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The Effect of Mobile Phone Use on Communication between Parents and Children : A Panel Study Examining Causality

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Abstract

We conducted a two-wave panel study in a total of 450 children, from elementary, junior, and senior high schools, to examine how their mobile phone use influenced parent-child face-to-face communication. The study indicated the following:
(1) The face-to-face communication between elementary school children and their parents decreased the more they used e-mail or the Internet; they felt a stronger sense of unrealistic psychological togetherness, or they had stronger emotional dependency. Therefore, this suggested that the amount of face-to-face communication may have decreased because it was replaced by e-mail use. The use of e-mail, or certain contents of e-mail messages, may have simultaneously caused weakening of the parent-child relationship, resulting in a decrease in communication.
(2) Since mobile phone use seemed to exert a psychological influence on the elementary school children alone, a study of the influence of mobile phone use on young children is warranted, although there have been very previous few studies in this area.

Key words: mobile phones, communication between parents and children, panel study, causality

Introduction

In Japan today, more children than ever have a mobile phone, and, in response, Japanese society is more diligently watching the use of mobile phones by children. In 2008, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) proposed that it should essentially be prohibited for elementary and junior high school children to take their mobile phones into schools. Furthermore, some municipal education boards are providing education for mobile phone literacy.

A nationwide survey found that in 2007, over 90% of the high school students surveyed and over 50% of the junior high school children surveyed had a mobile phone. In the elementary children surveyed, this figure was almost 30% (Takahashi, 2007). Moreover, it has been observed that children use a mobile phone in different ways in different stages of development. According to a survey carried out by Tsuchiya (2005), many elementary school children use their mobile phones primarily as "telephones" to contact their parents, while older children, those in secondary schools, exchange text messages with their friends more often and contact their parents less frequently. Therefore, some are today claiming that these differences in mobile phone use affect the ways in which children and their parents communicate with each other.

Therefore, our study begins by summarizing the preceding research into how mobile phone use affects parent-child relationships. One representative experimental study that described the influences of uses of media on family relationships came from Kraut et al. (1998). They conducted a panel study on how use of the Internet affected the relationships that users had with others, and discovered that, the more often an individual used the Internet, the more Internet relationships that individual had, but the less that person communicated with the people around them, such as the members of their family. Kraut et al. named this phenomenon the "Internet paradox." However, subsequent follow-up surveys found virtually no negative influences of this kind. Rather, they discovered that the more an individual used the Internet, the more that person enjoyed improved communication and relationships with the people around them, including their family (Kraut et al., 2002). All things considered, some investigators consider the "Internet paradox" (1998) to be a temporary phenomenon, witnessed only in the initial phase following the launch of a new medium of communication. Nevertheless, even if such a phenomenon occurs "during the initial phase only," it might emerge with regard to mobile phone use as well, particularly as some are pointing out some negative effects due to text messages sent and received with mobile phones. For example, during the late 1990s, when

mobile phones began to become prevalent in Japan, many stated that they exerted unfavorable influences on parent-child relationships. It was claimed by some that more use of text messages in particular could result in fewer interactions between parents and their children (The Asahi Shimbun, 2004; The Yomiuri Shimbun, 2005). Yamashita (2001) asserted that a young person who used text messages frequently held a mobile phone in one hand to exchange messages with friends, even when at the dinner table with family, and further claimed that it was possible that this practice could adversely influence the young person's relationship with members of their family. Elsewhere, a survey on mobile phone use in Norway, conducted by Katz & Aakhus (2003), found that many of the communication activities children carried out with a mobile phone were done out of the sight of their parents. Therefore, they concluded that children are now able to acquire more friends and acquaintances without their parents watching them.

Putting these preceding studies into perspective, we concluded the following: Firstly, although these studies suggested mobile phone use possibly leads to less communication between parents and their children, they did not go further than the use of interview results and correlation research only. They did not use impact research to assess the influences of mobile phone use on communication, and fell short of clarifying any cause-effect relationship.

Secondly, most of the studies covered high school and university students alone, excluding younger children, such as those in elementary and lower secondary school. However, as we mentioned at the beginning of this paper, in Japan, many more of these younger children now have a mobile phone. Therefore, we must consider what effects mobile phone use has on the development of children, and the influences that mobile phones exert, by including younger children in our surveys and comparing the influences observed across different stages of child development.

Thirdly, although much of the previous research has considered volume of text messages as an influential factor, more children today use their mobile phones to view the Internet. We cannot preclude the possibility of such Internet viewing leading to less interaction with their families. In addition, since many children of elementary school age also make and receive calls with their mobile phones, we should examine the effects of mobile phone calls on those children, so our studies must also include the volume of calls.

Based on these conclusions, the present panel study has surveyed children from elementary through high school at two points in time, and has considered cause-effect relationships in how mobile phone use can affect the face-to-face interactions that children have with their parents. This study included fifth and sixth graders as elementary school-age children, since many of the children at elementary school who hold a mobile phone are at these grades. The study also considers two kinds of parent-child communication activities. One is those "little" activities they have every day, which we have termed "everyday communication." The other consists of "inner communication" activities, which involve emotional interactions and are accompanied by senses of trust and intimacy. In this way, our study has analyzed influences on both of these two different kinds of communication. It should be also noted that in this study "parent-child communication" refers to face-to-face communicative activities only, and does not include communication with mobile phones.

