



FtF and Mobile email Personal Networks and Loneliness: Focusing on the Interaction Effects of Sociability and Personal Networks

Keywords:

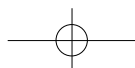
Loneliness Personal Network, Sociability Mobile email, Face-to-Face (FtF) Communication

Satoshi KITAMURA, The University of Tokyo

Abstract

This research has two purposes. The first purpose is to investigate the relationships between loneliness and the sizes of the personal networks in face-to-face (FtF) communication and in communication via mobile email (including email and short message services). The second purpose is to examine interaction effects on loneliness that exist between sociability and the size of FtF and mobile email personal networks. This paper discusses these points, based on the Japanese social survey by Hashimoto and his co-researchers in 2003. As seen in the results of regression analysis, the relationship between the size of mobile email personal networks and loneliness was weaker than between the size of FtF personal networks and loneliness. However, for the higher sociability group, there was a significant relationship between the size of FtF personal networks and loneliness, but not for the lower sociability group. On the other hand, for the lower sociability group, the size of mobile email personal networks showed a significant relationship to loneliness, but not for the higher sociability group. These findings indicate the interaction effects of sociability and personal networks on loneliness.

This paper is the English translation of the original Japanese paper which is published in Journal of Socio-Information Studies, Vol.10, No.1 and awarded for the Best Paper of the Year 2005 for Young Researchers.



1. Introduction

1.1. Mobile email and Loneliness

The number of mobile phone contracts reached 81,520,000 at the end of March, 2004 (FY2004 WHITE PAPER Information and Communications in Japan). If one contract per person is supposed, more than 60% of Japanese owned a mobile phone. According to the survey for personal use rate of mobile phones (including car telephones and PHS), 84.4% of 15-59 year-old Japanese use a mobile phone (NRI, 2003).

Current mobile telephones are treated as "personal digital assistant" with various functions even though we call them "mobile phones". In interpersonal communication, the text-message communication function becomes as important a function of the mobile phone as the call function. According to a survey by Video Research Ltd. (2002), 75.2% of mobile phone users use mobile email. More than 90% of mobile phone users of 12-29 years old use mobile email (Video Research Ltd., 2002).

Miyake (2001) found that a characteristic amongst university students is that mobile email is used for communication not only with friends they meet often but also with friends they rarely meet. She states that mobile email is the interpersonal communication media which is used very willingly for communication. According to a survey on university students by Tanaka (2001), 76.5% of respondents chose from specific options that "The spread of mobile email has made communication more convenient" and 60.7% of them chose the option of "Personal relationships have changed due to the spread

of mobile email."

We can say that a mobile phone, with its phone and email functions, is an important medium in personal relationships in Japanese modern society.

In the studies on interpersonal communication, many researchers have been interested in Computer-Mediated Communication (CMC) since the 1980s (e.g. Kiesler et al., 1984; Garramone et al., 1986). According to Miyata (1993), in CMC, the absence of face-to-face communication, individuality, non-verbal clues, and the liberation of distal and time limitation are notable characteristics.

Mobile email communication is an example of CMC and perhaps the CMC most widely practiced in Japan. In mobile email communication, synchronousness is considerably more guaranteed compared with email communication on the PC (Hashimoto, 2001).

A problem related to the use of CMC that is often cited, is the problem of mental well-being.

Kraut et al. (1998) researched the influence of Internet use on loneliness and depression. They gave computers with an Internet connection to people in Pittsburgh, Pennsylvania and tracked their Internet use and mental well-being over a period of two years. The results showed that greater use of the Internet was associated with statistically significant declines in social involvement, and increases in loneliness and depression. Their results drew a large amount of scrutiny and criticism (Joinson, 2003).

Also on the subject of mental well-being, the use of mobile email is often discussed with reference to the problem of loneliness. For example, Fujitake et al. (2001) suggested if

Satoshi KITAMURA—FtF and Mobile email Personal Networks and Loneliness: Focusing on the Interaction Effects of Sociability and Personal Networks

even one email does not reach its destination, the result can be uneasiness at not connecting with other people. Kawaura (2002) stated that the use of mobile email could expose the reality of personal relationships and possibly increase loneliness.

