Effect of internet use on depression, loneliness, aggression and preference for internet communication: a panel study with 10- to 12-year-old children in Japan

Mieko Takahira*
National Institute of Multimedia Education
2–12, Wakaba, Mihama-ku
Chiba 261–0014, Japan
Fax: 81–43–298–3249
E-mail: takahira@nime.ac.jp
*Corresponding author

Reiko Ando
Kinjo Gakuin University
2–1723 Omori, Moriyama-ku
Nagoya, Aichi 463–8521, Japan
E-mail: rei@kinjo-u.ac.jp

Akira Sakamoto
Ochanomizu University
2–1–1, Otuka, Bunkyo-ku
Tokyo 112–8610, Japan
E-mail: sakamoto.akira@ocha.ac.jp

Abstract: We investigated the effect of daily internet use on 10- to 12-year-old Japanese school children (n = 421). Data collected using a two-wave panel study were analysed by Structural Equation Modelling (SEM) using a cross-lagged effect model. The analysis indicated that the use of the internet tended to increase depression, aggression and preference for internet communication, but had no effect on loneliness. Examination of the causal relationships in the opposite direction indicated that children who have higher levels of depression, aggression and preference for internet communication, but lower loneliness, tended to use the internet more.

Keywords: internet use; loneliness; depressed mood; decreased interest; anger; hostility; verbal aggression; preference for internet communication; panel study; elementary school children.

Introduction

The information age is characterised by the widespread use of the internet. More and more children and adolescents are getting the opportunity to use it. However, there are strong concerns that using the internet on a daily basis may have harmful effects on the psychological well-being and social behaviour of children and adolescents. For example, a study conducted in the USA in 2000 (Turow and Nir, 2000) showed that 59% of parents of 8- to 17-year-olds thought that “Going online too often might lead children to become isolated from other people”, and 41% thought that “Children who spend too much time on the internet develop anti-social behaviour.” Moreover, the news media has frequently reported that internet usage promotes aggression in children and adolescents (e.g., Villani, 2001).

Are these concerns justified? We will first take a look at the relevant findings of previous studies in which the causal effects of internet use on psychological well-being and social behaviour were examined.

1.1 Previous studies

Many of the previous studies in this field were cross-sectional (correlation) studies. It is, however, difficult to identify causal relationships based on the results of cross-sectional studies. We thus focus our discussion on the results of experimental and...
longitudinal studies, which, to some degree, enable estimation of causal relationships. Moreover, we focus on four psychological variables that reflect the potentially harmful effects of internet use: loneliness, depression, aggression and preference for internet communication.

1.1.1 Loneliness and depression

Although most of the studies that examined the relationship between loneliness and internet use and/or between depression and internet use were cross-sectional (e.g., Moody, 2001), some were longitudinal or experimental.

The ‘HomeNet-1 Project (1995–1997)’ undertaken by Kraut et al. (1999) included a pioneering study that revealed how the use of the internet can affect psychological well-being, i.e., loneliness and depression. In this study, 93 households in Pennsylvania were provided computers with free internet access. The participants freely used the internet in their daily lives for one to two years while a longitudinal survey was carried out to examine how it affected their psychological well-being. Internet usage was found to be a causal factor of increased loneliness and depression. There was thus a contradiction – increased communication could impair psychological well-being. This so-called ‘internet paradox’ has attracted much attention as a harmful effect of internet use. Kraut et al. (1999) attributed the internet paradox to internet-based relationships being likely to have lower quality than face-to-face relationships.

However, follow-up studies in the ‘HomeNet-2 Project (1998–1999)’ had completely different results (Kraut et al., 2002). For example, a follow-up longitudinal study (1998) to the one described above and conducted with the same participants found no causal effect on loneliness, while internet use was found to reduce depression. An additional longitudinal study conducted with different participants (1998–1999) found that internet use did not have a causal effect on loneliness or depression.