Moreover, parent-child communication might be affected not just by the volume of mobile phone use, but also by the messages communicated. Therefore, we also consider influences of the content of text messages on parent-child communication, since many people have found such messages to be especially problematic in terms of influences on parent-child relationships. Akasaka & Takagi (2005) divided text messages into the following four categories: "Honest sense of togetherness," "fictional sense of togetherness," "emotional dependence," and "communication of information." "Honest sense of togetherness" refers to exchanges of honest messages, while "fictional sense of togetherness" includes those diplomatic messages, in which feelings expressed are not genuine, sent to maintain the relationship that the sender has with the recipient. "Emotional dependence" means communication of "little" feelings, and "communication of information" is transmission of necessary information. Of these, those messages of "honest sense of togetherness," which convey honest feelings, are deep in nature, and are therefore expected to improve communication. Conversely, "emotional dependence" and "fictional sense of togetherness" include those message exchanges that are superficial and poor in quality. We can expect that these can lead to inferior communication.

In addition we must account for differences in the relationship between mobile phone use and parent-child communication across the different stages of child development, as we mentioned earlier, since Akasaka & Sakamoto (2008) suggested that some developmental changes are associated with mobile phone use and its influences in their study of mobile phone use and its influences on friendship. Therefore, our study has compared participants at different stages of development, namely, elementary, junior high school, and high school. Moreover, we have considered influences in the opposite direction as well, i.e., the influences of communication between parents and children on mobile phone use by those children. Thus, we have searched for any cyclical relationship of influences between use of a mobile phone and parent-child communication. For instance, these two

might enhance each other.

In more specific terms, we have considered the following five hypotheses:

Hypothesis 1: The more a child talks over the phone, the less face-to-face communication is had with parents.

Hypothesis 2: The more a child uses text messages, the less face-to-face communication is had with parents.

Hypothesis 3: The more a child views the Internet, the less face-to-face communication is had with parents.

Hypothesis 4: The more a child uses text messages of the category of "honest sense of togetherness," the more face-to-face communication is had with parents.

Hypothesis 5: The more a child uses text messages of the categories of "fictional sense of togetherness" or "emotional dependence," the less face-to-face communication is had with parents.

Method

Analysis method and goodness-of-fit of models

Our study surveyed the participants at two points in time, and conducted a structural equation analysis employing the cross-lagged effect model (Figure 1). We also applied simultaneous analysis of multiple groups to elementary, junior high, and high school children for comparative purposes among those three age groups, and employed constraints based on the 10 analysis models listed in Table 1. For instance, if the analysis results based on Table 1 showed a significant effect of volume of mobile phone use on elementary school children at Time 1, and on their communication with their parents at Time 2, we can estimate that the volume of the use by these children affects their communication with their parents. In the opposite direction, if the parent-child communication at Time 1 significantly affected the mobile phone use of the children at Time 2, we can estimate that parent-child communication influences the use of mobile phones in the children.

Simultaneous analysis of multiple groups employs some equivalent constraints, in order to simultaneously verify and compare the same model across multiple groups. Our study employed the constraints based on the 10 models shown in Table 1. These models ranged from Model 1, which presupposed that all the six paths, a through f, shown in Figure 1 were identical for all the three age groups, elementary, junior high, and high school, to constraint-free Model 10, which presupposed that each and every one of those three age groups had different paths.

In judging each the goodness-of-fit of each model, we employed the χ^2 value, the NFI (Normed Fit Index), the CFI (Comparative Fit Index), RMSEA (Root Mean Square Error of Approximation), and the AIC (Akaike's Information Criteria) as indices of goodness-of-fit,. According to accepted practice, the smaller χ^2 is, the better the model fits the data. If the significance probability of an χ^2 value is 0.5 or below, the model is discarded. However, χ^2 is easily affected by the number of samples, so the smaller the number of samples, the harder it is to discard the model. Therefore, we must also

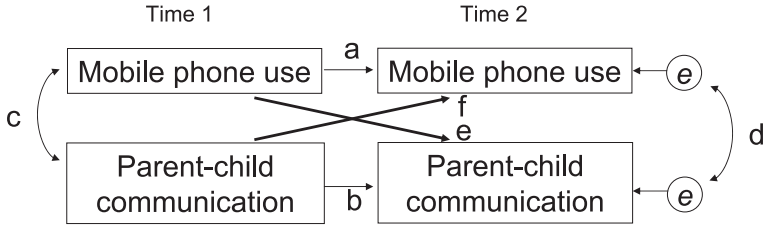

Figure 1. Cross-lagged effects model

Table 1. Equivalent constraints of analysis method

Model	Equivalent constraints	*DF*
Model 1	a, b, c, d, e, f	6
Model 2	a, b, c, d, e	5
Model 3	a, b, c, d, f	5
Model 4	a, b, c, d	4
Model 5	a, b, c	3
Model 6	a, b, d	3
Model 7	a, b,	2
Model 8	a	1
Model 9	b	1
Model 10	no constraints	0

consider the numbers of samples. Furthermore, if the AIC have the least value and the NFI and the CFI are both 0.9 or above, and the RMSEA is 0.05 or below, the model is considered to fit the data very well (Toyoda, 1998).

