequencies are significantly (95 percent) different.

4.3 The influence of relational distance and communication purpose

Using the survey question asking respondents about the F2F and electronic communication frequencies for the five most important relatives and friends, we studied whether respondents communicate more with closer persons. We assumed respondents to report the closest person at the first position, the second closest person at position two, etc. This assumption appears reasonable, especially since we explicitly asked respondents to mention only one person per street address or household, which means, for instance, that befriended couples or one’s parents (if both are alive) are included only once. In this way we hoped to reduce the likelihood of ties in the respondents ranking of network members’ closeness. Statistical analyses (results not shown here but available upon request) confirm that the average communication frequencies tend to be lower for higher positions and arguably also for less closer persons. However, because this finding only confirms that people on average write down their most important relatives and friends first, we also used a second survey question, asking respondents to indicate their communication mode choice for four different types of

² It has to be noticed that, strictly speaking, it is not correct to use ANOVA to analyze the relationship between distance and the communication frequency given the ordinal nature of the variable communication frequency. However, we chose to do so because ANOVA outcomes can be interpreted easily and straightforwardly.

relations (relatives, good friends, far friends/acquaintances and good colleagues). Relatives and good friends are assumed to be closer than far friends/acquaintances and good colleagues. We also analyzed to what extent the content of the communication influences the mode choice. Table 4 presents the results for ‘discussing something urgent’, Table 5 those for ‘discussing something important, but not urgent’.

For ‘discussing something urgent’, a telephone conversation is consistently chosen most often. A F2F conversation ranks second for both relatives and good friends. In fact, the overall pattern for good friends and relatives is quite similar. If relational distance increases (i.e., for far friends or good colleagues), asynchronous modes of communication, such as e-mail, become more important at the expense of F2F conversations. However, the (synchronous) telephone conversation remains the main mode. If ‘something important, but not urgent’ is to be discussed, phone or F2F conversations remain the most important for close relations. E-mail, however, is preferred more often at the expense of both synchronous modes (telephone and F2F) for discussing important, non-urgent matters with far friends or good colleagues. It is chosen even more frequently than the phone to contact far friends or acquaintances. Finally, when communication content is considered, urgent matters tend to be discussed relatively more often synchronously, whereas asynchronous modes are more often used for less urgent issues.

Table 4: Communication mode choice dependent on relational distance; discussing something urgent

Communication mode choice for discussing something <u>urgent</u> with a...	Relative	Good friend	Far friend/ acquaintance	Good colleague
F2F (%)	28.9	30.4	2.2	8.7
Phone call (%)	64.7	66.7	60.7	72.1
SMS (%)	1.8	0.3	5.3	2.9
E-mail (%)	1.5	0.8	29.8	14.4
Chat (%)	0.2	0.2	1.2	0.5
Combination of modes (%)	2.9	1.7	0.8	1.4

Table 5: Communication mode choice dependent on relational distance; discussing something important, but not urgent

Communication mode choice for discussing something <u>important</u> but not <u>urgent</u> with a...	Relative	Good friend	Far friend/ acquaintance	Good colleague
F2F (%)	23.6	25.5	3.7	11.1
Phone call (%)	60.7	54.3	38.0	42.5
SMS (%)	3.1	5.2	4.3	5.4
E-mail (%)	11.8	13.6	53.2	39.9
Chat (%)	0	0.3	0.3	0.5
Combination of modes (%)	0.8	1.2	0.5	0.6

5. Explanatory factors for people's communication pattern

An ordered probit analysis was carried out to gain more insight into the factors that affect the frequency of F2F and electronic communication with social network members. In total, the effects of more than 30 potential independent variables were tested, which can be grouped into the following classes: (i) factors associated with geographical and relational distance, (ii) social network characteristics, (iii) use of and opinions about ICTs, (iv) and respondent characteristics. The dependent variable in the ordered probit analysis is not the individual respondent but the relations with relatives and with friends that s/he reported in the questionnaire. This implies that each respondent is included up to five times in the data set used for estimation. Separate models are specified for contacts with relatives and with friends. The following procedure was adopted to arrive at the final model specification. First, bivariate analyses were undertaken to determine the explanatory power of several independent variables. Secondly, all significant variables ($p < 0.10$) were included in a multivariate analysis after checks to avoid multicollinearity problems. Thirdly, variables that were statistically insignificant in the probit models were excluded one by one, beginning with variables with the lowest t-value. The final models are shown in Table 6.