Loneliness is an important concept in the consideration of well-being. Loneliness is often discussed, not only with regards to modern society in general, but also in connection with the development of information and communication technologies (ICTs). This present study will deal with the relationship between mobile email use and loneliness, focusing mainly on a discussion of the relation between the size of mobile email personal networks and loneliness.

1.2. Loneliness and Personal Network

According to Peplau & Perlman (1979), loneliness is defined as the undesirable and subjective experience occurring from the discrepancy between achieved and desired levels of social contact. There has been a lot of research on the relationship between loneliness and personal networks. Many studies researching this relationship examine quantitative features of personal networks (e.g., the number of friends, the number of intimate friends).

To examine the validity of the revised UCLA loneliness scale, Russel et al. (1980) researched the relation between social behaviors and the scores on the scale. What they considered to be grounds for validity was significant negative correlation between the scores in the scale and the number of intimate friends. To examine the validity of the revised UCLA loneliness scale in Japanese, Kudo and

Nishikawa (1983) used the fact that the people who had higher scores on the scale had fewer friends than people with lower scores. Jones et al. (1985) and Levin & Stokes (1986) showed a significant negative correlation between the size of one's personal network and loneliness.

Research, however, has also been done on the relationship between the size of FtF personal networks and loneliness. Igarashi (2002) examined the relationship between the size of personal networks via CMC and loneliness. From the results of two surveys; one university students and one on the Internet, he showed that when friends talk about important things via CMC, the actual number of friends has no significant effect on loneliness, just as it doesn't in FtF conversation, conversation via telephone, or letters. In the survey on the users of Massively Multiplayer Online Role Playing Game "Lineage", Shimura & Ikeda (2004) showed that there was a weak relationship between the size of Lineage personal network and loneliness.

These findings indicate that the size of one's FtF personal network can have a relationship with loneliness, but the size of one's CMC personal network does not. Or if it does, it is weak.

Although loneliness is an undesirable and subjective experience occurring from the discrepancy between achieved and desired levels of social contact, the size of personal networks is a feature of the achieved level of social contact, and is not a feature of the desired level. Additionally, there can be a difference between the desired level of FtF and one's CMC personal network.

When we consider the relationship between the size of personal networks and loneliness, we must consider the cognitive factors which produce the discrepancy between the achieved and desired levels. When we want to compare FtF and mobile email personal networks, this perspective can be effective.

1.3. The Desired level of Personal Network and Sociability

I consider sociability as a factor in the recognition of the discrepancy. Sociability is defined as a tendency to affiliate with others and to prefer being with others to remaining alone (Cheek & Buss, 1981 ; Buss, 1986). People who have higher sociability might regard FtF communication as important. This then will affect the desired level of social contact in one's FtF personal network.

It is true that sociability affects not only personal networks but also loneliness itself.

Stokes(1985), and Levin & Stokes(1986) examined two theoretical models on the relationship between loneliness and personal traits: the "social network mediation" model and the cognitive bias model. The social network mediation model is a model that supposes that loneliness can be affected by personal traits mediating one's personal network, and predicts, for example, that people with nervous temperament will have difficulty making social contacts, so their personal networks will be poor and they will feel loneliness. On the other hand, the cognitive bias model predicts that people who have a negative understanding and poor opinion of other people will underestimate their personal relationships, and therefore experience greatest loneliness. The results of

analysis showed that each model showed partial validity.

According to the cognitive bias model, people who have higher sociability will have lower levels of loneliness. Sociability tends to go hand-in-hand with high levels of social skill and generalized trust. Social skill involves the verbal and non-verbal ability to build good human relationships. Some researchers show that social skill has a significant relationship with loneliness (e.g., Jones, 1982; Vaux, 1988; Igarashi, 2002), as does trust Moroi (1985).

But, when we control the relationship between loneliness and personal traits, we can form the following hypothesis: that people with higher sociability, but a small FtF personal network, may experience greater loneliness because of the greater discrepancy between their desired level of FtF personal network and their real network. The converse therefore is that there would be less loneliness with a lesser discrepancy. If, on the other hand, they have lower sociability, their desired level of FtF personal network may be lower. So, there is less or no discrepancy between their real and ideal situation. In other words, for people with lower sociability, there may be a weak relationship between the size of their FtF personal network and loneliness.