Study period and participants

A questionnaire was distributed over the Internet to students ranging from fifth graders to third year high school students from across Japan. The first wave was conducted in November 2005, and the second in January 2006. We chose those children of the school grades mentioned above, as well as those parents having children of those grades, to be our study participants, out of some 370,000 people (aged 10 through 69) whose data are owned by infoPLANT(The questionnaire research business). We then sent the questionnaire to the chosen participants, asking them if they would co-operate in the study. As a result, we collected responses from 900 elementary, junior high, and high school children (300 each) at Time 1, and from 450 in all at Time 2 (150 each from elementary, junior high, and high school children). Of all the respondents, 56.7% were female at Time 1, and 57.6% were female at Time 2. In each of the age groups, at Time 1, 65.7% of the elementary respondents were female, 54.3% of the junior high respondents were female, and males and females were equally divided across the high school respondents. At Time 2, 61.3% of the elementary school respondents were female, and 60.0% and 51.3% of the junior high and high school respondents were female, respectively. We terminated the collection of responses when the number collected reached 150 from each of the three age groups. This gave us the advantage of being able to control the range of time intervals between the two surveys, i.e., if we had collected those responses over longer periods of time, the actual time interval would have been quite diverse from one sample to another, a major disadvantage, although such longer collection periods would have resulted in greater numbers of responses from the three age groups. Therefore, we restricted the Time 2 collection period to approximately 2 two weeks, in order to restrict diversity in time intervals. We also had to beware of some sample biases, for instance those respondents who responded earlier were more interested in mobile phones than were those who responded later. Therefore, in order to confirm whether there was any sample bias in those who responded to us at both Time 1 and Time 2, we conducted a t-test comparison of the 450 children who responded at Time 1 alone and those children who responded at both Time 1 and Time 2, with respect to all the corresponding variables. The results of this comparison showed no significant difference between the two groups in all of the variables of volume of mobile phone use, the content of text messages, and relationships with friends. Therefore, we can conclude that the responses collected sufficiently represented all of the 900 samples surveyed. Schmidt (1997) and Webster & Compeau (1996) among others, stated that a further problem is that surveys conducted over the worldwide web require that the participants use a computer, and therefore can include only individuals who own a PC and their families. Therefore, such web surveys tend to be biased towards samples with higher levels of information technology literacy, meaning that our entire 900 samples might fall into this group of the general population. To mitigate this sample bias, we applied the principles of the study described by Akasaka & Sakamoto (2008) to our samples. As a result, we found that our samples did not deviate from the common population average. We are therefore confident that our study samples were free from any biases.

Questionnaire

The same questionnaire was used for the first and second surveys.

Questions about mobile phones

(1) Mobile phone ownership ratio

The participants selected one of the following responses: 1 = I own a mobile phone, 2 = I do not own a mobile phone, but I want to own one, or 3 = I do not own a mobile phone and I do not want one either.

(2) Amount of mobile phone use

The participants used 6-point and 9-point scales to indicate the amount of calling, e-mailing, and Internet use they carried out per day. Participants used a 6-point scale to indicate the amount of calling (1 = 0 seconds, 2 = 1 second to less than 5 minutes, 3 = 5 minutes to less than 10 minutes, 4 = 10 minutes to less than 30 minutes, 5 = 30 minutes to less than 60 minutes, and 6 = 60 minutes or longer), a 9-point scale to indicate the amount of e-mailing (1 = 0 messages, 2 = 1 to 4 messages, 3 = 5 to 9 messages, 4 = 10 to 14 messages, 5 = 15 to 19 messages, 6 = 20 to 29 messages, 7 = 30 to 39 messages, 8 = 40 to 49 messages, and 9 = 50 messages or more), and a 6-point scale to indicate the amount of Internet use (1 = 0 seconds, 2 = 1 second to less than 1 minute, 3 = 1 minute to less than 5 minutes, 4 = 5 minutes to less than 10 minutes, 5 = 10 minutes to less than 30 minutes, and 6 = 30 minutes or longer).

(3) Purpose of e-mailing

To identify the purpose of e-mailing, a total of 10 questions, developed by Akasaka and Takagi (2005), regarding the content of mobile phone e-mail messages were used. Participants used a 4-point scale (1 = strongly disagree; 4 = strongly agree) for two questions around sincerity-based emotional bonds; three questions concerning formality-based emotional bonds; three questions on emotional dependency; and two questions about information exchange.

Questions concerning parent-child communication

We extracted the lower portion of the "Scale of parent-child communication" created by Nagasaki (2000), as the scale to measure communication between a child and his or her parents, and modified it for use in our study. Items related to "everyday communication" consisted of seven questions, including "I speak to my parents about what I experienced in school and made me happy" and "I speak to my parents about what made me happy while I was out." Those related to inner communication included seven questions, two of which were "I occasionally express my gratitude to my parents by doing the house chores, etc." and "When a parent of mine is feeling down about work or about the family, I give them some words of consolation." For each of those items, we asked the respondent to choose one from the following four alternatives: 1 = Does not apply to me at all; 4 = Applies to me well.

Demographic items

We asked the respondent to indicate gender, type of school attended, and school grade by choosing one of multiple alternatives.

Results

Ratio of respondents having a mobile phone and their volume of use

Of the 900 respondents, 569 (63.2%) had a mobile phone at Time 1. Of those who did not, 275 (30.6%) replied "I don't have one and I want one," while the remaining 56 (6.2%) said "I don't have one and I don't want one." Looking at the different school groups, 29.7% of the elementary school children surveyed had a mobile phone, as did 65.3% of the junior high school students, and 94.7% of the high school students. There was a trend that the ratio of ownership rose in the order of elementary, junior high, and high schools, respectively ($p<.001$).

We then obtained the average use volume and its standard deviation for each function of a mobile phone, and these results are shown in Table 2, which also shows that the average use volume of calls, text messages, and Internet viewing all tended to increase in the ascending order of elementary, junior high, and high schools, respectively ($p<.001$). Furthermore, we saw no significant difference (*n. s.*) in the averages between Time 1 and Time 2.

With regard to the content of the text messages, we summed up the scores, based on the scale described in (3) Purpose of e-mailing for each of the 450 respondents who replied at both Time 1 and Time 2. Furthermore, we excluded one from the two items of the "emotional dependence" category from our item analysis. The correlations between two different items at Time 1 and Time 2 respectively were .60 and .66 ($p<.01$) between Items 8 and 10, both belonging to the category "honest sense of togetherness," .37 and .41 ($p<.01$) between Items 5 and 7 of "fictional sense of togetherness," .33 and .30 ($p<.01$) between Items 5 and 9 of the same category, and .23 and .40 ($p<.01$) between Items 7 and 9 of the same category, .38 and .56 ($p<.01$) between Items 1 and 4 of "emotional dependence," and .45 and .48 ($p<.01$) between Items 2 and 3 of "communication of information" (Appendix 1). We also obtained the averages and standard deviations regarding the content of mailing, as shown in Table 3. The average values again tended to increase, following the ascending order of elementary, junior high, and high schools. ($p<.001$), and we did not recognize any significant difference (*n. s.*) between the results from Time 1 and Time 2.