Kraut et al. (2002) attributed these discrepancies to changes in the internet environment, including the popularisation of the internet and the increased number of internet communication tools. This suggests that, as the internet environment evolved, the quality of internet-based communication improved, reducing the adverse effects of its use on loneliness or depression.

Other studies have suggested the possibility that internet use has a desirable effect on loneliness and depression. For example, Shaw and Gant (2002) conducted an experiment to examine the relationship between participation in internet-based chat sessions and loneliness and depression. The participants were undergraduate students; they participated in five chat sessions with an anonymous partner. Their levels of loneliness and depression were found to be lower on average following these sessions than they were before. White et al. (1999) conducted an experiment with retired seniors. After five months of using the internet freely, the members of the ‘intervention’ group had much more reduced levels of loneliness, on average, than the members of the control group, who did not use the internet. White et al. (2002) conducted a similar experiment with seniors living in nursing facilities. They found no significant differences between the two groups in the levels of loneliness and depression after five months.

The results of these longitudinal studies and experiments indicate that the harmful effects of internet use on loneliness and depression are not as strong as first suspected. However, most of them were conducted with adults or young adults. What about studies conducted with children or adolescents?
Most of the studies with children or adolescents were cross-sectional studies (e.g., Ybarra et al., 2005), and few investigated the causal effects of internet use. One of the few studies with them that examined the causal relationship between the amount of internet use and well-being was conducted as part of the abovementioned HomeNet-1 and -2 Projects. The results for the children and adolescents were generally the same as those for the adults. In these studies, the 10- to 19-year-olds were categorised as ‘teens’, and those who were 20 years old or older were categorised as ‘adults’ to examine the effect of age. Therefore, to clarify the causal relationships between internet use and loneliness and depression in children and adolescents, we need to use better-defined age groups.

1.1.2 Aggression

Compared with those for depression and loneliness, the relationship between daily internet use and aggression is even more ambiguous. This is because almost every study has been a case study or a cross-sectional study (e.g., Greenfield, 2004).

However, there have been a few longitudinal studies that examined the causal effect of internet use on aggression. For example, Williams and Skoric (2005) examined the effect of playing online games. The participants covered a wide age range (14–68, average of 27.7). The results showed no significant causal effect of playing online games on aggression-related beliefs or on the frequency of serious arguments with others. Slater et al. (2003) conducted a longitudinal study with sixth and seventh graders (average age of 12.3) to examine the causal relationship between the amount of violent media content viewed and aggression. The results showed bi-directional causal relationships: greater viewing of violent media contents increased aggression, and children with a higher level of aggression viewed more violent media contents. These studies, however, provide limited insight since they examined only the effect of using online games even though there are a wide variety of ways to use the internet (sending and receiving e-mail, browsing websites and so on) and also because they examined the effect of ‘the amount of use of aggressive media contents’, which includes not only the amount of internet use but also the amount of use of other types of media. Additional study is needed to get a more comprehensive understanding of the effect of internet use on aggression.

Consequently, the causal effect of internet use on aggression is still unknown regardless of the age of the participants. Nevertheless, previous studies that examined the effects of traditional media show that it is indeed quite possible that internet use promotes aggression in children and adolescents (Federman, 1998). The processes generated by viewing violent TV programmes or movies are highly likely to be generated in the same way as those generated by viewing violent contents on the internet.

In addition to this similarity with traditional one-way media, the internet enables the easy establishment of two-way communications in which users not only can simply view websites or Bulletin Board System (BBS) contents, but also can post to a BBS, join a chat session, or write and receive e-mail. In such internet communications, there is more flaming, a type of verbal aggressive behaviour, than in face-to-face communications (e.g., Castella et al., 2000). Kiesler and Sproull (1992) suggested that flaming is more likely to occur in internet-based communication because social and psychological barriers are weaker, since social context clues such as people’s expressions and gestures are less likely to be perceived than in face-to-face communication.
1.1.3 Preference for Internet Communication

In addition to the concern that internet use may increase loneliness, depression and aggression in children and adolescents, there is also the concern that children and adolescents may begin to prefer internet communication to face-to-face communication (e.g., Griffiths, 2000).