What relationship does sociability have with mobile email communication?

First, Kasagi & Daibo (2003) pointed out that people are less likely to recognize interpersonal pressure in CMC. This is true in communication via mobile emails, which use mainly text messages. Tsuzuki & Kimura (2000) analyzed the evaluation of communication media by university students, and found that there may be lower interper-

Satoshi KITAMURA—FtF and Mobile email Personal Networks and Loneliness: Focusing on the Interaction Effects of Sociability and Personal Networks

sonal pressure in mobile email communication than in other mediated communications.

From these findings, even people who have lower sociability can maintain their personal network easily using mobile email communication. Human beings are social animals and need social relationships (Buss, 1986). Although the desired level of FtF personal network amongst people with lower sociability might be lower, the desired level and expectation of mobile email personal network would be relatively higher, because of the general desire for social relationships.

It would follow them that if these people with lower sociability had a small mobile email personal network, the discrepancy between their real and ideal situation would be bigger, and their loneliness greater. On the other hand, people with higher sociability, and a greater desire for FtF communication, media-assisted communication might complement their FtF communication but the size of their mobile email personal network would have a weaker relationship with loneliness than the size of FtF personal network.

When we consider the effects of the size of FtF and mobile email personal networks on loneliness, we have to focus on sociability. It may be especially useful to examine the interaction effects of the size of FtF and mobile email personal networks, and sociability, on loneliness.

1.4. The purposes of this study

The purposes of this study are as follows. To examine the relationships between the size of FtF and Mobile email personal networks and loneliness.

This study examines findings of earlier studies. The hypothesis is as follows: The size of mobile email personal networks has a weaker relationship with loneliness than the size of FtF mobile networks.

To examine the interaction effects between sociability and the size of personal networks on loneliness.

On the relationship between loneliness and personal networks, the recognition of the discrepancy between the achieved and desired levels of personal networks is crucial. This study examines the interaction effects of sociability and the size of FtF and mobile email personal networks on loneliness.

2. Data

2.1. Survey

In this study, I performed a second analysis of the data collected by a Japanese national survey conducted by Prof. Hashimoto and his co-researchers in 2003 ⁽¹⁾.

This poll was a panel survey following a survey conducted on Japanese males and females who were 12-69 years in November to December, 2001. One in 2001 was based on a two-stage stratified random sampling of 3000 people in Japan. Hard-copy versions were hand-delivered to respondents, and also collected by hand. Of the selected individuals, 62.6% completed the survey, providing a total sample size of 1878 respondents. The data used in this present study was collected in November to December of 2003. This survey was conducted on the respondents who completed the one in 2001. Of the selected individuals, 66.3% completed this survey, providing a total sample size of 1246

respondents.

2.2. Scales construction

(1)Size of FtF personal network

The size of FtF personal networks was measured by asking respondents to imagine a maximum of ten people (network others) other than cohabiters, whom the respondents considered intimate. The number of network others whom the respondents met once or more a month (0 to 10) was used as the size of their FtF personal network.

(2)Size of mobile email personal network

The size of mobile email network was measured by asking respondents the number of people with whom they communicated by mobile emails.

(3)Loneliness

Loneliness was measured by revising three items from the revised UCLA loneliness scale in Japanese (Kudo & Nishikawa, 1983): "I have no friend whom I can trust", "My interests and opinions are different from those of other people in my environment," and "I get along well with people in my environment (Reversing item)." Each item was measured on a four-point scale: 1 = agree; 2 = somewhat agree; 3 = somewhat disagree; 4 = disagree. I conducted a principle component analysis and used the first principle component score as the score of loneliness (Eigenvalue: 1.35; Proportion: 0.45).

(4)Sociability

Sociability was measured by two items: "I do not feel uncomfortable when talking with a stranger," "I often go out to social gatherings". Each item was measured on a four-point scale: 1 = agree; 2 = somewhat agree; 3 = somewhat disagree; 4 = disagree. I

standardized and summed up the two items and used the score as the score for sociability ($r = .34, p < .001$).