Table 2. Mean values for each survey question regarding the amount of mobile phone use. Standard deviations are shown in brackets (n = 900).

	Calling		Mailing		Internet	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Total	2.16 (1.33)	2.12 (1.26)	2.76 (2.15)	2.89 (2.29)	2.40 (1.82)	2.39 (1.75)
Elementary school	1.41 (0.80)	1.47 (0.86)	1.35 (0.83)	1.39 (0.89)	1.16 (0.59)	1.20 (0.69)
Junior high school	2.09 (1.30)	2.05 (1.22)	3.03 (2.46)	3.23 (2.58)	2.27 (1.76)	2.29 (1.67)
Senior high school	2.99 (1.31)	2.84 (1.25)	3.91 (1.93)	4.05 (2.14)	3.77 (1.75)	3.69 (1.69)

Table 3. Mean values for each survey question concerning the contents of mailing. Standard deviations are shown in brackets (n = 900).

	Sincerity-based emotional bond		Formality-based motional bond		Information exchange		Emotional dependency	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Total	3.58 (1.94)	3.65 (1.98)	4.75 (2.23)	4.89 (2.36)	3.10 (1.59)	3.19 (1.63)	3.66 (2.10)	3.74 (2.16)
Elementary school	2.27 (0.96)	2.36 (1.15)	3.23 (0.89)	3.37 (1.21)	2.19 (0.78)	2.22 (0.77)	2.23 (0.88)	2.37 (1.18)
Junior high school	3.51 (1.93)	3.51 (1.95)	4.63 (2.20)	4.66 (2.23)	2.98 (1.45)	2.95 (1.43)	3.68 (2.23)	3.75 (2.25)
Senior high school	4.98 (1.73)	5.07 (1.71)	6.40 (2.07)	6.63 (2.20)	4.15 (1.72)	4.40 (1.69)	5.05 (1.89)	5.09 (1.96)

We then added up the scores for each of the items of "everyday communication" and "inner communication," according to the scales described with items related to parent-child communication above. On each of these scales, Cronbach's αs at Time 1 and Time 2 were .92 and .92 for "everyday communication" and .85 and .85 for "inner communication" respectively (Appendix 2). Moreover, we also obtained averages and standard deviations for both "everyday" and "inner communications" (Table 4). These results indicated that the elementary school children were communicating with their parents more than were the children from junior high and high school (p<.001) using both types of communication. We also saw no significant difference (*n. s.*) between Time 1 and Time 2.

In addition, we obtained coefficients of correlation and test-retest reliabilities for each of the variables (volume of calls, volume of text messages, volume of Internet viewing, "honest sense of togetherness," "fictional sense of togetherness," "emotional dependence," "communication of information," "everyday communication," and "inner communication"), at each of Time 1 and 2, for the elementary, junior high, and high school children, respectively, as shown in Tables 5 through 8.

Table 4. Mean values for each survey question regarding the amount of communications. Standard deviations are shown in brackets (n = 900).

	Everyday communication		Inner communication	
	Time 1	Time 2	Time 1	Time 2
Total	19.47 (4.86)	19.13 (5.20)	16.86 (4.33)	16.96 (4.47)
Elementary school	21.17 (3.62)	21.05 (3.92)	17.95 (3.36)	18.31 (3.64)
Junior high school	18.95 (5.28)	18.42 (5.75)	16.71 (4.89)	16.67 (4.94)
Senior high school	18.28 (5.07)	17.93 (5.25)	15.93 (4.39)	15.89 (4.42)

Table 5. Correlation matrix for all variables for all participants. Rows refer to values obtained in the first survey and columns show values obtained in the second survey. Test-retest reliability coefficients are shown in brackets.

	Calling	Mailing	Internet	Sincerity-based emotional bond	Formality-based emotional bond	Information exchange	Emotional dependency	Everyday communication	Inner communication
Calling	(.72**)	.60 **	.53 **	.53 **	.44 **	.46 **	.51 **	-.02	-.05
Mailing	.58 **	(.87**)	.61 **	.50 **	.51 **	.30 **	.61 **	-.14 **	-.14 **
Internet	.54 **	.62 **	(.84**)	.72 **	.71 **	.58 **	.78 **	-.12 *	-.13 **
Sincerity-based emotional bond	.50 **	.57 **	.77 **	(.72**)	.63 **	.69 **	.82 **	.00	-.01
Formality-based emotional bond	.42 **	.59 **	.72 **	.69 **	(.71**)	.63 **	.74 **	-.15 **	-.13 **
Information exchange	.38 **	.34 **	.61 **	.70 **	.60 **	(.69**)	.52 **	-.11 *	-.11 *
Emotional dependency	.49 **	.69 **	.78 **	.80 **	.79 **	.55 **	(.78**)	-.06	-.06
Everyday communication	-.05	-.10 *	-.12 *	-.01	-.18 **	-.09	-.07	(.74**)	.78 **
Inner communication	-.03	-.08	-.08	.00	-.14 **	-.06	-.04	.74 **	(.65**)