The tendency to prefer internet-based communication can affect their lives in various ways. For example, some research has indicated that the quality of internet communication is lower than that of face-to-face communication and that internet communication cannot necessarily replace face-to-face communication (e.g., Kraut et al., 1999). Therefore, if children and adolescents engage mainly in internet communication, there is a risk that their psychological well-being may be degraded.

Furthermore, according to the “cognitive-behavior model of pathological Internet use” suggested by Davis (2001), maladaptive cognition, in which individuals prefer internet communication, may trigger pathological internet use, which in turn may trigger problematic behaviour such as academic failure, family disruption and work desertion. To test this model, Caplan (2002) conducted a cross-sectional study with undergraduate students. The results suggested that those who showed more maladaptive cognition such as “preference for the social benefits available online” were likely to exhibit problematic behaviour such as missing classes or social events.

What causes this maladaptive cognition? According to the cognitive-behaviour model of pathological Internet use (Davis, 2001), it is caused by “the experience of the internet” or by a psychopathology. Caplan (2003) conducted another cross-sectional study and found that, for undergraduate students, there was a positive correlation between such psychopathologies as loneliness and depression and a preference for online social interaction.

We thus need to examine a relationship that has not been sufficiently tested: the relationship between ‘the experience of using the internet’ (e.g., daily internet use) and ‘a maladaptive cognition’, such as preference for internet communication. Furthermore, this examination should be done using a longitudinal or experimental study with children and adolescents as participants.

1.2 Present Study

While the studies described above have shed some light on the relationships between internet use and depression, loneliness, aggression and preference for internet communication, more studies are needed.

First, few studies have examined the causal relationships; most were cross-sectional or case studies, in which identifying causal relationships is difficult. To have a more meaningful discussion about the effects of internet use, we need to examine the causal relationships more explicitly (Shklovsky et al., 2006).

Second, few included children and adolescents. It is likely, however, that adolescents and especially children are more adversely affected by internet use than adults since their cognitive abilities and social skills are immature. Children may not be able to properly handle online communication, in which they do not see the person with whom they are communicating.
Third, few studies have examined the causal relationships in the opposite direction. It has been pointed out that causal relationships from psychological variables (e.g., loneliness) to internet use may exist, but such claims are based on cross-sectional data (e.g., Amichai-Hamburger and Ben-Artzi, 2003). While more attention is generally paid to the effects of internet use on psychological variables, the effects of psychological variables on internet use are also important. For example, the problem of internet use increasing the feeling of loneliness differs from the problem of lonely children using the internet more. By better understanding the bi-directional causal relationships, we should be able to provide a more appropriate approach to overcoming actual problems.

To address these shortcomings, we investigated the use of the internet by children to identify the bi-directional causal relationships between daily internet use and the four psychological variables.

2 Method

2.1 Study design

We used a panel study, which is a type of longitudinal study that follows a fixed group of individuals. Although there are various types of longitudinal studies, a panel study is particularly useful because it enables examination of bi-directional causal relationships. In a panel study, the same questionnaire is administered more than once to the same participants within a certain time interval (Finkel, 1995). By gathering data at several different points in time from the same participants, we can more directly estimate the intervariable causal relationships because the data show the changes for each person.

Compared with experimental studies, a panel study enables examination of the effect of daily internet use in as natural an environment as possible because we do not have to manipulate variables in order to estimate the causal relationships, unlike in an experimental study. Therefore, a panel study has a large number of advantages when examining the effects of daily internet use.

2.2 Participants and procedure

We conducted a two-wave panel study with 5th and 6th graders (10- to 12-year-olds) at seven public elementary schools in Tokyo. The first survey was conducted in November 2002, while the second was conducted in February 2003. The same questionnaire was administered both times while the children were in a school class. The data gathered from the 421 children (222 males, 197 females and two not specified) were then analysed.