(5)Personal traits: Social Skill, Generalized Trust

I used social skill and generalized trust as controlling variables, because they were the personal traits expected to correlate highly with loneliness and sociability.

Social skill was measured by revising 8 items from KiSS-18 (Kikuchi, 1988): "I can continue a conversation with a stranger," "I can express my emotions frankly", etc. Most of the items were those items which Kim (2004) defined as basic to communication skill ⁽²⁾. Each item was measured on a four-point scale: 1 = agree; 2 = somewhat agree; 3 = somewhat disagree; 4 = disagree. I conducted a principle component analysis on the eight items and used the first principle component score as the score for social skill (Eigenvalue: 4.07; Proportion: 0.51).

Generalized trust was measured by three items from Yamagishi's generalized trust scale (Yamagishi, 1998): "Most people are basically good and kind," "I can trust other people," "Most people trust other people". Each item was measured on a four-point scale: 1 = agree; 2 = somewhat agree; 3 = somewhat disagree; 4 = disagree. I conducted a principle component analysis on the three items and used the first principle component score as the score for generalized trust (Eigenvalue: 1.82; Proportion: 0.61).

(6)Demographic Variables

Demographic variables were gender (dummy variable), age, marital status (dummy variable), and number of cohabiters.

Satoshi KITAMURA—FtF and Mobile email Personal Networks and Loneliness: Focusing on the Interaction Effects of Sociability and Personal Networks

3. Results

3.1. Features of the Respondents

After dropping the respondents with missing data in the main variables, there were 586 remaining for the analysis in this study.

There were 245 males (41.8%) and 341 females (58.2%). The deviation toward females was because there were more females than males amongst the mobile mail users (51.0% of the males and 56.4% of the females used mobile email).

The Respondents' ages were as follows. 14-19 years old: 75 people (12.8%); 20-29 years old: 130 people (22.2%); 30-39 years old: 152 people (25.9%); 40-49 years old: 118 people (20.1%); 50-59 years old: 84 people (14.3%); 60-69 years old: 22 people (3.8%); and 70-71 years old: 5 people (0.9%)

As for marital status, married respondents numbered 337 (57.5%), and single respondents numbered 249 (42.5%).

The mean of the number of cohabiters was 3.97 (S.D. 1.50).

3.2. The size of Personal Networks

The mean of the size of FtF personal

network was 4.44 (S.D. 3.06). The mean of the size of mobile email network was 5.12 (S.D. 4.46). The mean of the number of people with whom respondents communicated by mobile email was 2.45 (S.D. 2.62).

3.3. Correlations between Variables

To confirm correlations between variables, I conducted correlation analysis. The results are shown in Table 1. All figures in table 1 are Pearson's correlation coefficients.

The correlation analysis showed that social skill, generalized trust, sociability, and size of FtF and mobile email personal networks had a significant negative relationship with loneliness ($p < .01$). Social skill had the biggest correlation coefficient with loneliness ($r = -.30$, $p < .01$), and amongst the variables with a significant relationship with loneliness, the size of mobile email personal network had the smallest correlation coefficient with loneliness ($r = -.12$, $p < .01$).

The relationship between the size of personal networks and personal traits (social skill, generalized trust, and sociability) were as follows. Social skill and sociability had a significant positive correlation with the size of

Table 1: Correlations between variables

	1	2	3	4	5	6	7	8	9
1 Loneliness	—								
2 Gender	-0.09 *	—							
3 Age	-0.02	-0.05	—						
4 Marital status	0.15 **	-0.01	-0.66 **	—					
5 The number of cohabiters	-0.07 †	0.06	-0.17 **	-0.07 †	—				
6 Social skill	-0.30 **	0.07 †	0.09 *	-0.09 *	0.001	—			
7 Generalized trust	-0.22 **	-0.01	0.16 **	-0.10 *	-0.04	0.16 **	—		
8 Sociability	-0.20 **	0.002	0.10 **	-0.12 **	0.02	0.50 **	0.23 **	—	
9 The size of FtF personal network	-0.20 **	0.07 †	-0.03	0.03	0.09 *	0.27 **	0.08 †	0.19 **	—
10 The size of mobile email personal network	-0.12 **	0.07 †	-0.15 **	0.13 **	0.005	0.12 **	-0.004	0.19 **	0.20 **

† $p < .10$; * $p < .05$; ** $p < .01$ ($N = 586$)

FtF personal networks ($p < .01$). At 10% significant level, generalized trust had significant correlation coefficient with the size of FtF personal networks. With the size of mobile email personal network, social skill and sociability had a significant positive relationship ($p < .01$). But generalized trust had no significant relationship with the size of mobile email personal network ($r = -.004, n.s.$).