5.1 Geographical and relational distance

The results of sections 4.2 and 4.3 about geographical and relational distance remain valid in a multivariate analysis: (i) the communication frequency decreases with increasing geographical distance (ii) and also when the relational distance grows. Linear and quadratic terms were evaluated to test for nonlinear effects for geographical distance and both were found to be significant. They point at a turning point in the influence of distance. Further analyses showed, however, that a logarithmic distance variable fitted the data clearly better than did a linear distance factor. And, although hard to compare, models with a log distance variable sometimes also seemed to slightly 'outclass' the models including both linear and quadratic distance parameters. We chose to include a log-based distance variable in the final model estimations since the positive quadratic distance parameter, which points at an increase in the communication frequency with network members living further away (in this case for distances above approximately 100 kilometers), does not directly seem to correspond with our expectations, i.e.: one would rather expect a decreasing communication frequency (both F2F and electronically) with distance.

Table 6: Ordered probit analysis communication frequency	F2f freq. relatives		EC freq. relatives		F2f freq. friends		EC freq. friends	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	4.9543	0.0000	3.1287	0.0000	2.1571	0.0000	2.0834	0.0000
Geographical distance to relatives (km): logarithmic term	-0.4218	0.0000	-0.1174	0.0000	-0.3233	0.0000	-0.0974	0.0000
Relational distance (rank in social network, 1 to 5; increasing distance)	-0.3138	0.0000	-0.4657	0.0000	-0.1739	0.0000	-0.2994	0.0000
Social network member lives abroad (yes = 1)	-1.7677	0.0000			-1.3271	0.0000	-0.3538	0.0123
<i>Social network characteristics</i>								
Size of social network (no. of persons)	0.0052	0.0009	0.0105	0.0000	0.0032	0.0385	0.0054	0.0003
Share of relatives in the total social network (%)	0.0073	0.0000	0.0104	0.0000	-0.0056	0.0071	-0.0108	0.0000
Share of friends in the total social network (%)	-0.0038	0.0190			0.0073	0.0001	0.0041	0.0057
Share of colleagues in the total social network (%)					0.0059	0.0130		
Age of person in social network (years): linear term	-0.0681	0.0000	-0.0304	0.0000	-0.0285	0.0107	-0.0491	0.0000
Age of person in social network (years): quadratic term	0.0006	0.0000	0.0002	0.0001	0.0003	0.0291	0.0004	0.0020
Gender family member social network (male=1)			-0.2133	0.0000				
<i>ICT use and opinion</i>								
Fixed phone frequency (1-7; higher number corresponds with higher freq.)			0.0827	0.0000				
Mobile phone frequency (1-7; higher number corresponds with higher freq.)					0.0850	0.0000	0.0753	0.0000
E-mail frequency wired (1-7; higher number corresponds with higher freq.)							0.0451	0.0001
SMS frequency (1-7; higher number corresponds with higher freq.)	0.0867	0.0000	0.0817	0.0000			0.1185	0.0000
MSN frequency (1-7; higher number corresponds with higher freq.)			0.0470	0.0138			0.1018	0.0000
Internet use (hours/week)	0.0061	0.0636	0.0067	0.0415				
Personal innovativeness	0.0244	0.0001	0.0186	0.0016				
Negative image ICT in future (factor scores)	0.0575	0.0232						
<i>Characteristics respondent</i>								
Age respondent (years): linear term	-0.0557	0.0008	-0.0512	0.0013			0.0080	0.0257
Age respondent (years): quadratic term	0.0006	0.0008	0.0007	0.0001				
Gender respondent (male=1)			-0.3065	0.0000			-0.2212	0.0000
Education level					-0.0568	0.0440		
Single (yes=1)					0.1526	0.0165	0.2582	0.0000
Household income (class 1 to 5, increasing income)	-0.0701	0.0053	-0.0564	0.0165	-0.1285	0.0000	-0.1218	0.0000
Number of hours/week working	-0.0051	0.0132	-0.0048	0.0193				
Number of cars in household	0.1493	0.0005	0.1347	0.0005	0.1547	0.0002	0.1977	0.0000
Religion = Catholic	0.1342	0.0304						
Religious, but other than Catholic, Protestant, Muslim			-0.1745	0.0321	-0.2304	0.0051		
<i>Characteristics environment</i>								
Degree of urbanization (low to high)	-0.0912	0.0000						
μ_1	1.3387	0.0000	1.0710	0.0000	1.0013	0.0000	1.1757	0.0000
μ_2	2.2630	0.0000	2.0086	0.0000	1.8837	0.0000	2.0562	0.0000
μ_3	3.1489	0.0000	3.0621	0.0000	2.7689	0.0000	3.0496	0.0000
N (number of respondents in estimation)	2299		2252		2280		2241	
Log likelihood (constants)	-2983.6		-3389.7		-3126.1		-3246.9	
Log likelihood (convergence)	-2275.3		-2879.1		-2683.0		-2792.4	
X^2	1416.6		1020.1		886.3		909.1	