Note. *p < .05, **p < .01 n=450

Table 6. Correlation matrix for all variables in elementary school children

	Calling	Mailing	Internet	Sincerity-based emotional bond	Formality-based emotional bond	Information exchange	Emotional dependency	Everyday communication	Inner communication
Calling	(.66**)	.74 **	.42 **	.44 **	.38 **	.36 **	.45 **	.08	.09
Mailing	.69 **	(.79**)	.65 **	.53 **	.64 **	.41 **	.69 **	-.08	-.01
Internet	.35 **	.65 **	(.53**)	.82 **	.85 **	.57 **	.92 **	-.07	-.05
Sincerity-based emotional bond	.36 **	.65 **	.92 **	(.54**)	.78 **	.77 **	.91 **	-.06	.02
Formality-based emotional bond	.33 **	.75 **	.75 **	.79 **	(.54**)	.77 **	.88 **	-.12	-.04
Information exchange	.35 **	.64 **	.66 **	.82 **	.85 **	(.54**)	.66 **	-.03	.08
Emotional dependency	.35 **	.73 **	.88 **	.84 **	.88 **	.72 **	(.67**)	-.13	-.07
Everyday communication	.11	.08	.13	.08	-.02	.02	.09	(.55**)	.71 **
Inner communication	.11	.24 **	.25 **	.23 **	.16 *	.18 *	.27 **	.62 **	(.47**)

Note. *p < .05, **p < .01 n=150

Table 7. Correlation matrix for all variables in junior high school students

	Calling	Mailing	Internet	Sincerity-based emotional bond	Formality-based emotional bond	Information exchange	Emotional dependency	Everyday communication	Inner communication
Calling	(.67**)	.48 **	.52 **	.56 **	.35 **	.47 **	.50 **	.15	.02
Mailing	.53 **	(.85**)	.58 **	.43 **	.39 **	.26 **	.52 **	.03	-.08
Internet	.55 **	.53 **	(.77**)	.71 **	.73 **	.61 **	.80 **	.05	.00
Sincerity-based emotional bond	.45 **	.51 **	.79 **	(.68**)	.61 **	.74 **	.82 **	.19 *	.14
Formality-based emotional bond	.33 **	.52 **	.71 **	.71 **	(.60**)	.55 **	.76 **	.06	.07
Information exchange	.40 **	.26 **	.68 **	.80 **	.59 **	(.59**)	.55 **	.11	.11
Emotional dependency	.45 **	.64 **	.78 **	.83 **	.76 **	.56 **	(.74**)	.09	.06
Everyday communication	.02	.00	.02	.17 *	-.04	.08	.11	(.78**)	.81 **
Inner communication	.08	.00	.09	.14	-.02	.11	.13	.80 **	(.70**)

Note. $^{*}p < .05$, $^{**}p < .01$ n=150

Table 8. Correlation matrix for all variables in senior high school students

	Calling	Mailing	Internet	Sincerity-based emotional bond	Formality-based emotional bond	Information exchange	Emotional dependency	Everyday communication	Inner communication
Calling	(.61**)	.47 **	.23 **	.15	.11	.11	.18 *	.05	.09
Mailing	.33 **	(.80**)	.31 **	.14	.23 **	-.18 *	.38 **	-.05	.00
Internet	.17 *	.41 **	(.77**)	.38 **	.33 **	.16 *	.51 **	.04	.00
Sincerity-based emotional bond	.15	.20 *	.46 **	(.49**)	.16 *	.31 **	.60 **	.26 **	.19 **
Formality-based emotional bond	.03	.27 **	.41 **	.29 **	(.55**)	.30 **	.44 **	-.08	-.08
Information exchange	-.05	-.09	.22 **	.33 **	.24 **	(.55**)	.04	-.05	-.12
Emotional dependency	.12	.46 **	.55 **	.54 **	.58 **	.13	(.63**)	.17 *	.15
Everyday communication	.12	.04	.01	.20 *	-.08	.00	.03	(.75**)	.74 **
Inner communication	.05	-.02	-.09	.10	-.12	-.08	-.07	.69 **	(.65**)

Note. $^{*}p < .05$, $^{**}p < .01$ n=150

Selection of the analysis model

We compared all of the models from 1 through 10 shown in Table 1, referring to their fit indices. This comparison was based on a combination of 14 variables, which were seven variables ((1) volume of calls, (2) volume of text messages, (3) volume of Internet viewing, (4) "honest sense of togetherness," (5) "fictional sense of togetherness," (6) "emotional dependence," and (7) "communication of information") multiplied by two variables((1) "everyday communication" and (2) "inner communication"). In addition to the combination in which all of the paths of the three age groups were treated as equals, with one constraint was removed after another, as shown in Table 1, we also employed another model of combinations, in which only the paths of a single group were treated as independent of those of the other two groups treated as equals, and then one constraint was removed after another. Note that we decided that those respondents who replied that they had no mobile phone also did not use any of its functions, so we treated their volumes of calls, text messages, and Internet viewing as "zero" and assumed "Does not apply to me at all" as their replies to the questions related to the content of text messages.

In judging the goodness-of-fit of each model, we carefully examined their AIC values, while also considering those of the other goodness-of-fit indices, namely NFI, CFI, and RMSEA, since the models carrying the smallest AIC are believed to have the best fit. As a result, we chose the final model described in Table 9. This chosen model had degrees of goodness-of-fit as follows: NFI = .90 to 1.00, CFI = .90 to 1.00, and RMSEA = .00 to .05, indicating high enough goodness. We then verified the path coefficients of the three groups in the chosen model.

Table 9. Chosen model

Mobile - phone use	Everyday communication	Inner communication
Calling	Model 8	Model 1
Mailing	Model 8	Model 4
Internet	Model 3	Model 3
Sincerity-based emotional bond	Model 10	Model 1
Formality-based emotional bond	Model 3	Model 6
Information exchange	Model 8	Model 1
Emotional dependency	Model 3	Model 3

Estimating influences on parent-child communication by mobile phone use

To assess the effect that mobile phone use has on communication, both "everyday" and "inner," we verified the path coefficient values in the chosen model, for each of the three age groups, elementary, junior high, and high school (Tables 10 and 11).