The correlation analysis showed a positive relationship between the size of FtF and mobile email personal networks. ($r = .20, p < .01$).

These results support the opinion that people communicate with close others called "strong ties", by mobile email (Hashimoto 2001; Kobayashi and Ikeda 2004).

To be exact, according to Hashimoto et al. (2002), "when respondents were asked with whom they communicated most frequently by mobile email in private, most chose the option "others whom you see frequently". However, when asked with whom they communicated the second most frequently by mobile email in private, they chose the option "others whom you do not see frequently". (Figure 1).

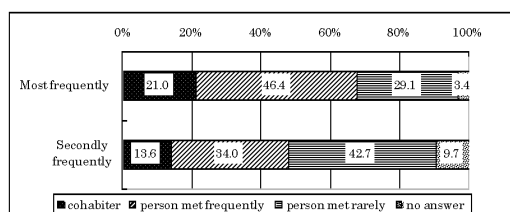


Figure 1: people with whom you communicate by mobile email
(Based on Hashimoto et al., 2004)

According to the surveys on Internet usage

trends in Japan (Hashimoto and Mikami et al., 2002; 2004), about 60% of the respondents chose the option, "Friends whom you see frequently" as the person with whom they communicated by mobile emails, and about 40% said "Friends whom you do not see frequently" (Figure 2).

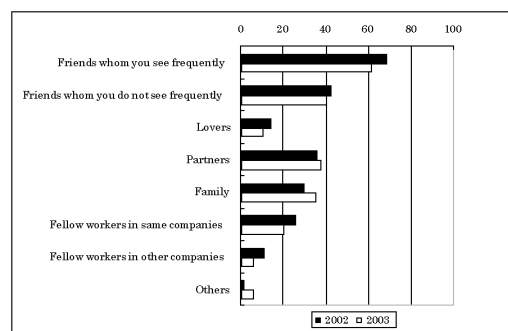


Figure 2: People with whom you communicate by mobile emails (Multi answers)
(Based on Hashimoto and Mikami et al., 2002; 2004)

These findings indicate that, people frequently communicate with "strong ties" by mobile emails, but, more than a few people communicate by mobile emails with others whom they do not see frequently.

3.4. Examination of the Interaction Effects

I conducted regression analysis on all the respondents to examine the effect of the size of personal networks on loneliness (Table 2). The dependent variable was the score of loneliness.

In model 1, the independent variables were demographic variables and personal traits (social skill, generalized trust, and sociability). The result showed that age, marital status, social skill, and generalized trust had significant coefficient. These effects of the

Satoshi KITAMURA—FtF and Mobile email Personal Networks and Loneliness: Focusing on the Interaction Effects of Sociability and Personal Networks

demographic variables and the personal traits were consistent in all models.

In model 2, I added the size of the FtF personal network as an independent variable to model 1. The result showed that the size of the FtF personal network had a significant negative coefficient on loneliness ($b = -.04$, $\beta = -.11$, $t(577) = 2.85$, $p < .01$). This result indicates that the size of the FtF personal network has a significant relationship with loneliness, even if the demographic variables and personal traits are controlled.

In model 3, I added the size of the mobile email personal network as an independent variable to model 1. The result showed that the size of the mobile email personal network had a significant negative coefficient on loneliness ($b = -.02$, $\beta = -.09$, $t(577) = 2.35$, $p < .05$). This result indicates that the size of the mobile email personal network has a significant relationship with loneliness, even if

the demographic variables and personal traits are controlled.