2.3 Measurements

2.3.1 Amount of internet use

In this study, two types of self-rating questionnaires were prepared for measuring the amount of internet use. Note that the amount of internet use included daily internet use both at school and at home, and including use by mobile phone.
Internet use for each tool – the participants estimated the amount of time they spent each week (a) using e-mail (sending/receiving), (b) browsing websites and BBSs and/or reading e-mail magazines, (c) posting messages on BBSs or mailing lists, (d) creating or revising websites, (e) using chat programs and (f) playing online games. The amounts were self-scored using a seven-point Likert-type scale: do not use (0 points), less than 10 min (1 point), 10 to 30 min (2 points), 30 min to 1 h (3 points), 1 to 2 h (4 points), 2 to 3 h (5 points), and longer than 3 h (6 points).

Internet use for each purpose – the participants estimated the amount of time they spent each week (a) using the internet in school classes, (b) using the internet to do homework or to study, (c) using the internet to check information for fun, (d) using the internet to communicate with family members or friends, and (e) using the internet to make new friends. The amounts were again self-scored using the same seven-point Likert-type scale, from do not use (0 points) to longer than 3 h (6 points).

2.3.2 Loneliness

We selected five items from the friendship loneliness subscale (e.g., “I have few friends who understand my thoughts or feelings”) in the Multidimensional Scale of Loneliness in Different Human Relations developed by Hiro sawa and Tanaka (1984). The participants used a four-point Likert-type scale that ranged from strongly disagree (1 point) to strongly agree (4 points) to respond to these five items.

2.3.3 Depression

The two main symptoms of depression measured were ‘depressed mood’ and ‘decreased interest’. To measure depressed mood, we placed two items on the questionnaire: ‘I feel sad’ and ‘I want to cry.’ To measure decreased interest, we included two items: ‘Nothing excites me’ and ‘I do not feel like doing anything.’ These items were developed by referring to the diagnosis criteria for major depressive disorder in DSM-IV (American Psychiatric Association, 1994). The participants used a four-point Likert-type scale that ranged from strongly disagree (1 point) to strongly agree (4 points) to respond to these four items.

2.3.4 Aggression

We selected 12 items from three subscales in the Japanese version of the Buss-Perry Aggression Questionnaire developed by Ando et al. (1999): anger (e.g., ‘I cannot help being overcome by anger’), hostility (e.g., ‘I believe there are many people who do not like me’) and verbal aggression (e.g., ‘I say my opinions very clearly when I cannot agree with my friend’s opinions’). The participants used a four-point Likert-type scale that ranged from strongly disagree (1 point) to strongly agree (4 points) to respond to these 12 items.
2.4 Preference for internet communication

We developed two items to measure preference for internet communication by referring to articles on pathological internet use (e.g., Young, 1998): ‘I feel it is easier to play with someone on the internet than playing with someone outdoors or at home’ and ‘I feel it is easier to communicate with someone over the internet than to communicate with someone face-to-face.’ The participants used a four-point Likert-type scale that ranged from strongly disagree (1 point) to strongly agree (4 points) to answer these two items.

3 Results

3.1 Descriptive statistics

Table 1 shows the means and standard deviations for the amount of internet use as measured in the first and second surveys. The means and standard deviations for loneliness, depression, aggression and preference for internet communication are shown in Table 2.

3.2 Analysis models

To examine the causal relationships between internet use and each psychological variable (e.g., loneliness), we analysed the gathered data by Structural Equation Modelling (SEM) using a cross-lagged effect model (see Figure 1). This model is commonly used to analyse two-wave panel data (Finkel, 1995).