The standard partial regression coefficients related to "everyday communication" obtained from our analysis showed that, among the elementary school children, there

Table 10. The effect of mobile phone use on everyday communication. For each item, the first line shows a standardized path coefficient for which there was a significant effect of mobile phone use on everyday communication, and the second line shows a standardized path coefficient for which there was a significant effect of everyday communication on mobile phone use. Positive values indicate positive effects, and negative values indicate negative effects.

		School type		
		Elementary school	Junior high school	Senior high school
Calling	(Calling → Everyday communication)	–	–	–
	(Everyday communication → Calling)	–	–	–
Mailing	(Mailing → Everyday communication)	-.16 *	–	–
	(Everyday communication → Mailing)	–	–	-.12 *
Internet	(Internet → Everyday communication)	-.18 **	–	–
	(Everyday communication → Internet)	–	–	–
Sincerity-based emotional bond	(Sincerity-based emotional bond → Everyday communication)	–	–	–
	(Everyday communication → Sincerity-based emotional bond)	–	–	–
Formality-based emotional bond	(Formality-based emotional bond → Everyday communication)	-.17 *	–	–
	(Everyday communication → Formality-based emotional bond)	–	–	–
Information exchange	(Information exchange → Everyday communication)	–	–	–
	(Everyday communication → Information exchange)	–	–	–
Emotional dependency	(Emotional dependency → Everyday communication)	-.23 ***	–	–
	(Everyday communication → Emotional dependency)	–	–	–

Note. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table 11. The effect of mobile phone use on inner communication. For each item, the first line shows a standardized path coefficient for which there was a significant effect of mobile phone use on inner communication, and the second line shows a standardized path coefficient for which there was a significant effect of inner communication on mobile phone use. Positive values indicate positive effects, and negative values indicate negative effects.

		School type		
		Elementary school	Junior high school	Senior high school
Calling	(Calling → Inner communication)	–	–	–
	(Inner communication → Calling)	–	–	–
Mailing	(Mailing → Inner communication)	-.14 *	–	–
	(Inner communication → Mailing)	–	–	-.15 ***
Internet	(Internet → Inner communication)	-.16 *	–	–
	(Inner communication → Internet)	–	–	–
Sincerity-based emotional bond	(Sincerity-based emotional bond → Inner communication)	–	–	–
	(Inner communication → Sincerity-based emotional bond)	.09 *	.08 *	.07 *
Formality-based emotional bond	(Formality-based emotional bond → Inner communication)	-.15 *	–	–
	(Inner communication → Formality-based emotional bond)	–	–	–
Information exchange	(Information exchange → Inner communication)	–	–	–
	(Inner communication → Information exchange)	–	–	–
Emotional dependency	(Emotional dependency → Inner communication)	-.22 ***	–	–
	(Inner communication → Emotional dependency)	–	–	–

Note. $^{*}p < .05$, $^{***}p < .001$

was a tendency that the more a child used a text message, viewed the Internet, and/or had "fictional sense of togetherness" and/or "emotional dependence," the less "everyday communication" that child had. Among the junior high and high school children, no significant tendency was observed (Table 10).

Similar results were also obtained with "inner communication"; among the elementary school children, the more a child used text messages, viewed the Internet, and/or had "fictional sense of togetherness" and/or "emotional dependence," the less "inner communication" that child had. Among the junior high and high school children, no significant tendency was observed (Table 11).

Estimating influences of parent-child communication on use of a mobile phone

We then considered the cause-effect relationship in the opposite direction (Tables 10 and 11). With respect to "everyday communication," the standard partial regression coefficients we obtained showed no significant results among the elementary and junior high school children. Among those from high school, our coefficients indicated that the more "everyday communication" a child had, the less text messages he or she used (Table 10).

The results of our analysis showed that the more "inner communication" an elementary school child had, the more "honest sense of togetherness" he or she had. This also held true for the junior high school children. Among the high school children, the more "inner communication" they had, the fewer text messages they used and, as with the elementary and junior high school children, the more "honest sense of togetherness" they had (Table 11).

Discussion

To assess the effect of mobile phone use on parent-child communication, we compared and analyzed statistics for three different stages in child development, elementary, junior high, and high school. We shall now describe and discuss our findings for each of the three stages, then consider the cause-effect relationship in the opposite direction, and finally draw our conclusions.

Consideration of influences from use of a mobile phone on parent-child communication

Among the elementary school children, our results showed that the more a child used text messages, viewed the Internet, and/or had a "fictional sense of togetherness" and/or "emotional dependence," the less "everyday" and "inner communication" that child had.

Firstly, the volume of calls showed no significant influence. Therefore, our Hypothesis 1 was not supported. It has been stated that, among elementary pupils, many of the mobile phone calls they make are to their parents, if they need to speak to them urgently about something and/or communicate necessary information (Tsuchiya, 2005), so most of the calls these children make do not concern "everyday" or "inner communication." Therefore, it is our opinion that the calls they make do not affect "everyday" or "inner communication."

We found that the more a child used text messages, the less "everyday" and "inner communication" that child had. This supported our Hypothesis 2. The people who elementary school children most frequently interact with via mobile phone are the members of their family (Tsuchiya, 2005), so we can assume that the people who they most use text messaging to communicate with are also family members. Moreover, text messages can be sent and received more frequently and in more places than can calls, so those messages tend to convey information that is less urgent or important (Matsuda et al., 1998). Thus, text messages more often communicate "little" feelings, and we can infer that such "little" exchanges satisfy the need for "everyday" and "inner communication." This results in less need for both types, "everyday" and "inner," of face-to-face communication, which might explain the decline in face-to-face communication among the children who most frequently use those text messages. Thus, it is possible that, among elementary school children, text messages can take the place of face-to-face communication and therefore lead to less frequent communications of this type.