In model 4, I added the size of the FtF and mobile email personal networks as independent variables to model 1. The result showed that the size of the FtF personal network had a significant negative coefficient on loneliness ($b = -.04$, $\beta = -.10$, $t(576) = 2.52$, $p < .05$), the effect of the size of the mobile email network on loneliness was a significant tendency ($b = -.02$, $\beta = -.07$, $t(576) = 1.94$, $p < .10$). These results show consistency with Igarashi's findings (2002), in which the CMC personal networks have little effect on loneliness, compared with the FtF personal network. A significant effect of the mobile email personal network shown in model 4 might include the effect of the FtF personal network with mobile email communication.

In model 5, I examined the interaction

Table 2: Regression analysis on all the respondents

Dependent variable: loneliness	Standardized coefficients (β)				
Independent variables	model1	model2	model3	model4	model5
Gender (male = 0 / female = 1)	-0.06 [†]	-0.06	-0.06	-0.05	-0.05
Age	0.17 **	0.17 **	0.15 **	0.16 **	0.16 **
Marital status (married = 0 / single = 1)	0.22 **	0.22 **	0.22 **	0.23 **	0.23 **
The number of cohabiters	-0.03	-0.02	-0.03	-0.02	-0.03
Social skill	-0.25 **	-0.23 **	-0.25 **	-0.23 **	-0.23 **
Generalized trust	-0.18 **	-0.18 **	-0.18 **	-0.18 **	-0.19 **
Sociability	-0.02	-0.01	-0.004	0.0004	-0.003
The size of FtF personal network	—	-0.11 **	—	-0.10 *	-0.09 *
The size of mobile email personal network	—	—	-0.09 *	-0.08 [†]	-0.10 *
Sociability * The size of FtF personal network	—	—	—	—	-0.05
Sociability * The size of mobile email personal network	—	—	—	—	0.07 [†]
<i>N</i>	586	586	586	586	586
<i>R</i> ²	0.16	0.17	0.16	0.17	0.18
ΔR^2 from model4	—	—	—	—	0.01
<i>F</i> value of ΔR^2 from model4	$F(2,574)=3.50^*$				

[†] $p < .10$; * $p < .05$; ** $p < .01$

effects of sociability and the size of personal networks on loneliness.

Conforming to the Cronbach method (Cronbach, 1987), I added the products of sociability grand centered and the size grand centered of FtF and mobile email personal networks as independent variables to model 4. The result showed that the interaction effect of sociability and the size of the mobile email personal network on loneliness was a significant tendency ($p < .10$). The R-squared of model 5 was significantly higher than that of model 4 ($F(2, 574) = 3.50, p < .05$). These results indicate that there may be interaction effects of sociability and the size of personal networks, especially of mobile email networks, on loneliness.

3.5. Differences by Sociability

To examine and analyze differences between respondents with higher sociability and those with lower sociability, I separated them into two groups based on the mean of the score of sociability. The lower sociability group included 241 people, and the higher

sociability group included 345 people.

To examine the effects of the sizes of FtF and mobile email personal networks on loneliness, I conducted regression analysis, with loneliness as the dependent variable for each group. These results are in Table 3.

In model 1, the independent variables are demographic variables and personal traits (social skill, generalized trust, and sociability). The result in the lower sociability group showed that social skill and generalized trust had significant coefficients on loneliness. And the result in the higher sociability group showed that besides social skill and generalized trust, also age and marital status had significant coefficients on loneliness. In all models, these results were consistent.

In model 2, to examine the effect of the size of FtF personal networks on loneliness, I added the size of FtF personal networks as an independent variable to model 1. The results showed that, in the lower sociability group, the size of FtF personal networks had no significant coefficient on loneliness ($b = -.02, \beta = -.06, t(233) = .95, n.s.$), but, in the