Furthermore, related to geographical distance, we also tested the influence of international relations on the communication frequency. As Table 6 shows, the F2F frequency with relatives and friends living abroad is lower, which may be explained by the higher effort/costs to maintain such long-distance contacts. Although not as strong, a lower electronic communication with friends living abroad was also found. This may have to do with higher communication costs for international communications but may also be attributed to a sort of ‘from the eye from the heart’ effect.

5.2 Social network characteristics

The potential effects of several social network characteristics were tested. Respondents with a larger social network (measured as the number of network members) indicated to communicate relatively more often with their important social contacts, both F2F and electronically. Therefore, maintaining a larger network appears not to have adverse effects on the frequency of contacts with close social network members. Maybe our indicator of network size acts as a proxy variable for the extent to which respondents are socially orientated/extravert.

Not only the size of the social network was found to influence the communication frequency; the composition of the network is also important. The higher the share of relatives within respondents’ social network, the more they communicate with their relatives but the less they communicate with friends. A higher share of friends leads to the opposite effect. Moreover, the influences of the age and gender of the network members were tested. In all models, the frequency of communicating with a relative decreases with age of the relative, but tips toward a positive relation at the age of 55. This is likely to reflect a ‘parent effect’ (i.e., the average age of the contacted relatives is higher than of the respondents). A similar age effect was found for electronic communications, which also includes landline phones, with relatives (more contact above 61 years of age). For friends turning points were found at 60 and 67 years for F2F and electronic contacts respectively.

5.3 Use of and opinions about ICT

Another group of significant factors were grouped as ‘use of and opinions about ICT’. We tested, for instance, the influence of the current general use of different communication services in order to observe amongst other things whether ICT-use also influences the F2F

contact frequency. We found that respondents that use the landline phone more intensively, more frequently communicate with their relatives via electronic means. The same goes for respondents that frequently use SMS or MSN. This may be (partly) due to a self-selection effect: people that use ICT-services more often communicate more frequently with network members via electronic means. The same explanation can be given for the effect of the SMS and MSN frequency on the number of electronic communications with friends. In addition, respondents using SMS seem to physically meet their relatives more frequently (meaning a possible communication generation effect). This may be due to the nature of SMS: especially by juveniles, SMS may be used to almost constantly stay in contact with people that are close with no other purpose as to stay into contact (the connected presence as described in Licoppe and Smoreda, 2005). However, it may also serve a more instrumental character, e.g.: the coordination of the time and place for a physical meeting (i.e., micro-coordination as described by Ling, 2004). Two other services, i.e. mobile phone and email use, only have a positive significant effect on the communication frequency with friends, whereas Internet use seems to have a positive effect on the frequency of contacts with relatives only. It can be concluded that the frequency of ICT use rather seems to lead to more than to fewer electronic and F2F contacts, which corresponds with findings from, for example, Boase *et al.* (2006). Finally, a lifestyle and an 'opinion' variable were found to be significant. Respondents who consider themselves more innovative (also in using ICT) communicate relatively more frequently with relatives both F2F as well as electronically.

5.4 Respondent and environmental characteristics

Among the characteristics of the survey respondents, age was one of the significant factors. Just as for the age of the network members, linear and quadratic terms show that the frequency of communicating with relatives decreases until the age of 48 years after which it starts to increase again. This may be explained by the earlier described larger portion of leisure time that higher aged employees possess, but may also be due to lower time constraints (e.g. children may already have left the house), new 'obligations' (e.g. babysitting grand children), or a growing dependency on others with increasing age. For electronic contacts with relatives the tipping point lies at 38 years with older respondents communicating more frequently electronically. In contrast, the frequency of electronically

mediated contacts with friends increases linearly with age, but no effect was found for F2F contact with friends³.