From the perspective of child development, the higher-grade elementary pupils are learning to improve their writing, both at school and out of school. As they learn more sophisticated language, their internal speech grows richer. Therefore, in this stage, many children are eager to write text, including short messages. In addition, many learn to use external and internal speech differently, adapting to their situations, as they develop their internal speech. This may also explain how those children learn to control their communicative activities with their parents, which are part of their external speech, and may be partly responsible for the decline in those activities, we suspect.

Next, our findings showed that the more those children viewed the Internet, the less face-to-face, "everyday" and" inner" communication they had. This supported our Hypothesis 3. Unlike communicative media, such as the telephone and short messages, the Internet is intended for the use of individuals who want to view some websites, download ring tones, etc. Therefore, we believe that more time spent using the Internet reduces the time and opportunities for in-person exchanges between parents and their children. Nevertheless, our study did not consider the objectives of Internet use, so in the future we should assess which types of Internet content could lead to less parent-child communication.

With regard to the content of the text messages, our

results indicated that the more fictional "sense of togetherness" and "emotional dependence" a child had, the less "everyday" and "inner communication" that child had. Thus, we can conclude that while our results did not support our Hypothesis 4, they did support our Hypothesis 5.

In setting up Hypothesis 4, we expected that exchanges of messages with "honest sense of togetherness" would deepen relationships and stimulate communication activities, since it was thought that such "honest sense of togetherness" would lead to meaningful communication. However, our results showed no sign that "honest sense of togetherness" enhanced communication. On this basis, we suggest that exchanges such as text messages do not necessarily lead to more face-to-face communication. However, we observed no negative effects on parent-child communication from the use of "honest sense of togetherness" or "communication of information" text messages. Traditionally, many have thought that use of text messages leads to fewer exchanges between parents and their children, and thus diminishes parent-child relationships. Our findings suggest that use of text messages does not necessarily lead to less face-to-face communication, at least if the messages are of the categories of "honest sense of togetherness" and "communication of information."

Messages of emotional dependence carry "little" feelings and those of "fictional sense of togetherness" conceal the honest feelings of the sender and try to please the recipient, in order to maintain the relationship between sender and recipient. These messages are superficial and are therefore not considered to be meaningful. We can therefore expect that exchanges of text messages of these two categories can lead to less communication.

In summary, we can think of at least two processes that result in a decline in communication. In the first, text messages take the place of face-to-face communication, and thus lead to less of the latter. In the second, exchanges of messages that are not meaningful and viewing of the Internet lead to diminished intentions and opportunities for parents and their children to communicate with each other. This leads to less face-to-face communication.

Furthermore, from the child development perspective, elementary school children tend to form groups of friends, in which they learn to assert themselves, as well as to cooperate with others, as they develop. As they grow up this way, they try to keep some distance from their parents in their efforts to gain some independence, while still remaining dependent on their parents, and they place greater emphasis on their relationship with friends. Many girls especially show the tendency to strive for independence from their parents, due in part to the earlier emergence of their secondary sexual characteristics (Murase, 1983). This may explain why the face-to-face communication between upper elementary school children and their parents ceases to expand, while these children still maintain their psychological ties and "honest sense of togetherness" with their parents. As these children try to gain independence and seek some distance from their parents, their communication with them becomes superficial, consisting more of "fictional sense of togetherness" and "emotional dependence," resulting in diminished psychological ties and less face-to-face communication.

Our results suggested no significant influence of mobile phone use on the communication between junior high and high school children and their parents. Our Hypotheses were not supported, which we explain as follows: While elementary children primarily use their mobile phones to communicate with their parents, junior high school students have more communication with their friends by mobile phone, and high school children use their mobile phone primarily to exchange words with their friends (Tsuchiya, 2005). We can ascribe these changes to child development. As a child grows from an elementary pupil into a high school student, this child places more emphasis on peers and friends, rather than parents. During secondary school years, the child keeps some distance from his or her parents, as well as from other adults (Naganuma & Ochiai, 1998). Therefore, as children grow up, there is a change in the people with whom they communicate by mobile phone. To many secondary school students, their exchanges with their parents grow to mean less, and those with their friends grow to mean more, so they communicate less with their parents using a mobile phone (Tsuchiya, 2005). This, in turn, means their mobile phone use has an insignificant effect on their communication with their parents. Furthermore, Akasaka & Sakamoto (2008) examined the influences that mobile phone use has on friendships and found no significant effect among elementary children. Rather, they discovered some significant effects among secondary school students. In consideration of these findings as well as our own, we can suppose that while mobile phone use can significantly affect the relationship between an elementary child and his or her parents, such phone use has a greater influence on the relationship a secondary school student has with friends than with parents, since it affects the relationships with the people with whom the phone is most frequently used to communicate.

So far, we can conclude that influences of mobile phone use on parent-child communication can differ, depending on the stage of development of the child. While mobile phone use can lead to less parent-child communication among many elementary school children, its effects on such communication are considered to be limited for many junior high and high school students, who communicate more with their friends and less with their

parents.

As we have already mentioned, Kraut et al. (1998) asserted that more use of the Internet could lead to less communication between the user and the people around that individual, such as family, resulting in diminished relationships. However, a later longitudinal study, conducted by Kraut et al. (2002), showed no sign of such negative influences. Therefore, many consider today that the negative influences described by Kraut et al. (1998) were temporary in nature and only observed in the early phase of the spread of use of a new medium. Our studies have now shown that mobile phone use by elementary children can reduce parent-child communication. In accordance with the above, we can ascribe such negative effect to the fact that most elementary school users of a mobile phone are beginners with regard to the device. In the early phase of use, a user can barely employ the medium to good effect, which may lead to some temporary negative effects on relationships with those people with whom that individual most has mobile phone communication exchanges. Since our study was short-term, conducted at an interval of only 2 months, it is not powered to measure any long-term influences. Therefore, we are unable to ascertain whether the influences observed are temporary. However, we believe that, with individuals who are new to the use of a particular medium, we need to be mindful of those temporary, initial effects.