Table 3: Regression analysis on the lower and higher sociability groups

Dependent variable: Loneliness	Standardized coefficients (β)							
	lower sociability group				higher sociability group			
Independent variables	model1	model2	model3	model4	model1	model2	model3	model4
Gender (male = 0 / female = 1)	-0.07	-0.06	-0.05	-0.05	-0.04	-0.04	-0.04	-0.03
Age	-0.01	-0.03	-0.05	-0.06	0.26 **	0.28 **	0.26 **	0.27 **
Marital status (married = 0 / single = 1)	0.03	0.02	0.02	0.02	0.32 **	0.35 **	0.33 **	0.35 **
The number of cohabiters	-0.05	-0.05	-0.07	-0.07	-0.02	-0.002	-0.02	-0.001
Social skill	-0.20 **	-0.19 **	-0.21 **	-0.20 **	-0.30 **	-0.25 **	-0.28 **	-0.24 **
Generalized trust	-0.23 **	-0.23 **	-0.26 **	-0.26 **	-0.15 **	-0.14 **	-0.14 **	-0.13 **
The size of FtF personal network	-	-0.06	-	-0.02	-	-0.18 **	-	-0.17 **
The size of mobile email personal network	—	—	-0.16 *	-0.16 *	—	—	-0.08 †	-0.07
N	241	241	241	241	345	345	345	345
R^2	0.12	0.12	0.14	0.14	0.19	0.22	0.20	0.22

† $p < .10$; * $p < .05$; ** $p < .01$

Satoshi KITAMURA—FtF and Mobile email Personal Networks and Loneliness: Focusing on the Interaction Effects of Sociability and Personal Networks

higher sociability group, it had a significant negative coefficient on loneliness ($b = -.06$, $\beta = -.18$, $t(337) = 3.49$, $p < .01$).

In model 3, to examine the effect of the sizes of mobile email personal networks on loneliness, I added the size of mobile email personal networks as an independent variable to model 1. The results showed that, in the lower sociability group, the size of mobile email personal networks had a significant negative coefficient on loneliness ($b = -.06$, $\beta = -.16$, $t(233) = 2.57$, $p < .05$), but, in the higher sociability group, the effect was significant tendency ($b = -.02$, $\beta = -.08$, $t(337) = 1.68$, $p < .10$).

Finally, in model 4, I added the size of FtF and mobile email personal networks as independent variables to model 1 to examine the effects of these on loneliness. The results showed that, in the lower sociability group, the size of FtF personal networks had no significant effect on loneliness ($b = -.01$, $\beta = -.02$, $t(232) = .23$, *n.s.*), but the size of mobile email personal networks had a significant effect on loneliness ($b = -.05$, $\beta = -.16$, $t(232) = 2.39$, $p < .05$). On the other hand, the results showed that, in the higher sociability group, the size of FtF personal networks had a significant negative effect on loneliness ($b = -.06$, $\beta = -.17$, $t(336) = 3.34$, $p < .01$), but the size of mobile email personal network had no significant effect on loneliness ($b = -.02$, $\beta = -.07$, $t(336) = 1.36$, *n.s.*).

4. Discussion and Future Research

The analysis of all the respondents showed that the main effect on the size of mobile email personal networks was a significant

tendency when the size of FtF personal networks was controlled. This result is consistent with Igarashi's (2002) findings. Model 5, including the interaction effects, however, had significantly higher R-squared than model 4. This result indicates that it might be important to consider sociability as the personal trait responsible for the discrepancy between the size of personal networks and the desired level of social contact when we analyze the relationship between the size of personal networks and loneliness.

The separable analysis on the lower and higher sociability groups produced clear results.

In the lower sociability group, the size of FtF personal networks had no significant coefficient on loneliness. People who have lower sociability may have a lower desired level and expectation of FtF personal network, so there is no discrepancy between the desired and achieved levels. On the other hand, in the lower sociability group, the size of mobile email personal network had a significant negative coefficient on loneliness.

These results may be interpreted as indicating that the lower sociability group's cognition of the discrepancy between the achieved and desired levels of social contacts was influenced by the size of mobile email personal networks because they have a relatively higher desired level and expectation of mobile email personal network than of FtF personal network. Even if people have lower sociability, they avoid social isolation, because humans are social animals.

On the other hand, in the higher sociability group, the size of FtF personal networks

consistently had a significant negative coefficient on loneliness, but the size of mobile email personal networks had no significant coefficient on loneliness when the size of FtF personal networks was controlled.

People who have higher sociability would have the need to affiliate with others, so their desired level of social contacts would be higher. If they have a lower achieved level of social contacts, there would be a discrepancy between the desired and achieved levels. The achieved level of mobile email personal networks of people with higher sociability cannot reduce their cognition of the discrepancy.