Table 1 Means and standard deviations of the amount of internet use

<table>
<thead>
<tr>
<th>Amount of internet use</th>
<th>First survey M (SD)</th>
<th>Second survey M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of internet use for each tool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using e-mail (e-mail sending/receiving)</td>
<td>1.18 (1.69)</td>
<td>1.18 (1.71)</td>
</tr>
<tr>
<td>Browsing websites or BBSs</td>
<td>1.07 (1.59)</td>
<td>1.16 (1.70)</td>
</tr>
<tr>
<td>Posting messages on BBSs or mailing lists</td>
<td>0.33 (0.99)</td>
<td>0.36 (1.05)</td>
</tr>
<tr>
<td>Creating or revising websites</td>
<td>0.48 (1.26)</td>
<td>0.29 (1.06)</td>
</tr>
<tr>
<td>Using chat programs</td>
<td>0.53 (1.26)</td>
<td>0.48 (1.28)</td>
</tr>
<tr>
<td>Playing online games</td>
<td>0.47 (1.22)</td>
<td>0.50 (1.27)</td>
</tr>
<tr>
<td>Amount of internet use for each purpose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using the internet in school classes</td>
<td>2.16 (1.35)</td>
<td>2.51 (1.30)</td>
</tr>
<tr>
<td>Using the internet to do homework or to study</td>
<td>1.38 (1.47)</td>
<td>1.39 (1.45)</td>
</tr>
<tr>
<td>Using the internet to check information for fun</td>
<td>1.63 (1.71)</td>
<td>1.84 (1.74)</td>
</tr>
<tr>
<td>Using the internet to communicate with others</td>
<td>0.54 (1.20)</td>
<td>0.65 (1.40)</td>
</tr>
<tr>
<td>Using the internet to make new friends</td>
<td>0.19 (0.82)</td>
<td>0.20 (0.85)</td>
</tr>
</tbody>
</table>
Table 2  Means and standard deviations of loneliness, depression, aggression and preference for internet communication

<table>
<thead>
<tr>
<th>Psychological variables</th>
<th>First survey M (SD)</th>
<th>Second survey M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loneliness</td>
<td>10.05 (3.12)</td>
<td>10.09 (3.04)</td>
</tr>
<tr>
<td>Depression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depressed mood</td>
<td>4.17 (1.79)</td>
<td>3.95 (1.68)</td>
</tr>
<tr>
<td>Decreased interest</td>
<td>4.20 (1.44)</td>
<td>4.10 (1.49)</td>
</tr>
<tr>
<td>Aggression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anger (the emotional aspect of aggression)</td>
<td>8.93 (2.86)</td>
<td>8.76 (2.91)</td>
</tr>
<tr>
<td>Hostility (the cognitive aspect of aggression)</td>
<td>10.31 (2.81)</td>
<td>10.17 (2.61)</td>
</tr>
<tr>
<td>Verbal aggression</td>
<td>9.99 (2.49)</td>
<td>10.14 (2.38)</td>
</tr>
<tr>
<td>Preference for internet communication</td>
<td>2.77 (1.31)</td>
<td>2.83 (1.32)</td>
</tr>
</tbody>
</table>

Figure 1  Cross-lagged effect model

![Cross-lagged effect model](image)

Note: e1 and e2 represent errors.

In this model, if ‘Path a’ (dotted line in Figure 1) shows a significant positive coefficient, there is a causal relationship in which a larger amount of internet use adversely affects a psychological variable. If Path a shows a significant negative coefficient, there is a causal relationship in which a larger amount of internet use favourably affects a variable. ‘Path b’ (solid line in Figure 1) was used to examine the causal relationship in the direction of each psychological variable to internet use.

Note that we compared the $\chi^2$ values between Model 1, in which the covariance between errors in the second survey was restricted to zero, and Model 2, in which there was no such restriction. Since there was no significant difference between the $\chi^2$ values, Model 1, with fewer parameters to be estimated, was selected. To examine the appropriateness of the selected model, the Goodness of Fit Index (GFI), the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA) were used. For the model we used, GFI was 0.99 to 1.00, CFI was 0.99 to 1.00 and RMSEA was 0 to 0.07; therefore, the fit was good.
3.3 Causal relationship with amount of internet use for each tool

First, we examined the effects of internet use for each tool on each psychological variable (Path a) and the causal relationships in the opposite direction (Path b). Table 3 lists the estimated causal coefficients for Paths a and b.