Consideration of influences in the opposite direction

Our study has shown that, among the high school children, the more they used "everyday" and "inner communication," the less text messages they used. We can assume that the more "everyday" and "inner communication" a student has with parents, means a longer amount of time spent face-to-face with them, leading to fuller communication and relatively less use of text messages. In particular, a student who has good "inner communication" with his or her parents spends a considerable length of time with them in psychological intimacy and with a sense of trust. We can suppose that this can result in a high level of satisfaction with the relationship and therefore reduces text message communication.

In addition, after facing their inner conflicts between dependence and independence, children of high school age start to work towards achieving independence in society, and as they gain more of that independence, they learn to see things from a broader range of viewpoints, including those of a parent. Along with such growth in perspectives, the parent-child relationship can become more mutually beneficial, in that the parents and the child rely on each other as independent persons. This leads to a deeper intimacy between the child and his or her parents (White et al., 1983). If "everyday" and "inner communication" expands during these years, the child can gain greater independence and feel more intimacy with his or her parents as an independent person respecting other independent persons. We can suppose that such development reduces the need for text messages. Therefore, we think it possible that, in the case of many high school students who are undergoing the developmental process just described, the more face-to-face communication they have with their parents, the more intimacy and satisfaction they have with them and the fewer text messages they use.

In addition, our study has shown that the more "inner communication" a child had, the more "honest sense of togetherness" it had, and this was true of all the groups studied (the elementary, junior high, and high school children). In our study, "honest sense of togetherness" refers to exchanging honest opinions and feelings using text messages. The two parties in such an exchange disclose their true thoughts and feelings to each other, even if it occasionally results in a conflict of opinions or an argument. Thus, we can expect that the more "inner communication" a child has with his or her parents, which involves the affection for, and sense of trust in his or her parents, the deeper exchanges the child can have. This can result in such a child exchanging more text messages of "inner communication." Nevertheless, the coefficients we obtained from our results are generally not high, and we must acknowledge that some other factors might also play a part. Therefore, in future studies, we must account for other factors, which may be moderator variables. Notwithstanding, we can say that our results suggest that the way in which children interact with their parents can affect how they use another form of communication, namely, text messages, as well as how they exchange messages with friends.

Conclusion and future studies

We have assessed cause-effect relationships with respect to the effect that mobile phone use can have on parent-child communication. The results showed that influences of mobile phone use on communication between a child and his or her parents differ, depending on the developmental stage of the child. Among the younger children, pupils at elementary school, we observed some influences, while we saw no such influence among the junior high and high school students. Thus, we can say that our study has highlighted the need to consider the influences of mobile phone use on younger children, who were frequently not considered in many preceding studies of this kind.

Furthermore, among the elementary school pupils surveyed, our study has shown that the volume of text messages, the volume of Internet viewing, "fictional sense of togetherness," and "emotional dependence" are all factors that lead to less parent-child communication.

Thus, we have identified the following three possibilities with regard to the mobile phone use of elementary school children: 1) Use of text messages can take the place of face-to-face communication activities and thus lead to less communication. 2) Use of the Internet can lead to fewer interactions and communication between a child and his or her parents. 3) Text messages that do not contain meaningful content can lead to fewer interactions and communication between a child and his or her parents. However, our study only included the effects that mobile phone use can have on parent-child communication, and did not consider how reduced communication between parents and their child can affect the parent-child relationship. We believe this is an issue we need to examine in the future.

Our study also showed that the volume of Internet viewing could lead to less everyday and inner communication in elementary school children. We believe it is now necessary to clarify what particular content on the Internet exerts such negative influence, examining each different use separately.

Although these tasks remain to be accomplished, our study has considered what effect mobile phone use can have on parent-child communication, and has positively shown that it can lead to less communication between parents and their child, especially if the child is young. We believe this is where the significance of our study lies.

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Appendix 1. Questions about mailing

	Item
Sincerity-based emotional bond	
8	I always reply honestly to e-mail from my friends.
10	I always communicate my true feelings in e-mail.
Formality-based emotional bond	
5	I sometimes lie in e-mail.
7	I do not have to show my true feelings in e-mail.
9	I sometimes say in my e-mail that I agree with my friends when I actually do not.
Information exchange	
1	When exchanging e-mail messages, I try not to use pictograms or words that are not related to information to be communicated.
4	I do not write long e-mail messages; I write only what needs to be communicated.
Emotional dependency	
2	I think I will feel lonely if I do not receive any e-mail messages from my friends for a whole day.
3	When little things happen, I sometimes talk about these events to my friends through e-mail.

Appendix 2. Items of parent-child communication

	Item
Everyday communication	
18	I speak to my parents about what I experienced in school and made me happy.
10	I speak to my parents about things I enjoyed at school or in extra-curricular activities.
1	I speak to my parents about what made me happy while I was out.
14	I speak to my parents about jokes I heard in chatting with my friends.
6	I speak to my parents about TV programs, etc.
2	I speak to my parents about the problems I have with a friend or a teacher.
4	I try to spend some time with my parents and start conversations with them.
Inner communication	
3	I occasionally express my gratitude to my parents for doing the house chores, etc.
12	When a parent of mine is feeling down about his/her work or about the family, I give them some words of consolation.
8	I occasionally say thank you or other words of gratitude to my parents for the allowances and other money they give me.
11	When I fail in something or have a problem outside my family, I speak to my parents about it.
7	When I fail in something or feeling down at school, I speak to my parents about it.
19	I speak to my parents about what I learn at school or my trouble in academic performance.
15	I speak to my parents about my future career and my anxieties about the future.

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