There were differences between the lower and higher sociability groups in the coefficients on loneliness based on the respondents' ages and marital status. These results could be interpreted as indicating that older people with higher sociability could not engage as actively as young people in interpersonal behavior, but that they had a higher desired level of social contacts. Also people who have higher sociability would consider it important to have the stability of having others around them. So, in the higher sociability group, the respondents' marital status had a significant relationship with loneliness.

These points indicate the effectiveness of using sociability to explain the desired level and expectation of personal networks, and of considering the interaction effect of the achieved level of personal networks and sociability on loneliness.

The next thing to consider is problems connected with this study, and future issues to be explored.

In this study, the focus was on the quantitative features of personal networks. However, Cutrona (1982) and others showed that qualitative features of personal networks (satisfaction, intimacy, etc.) showed stronger correlation with loneliness than the quantitative features. While the study by Cutrona (1982) was on the relationship between FtF personal networks and loneliness, Shimura & Ikeda (2004) studied the relationship between the qualitative features of CMC personal networks and loneliness. They showed that the size of CMC personal networks had no significant effect on loneliness although the degree of satisfaction of CMC personal networks had a significant effect. These indicate that we have to examine the interactive effects of the qualitative features of personal networks and sociability on loneliness.

This study has a problem in terms of causal relationships. In this study, I conducted a one time data analysis. This study examined only the correlations, not the causal association. However, Igarashi & Yoshida (2003) and Shimura & Ikeda (2004) have examined the causal relationships between loneliness and personal networks by panel surveys. Although this study does not examine the causal relationships, based on the earlier studies, it is possible to reason that the personal network can affect loneliness. Because the earlier studies, however, had not examined the interaction effects, to examine the causal association should be a future issue for exploration.

Although this study examined the interaction effects of sociability and personal networks, there are some personal traits

Satoshi KITAMURA—FtF and Mobile email Personal Networks and Loneliness: Focusing on the Interaction Effects of Sociability and Personal Networks

which affect interpersonal behavior. Future research on loneliness must examine these personal traits closely.

Also the results in this study showed that the higher the level of sociability of people, the larger their size of personal network. As for the size of mobile email personal networks, the relationship was the same.

Sakamoto et al. (2000) indicate by their experiment the possibility of CMC as a tool for social training. They showed that shy people could increase their sociability in the real world by training in the Multi-User Dungeon. Mouri et al. (2001) pointed out, however, that the effect of such training on the shy people could not be sustained. Although there is mail counseling, which is counseling using CMC (e.g. Takaishi et al., 2002), it is also important to improve sociality in FtF communication.

And there is the problem with loneliness tolerance which was pointed out by Nakamura (2003) and Hashimoto et al. (2004). The problem is that people who use mobile email more frequently have, not only lower level of loneliness, but also lower loneliness tolerance. This can be related to the point by Kawaura (2002) that the use of interpersonal communication media might expose the reality of personal relationships.

The development of ICTs has made various communication modes possible. This causes various problems with interpersonal communication. We must continue to accumulate findings on interpersonal communication in modern society.

Lastly, this study is a second analysis, so it has certain limits. In this study, I examined my hypothesis by analyzing existing social survey data. Therefore, each concept was

manipulated by the available variables. This was a constraint that caused some problems in this experimental study.

Although there is a lot to be done in future research, the findings in this study hopefully could contribute to the theoretical exploration of this important social issue.

Acknowledgements

- (1) The data used in this study is by the survey supported by grants from the Japan Society for the Promotion of Science, KAKENHI13410046. The survey was conducted by Professor Yoshiaki Hashimoto, Associate professor Ken-ichi Ishii, Associate professor Tadamasa Kimura, Associate professor Daisuke Tsuji, and Assistant professor Sangmi Kim. The author would like to express his greatest thanks to them for their permission to use of data.
- (2) In this study, social skill was measured by the following eight items: "I can continue a conversation with a stranger," "I can express my emotions frankly," "I can initiate conversation with a stranger quickly," "I can express my emotions and feelings frankly," "I can introduce myself to a person I meet for the first time," "I can readily enter in a conversation others are having," "I can help others well," "I can instruct others clearly regarding what I would like them to do," "I can be reconciled with people I have argued with."

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