Table 3  Causal relationship between the amount of internet use by tool and psychological variables

<table>
<thead>
<tr>
<th>Amount of internet use for each tool</th>
<th>Depression</th>
<th>Aggression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Loneliness</td>
<td>Mood</td>
</tr>
<tr>
<td>Using e-mail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Path a</td>
<td>–</td>
<td>.14***</td>
</tr>
<tr>
<td>Path b</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Browsing websites or BBSs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Path a</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Path b</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Posting messages on BBSs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Path a</td>
<td>–</td>
<td>.08*</td>
</tr>
<tr>
<td>Path b</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Creating websites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Path a</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Path b</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Using chat programs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Path a</td>
<td>–</td>
<td>.13***</td>
</tr>
<tr>
<td>Path b</td>
<td>–</td>
<td>.08*</td>
</tr>
<tr>
<td>Playing online games</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Path a</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Path b</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Notes: Values shown in this table are significant causal coefficients (standardised coefficients). *p < .05, **p < .01, ***p < .001. Path a = The effects of the amount of internet use for each tool on each psychological variable. Path b = The effects of each psychological variable on the amount of internet use for each tool.

The amount of internet use for each tool did not have a significant effect on loneliness. Regarding depression, a large amount of using e-mail, posting messages on BBSs, and using chat programs had significantly harmful effects on a depressed mood. As for aggression, a greater amount of e-mail use resulted in significantly higher anger levels. Greater browsing of websites resulted in significantly higher anger and verbal aggression levels. Greater posting of messages on BBSs resulted in increased hostility. For preference for internet communication, the use of all the internet tools, with the exception of those for creating websites and using chat programs, had significant harmful effects on the preference for internet communication.
As for the causal relationships in the opposite direction, there was no effect on loneliness. Regarding depression, participants with a higher depressed mood used chat programs more frequently. As for aggression, a higher verbal aggression contributed to more e-mail use and browsing of websites. For preference for internet communication, a higher preference for internet communication led to a larger amount of internet use except for e-mail use.

3.4 Causal relationship with amount of internet use for each purpose

Next, we examined the effects of the amount of internet use for each purpose on each psychological variable (Path a) and the causal relationships in the opposite direction (Path b). Table 4 lists the estimated causal coefficients for both paths.

Table 4  Causal relationship between the amount of internet use by purpose and psychological variables

<table>
<thead>
<tr>
<th>Amount of internet use for each purpose</th>
<th>Psychological variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depression</td>
</tr>
<tr>
<td></td>
<td>Lonely</td>
</tr>
<tr>
<td>Using the internet in school classes</td>
<td>Path a</td>
</tr>
<tr>
<td></td>
<td>Path b</td>
</tr>
<tr>
<td>Using the internet to do homework</td>
<td>Path a</td>
</tr>
<tr>
<td></td>
<td>Path b</td>
</tr>
<tr>
<td>Using the internet to check information</td>
<td>Path a</td>
</tr>
<tr>
<td></td>
<td>Path b</td>
</tr>
<tr>
<td>Using the internet to communicate</td>
<td>Path a</td>
</tr>
<tr>
<td></td>
<td>Path b</td>
</tr>
<tr>
<td>Using the internet to make new friends</td>
<td>Path a</td>
</tr>
<tr>
<td></td>
<td>Path b</td>
</tr>
</tbody>
</table>

Notes: Values shown in this table are significant causal coefficients (standardised coefficients). *p < .05, **p < .01, ***p < .001. Path a = The effects of the amount of internet use for each purpose on each psychological variables. Path b = The effects of each psychological variable on the amount of internet use for each purpose.