The potential effects of gender, education level and household type have also been tested. The analysis showed that male respondents communicate less frequently via electronic modes. Note, however, that there are no gender differences for F2F contacts. Education only has a significant effect on the F2F frequency with friends: more highly educated people meet their closest friends less often physically. With respect to household type, singles communicate more frequently with their friends, both F2F as well as electronically. This is intuitively agreeable; they may be oriented more strongly on their network of close friends because they do not have a partner (e.g. doing nice things such as going out). Two employment related variables were considered in the model building process: the net household income and the weekly number of employment hours. Both variables are negatively associated with the frequency of communication and may function as proxy variables for time-pressured professionals with little time to maintain their social network. As expected, car availability is positively related to the frequency of F2F contact with network members, suggesting that better mobility options are conducive to physically meeting with significant others. However, the coefficient signs within the two electronic communication models are also positive and suggest a relationship of generation: people with a car can maintain their F2F relationships more efficiently, giving them more opportunities to undertake electronically mediated communications. Reversed causality is, however, also conceivable: people with a large social network need a car to maintain their contacts.

We also tested the influence of religion as it may influence people's lifestyle and their social behavior. Catholics were found to more frequently communicate with their relatives F2F. Finally, we tested whether the population density at the residential location influenced the communication pattern. Only one significant effect was found: respondents living in more dense areas have fewer F2F contacts with close relatives.

³ Including a log transformed age variable instead of a linear term often leads to a better model fit (except for explaining the electronic communication frequency with friends). However, models with inclusion of both linear and quadratic age terms seemed to slightly outclass models with only a logarithmic age term.

6. Conclusions

This paper aimed to gain more insight into (i) how and to what extent face-to-face (F2F) and electronic contacts interact, (ii) the influence of information content/urgency and relational distance on the choice of the communication mode/service and (iii) the influence of relational and geographical distance in addition to various other factors on the frequency of F2F and electronically mediated contacts with relatives and friends. For this we used questionnaire data collected among 662 persons (single and dual-earner households) residing in the Utrecht-Amersfoort-Hilversum area in the central part of the Netherlands.

Correlation analysis was employed to explore the interactions between the frequency of F2F and electronic contacts within the social network. We only found generation effects between (the frequency of) using different modes and no evidence of possible substitution effects. The choice of the communication mode/service depends on the (type of) social network member involved (relative, good friend, far friend/acquaintance and good colleague) but also on the communication content and urgency. Our analysis suggests that, irrespective of type of contact, urgent matters are discussed more often via synchronous types of communication (telephone, F2F), and less urgent issues more with asynchronous modes. The importance of F2F contacts tends to increase with decreasing relational distance or increasing closeness.

Descriptive and ordered probit analyses have shown that geographical and relational distances are important explanatory factors for the F2F and electronic communication frequency with close relatives and friends. A negative relationship was found for relational distance: respondents tend to communicate less often with network members that are less close. The communication frequency also decreases with geographical distance. This 'distance decay' effect is stronger for the F2F than for the electronic contact frequency and stronger for relatives than for friends.

The results have several implications for transportation research. It appears that physical travel does not seem to decrease due to the ICT-mediated possibilities for maintaining social relations. The observed generation effect between electronic and the F2F communication frequency even suggests more rather than less physical travel. It seems that people in general keep attaching a high value to physically meet others, which may have to do with the relative

richness of F2F communication (one really ‘senses’ each other) compared to other communication modes (Urry, 2003). This appears particularly important for communicating with people that are at a small relational distance and for discussing important or urgent things.

Some avenues for further research can be identified. First, several factors potentially influencing communication frequencies have not been included in the empirical analysis and their impact could be explored in future research. These include such time-related aspects as the time available for communication and time-of-day, and location-related factors like the immediate physical surrounding of the ‘communicator’ herself and of the person to be contacted (e.g. background noise, weather conditions, urban density). Additionally, although we provided some insight into the influence of the information content/urgency on the choice of communication mode, we could not study its influence on the communication frequencies in the ordered probit analyses. Nevertheless, the purpose of the information transfer might also influence the intention and frequency of communication. Second, operationalizing relational distance remains a topic for further research. Here the operationalization in Carrasco *et al.* (2006) and Boase *et al.* (2006) may serve as an example. Third, as human geographers we were especially interested in the role of geographical distance within social networks on the communication frequencies with network members. Yet, the spatial configuration of the network members may also matter. If, for instance, all social network members live at, say, 100 kilometers from the respondent but are all clustered in the same town (e.g. the respondent’s place of birth), his/her frequency of F2F contacts may be different than in a situation with more spatially dispersed networks. We plan to consider the impact of the spatial configuration of networks on communication behavior in addition to that of geographical distance in our future research endeavors.

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