The amount of internet use for each purpose did not have a significant effect on loneliness. Regarding depression, greater use of the internet for communication had significantly harmful effects on depressed mood and decreased interest. Greater use of the internet for making new friends caused a higher depressed mood. As for aggression, greater use of the internet for making new friends caused higher hostility. For preference for internet communication, internet use for all purposes, except in school classes, had significantly harmful effects on the preference for internet communication.
As for the causal relationships in the opposite direction, the participants who showed lower loneliness used the internet more frequently for communication. Regarding depression, a higher depressed mood contributed to greater use of the internet for doing homework and checking information for fun. As for aggression, a higher anger level caused a larger amount of internet use for doing homework and making new friends. Higher verbal aggression contributed to greater use of the internet for doing homework. For preference for internet communication, a higher preference for such led to a larger amount of internet use except in school classes and for doing homework.

4 Discussion

4.1 Causal relationships with internet use

4.1.1 Causal relationship between internet use and loneliness

Our study did not indicate that internet use has a causal effect on loneliness. This means that, for 10- to 12-year-old children, internet use does not reduce loneliness; however, there is no clear adverse effect. Recent studies with adults have generally shown that internet use does not have any harmful effect on loneliness (e.g., Kraut et al., 2002), which supports our results.

Kraut et al. (1999) explained the finding of the HomeNet-1 Project that internet use has an adverse effect on loneliness by suggesting that relationships established through the internet tended to have ‘weak ties’ when compared to those established through face-to-face contact. As the internet environment has become more useful for communication, however, children as well as adults may have become better able to establish ‘strong ties’ through the internet.

Note also that the internet is frequently used not only to communicate with online friends made through the internet but also to maintain offline friendships established in real life (e.g., Japanese Ministry of Internal Affairs and Communications, 2006; Zhao, 2006). Therefore, an increase in the amount of internet use does not necessarily cause a decrease in the amount of contact with offline friends and consequently an increase in loneliness.

Although our study did not indicate that internet use has a causal effect on loneliness, it did reveal a statistically significant causal effect in the opposite direction – children with a lower level of loneliness tended to use the internet more frequently to communicate with others. In other words, internet use does not increase loneliness and lonely children do not become addicted to the internet. Instead, children who do not feel lonely use the internet even more frequently to communicate with family members or friends. Therefore, internet use may have a ‘rich get richer’ effect, as Kraut et al. (2002) indicated.

4.1.2 Causal relationship between internet use and depression

Our study showed that internet use generally has a more adverse effect on depressed mood than on decreased interest. Although it indicated that only internet use for communication has a harmful effect on decreased interest, we found that using e-mail, posting to BBSs, and using chat programs had harmful causal effects on depressed mood. Moreover, the more the internet was used for communicating and making new friends,
the greater the negative effect on depressed mood. That is, a depressed mood is worsened if children have a large number of opportunities to communicate using the internet, regardless of whether the communication is synchronous or asynchronous.

In internet communication, nonverbal cues are not likely to be communicated, making it more difficult to adjust one’s comments to the situation than in face-to-face communication (e.g., Kiesler and Sproull, 1992). Children, whose social skills are immature, may therefore find internet-based communication a serious stressor. Negative experiences on the internet, such as cyber harassment, can also adversely affect depression mood (e.g., Beran and Li, 2005).

We also examined the causal relationship in the opposite direction, meaning the effect of depressed mood and decreased interest on the amount of internet use. We found that children in a depressed mood frequently used the internet in a social way such as chat. Moreover, children with a depressed mood showed a larger amount of non-social internet use such as for doing homework or checking information for fun. As for decreased interest, we found no causal effect on any of the internet uses we examined.

4.1.3 Causal relationship between internet use and aggression

Examination of the effect of internet use by tool showed that ‘anger’ became heightened with increasing e-mail use and website browsing. ‘Verbal aggression’ also became heightened with website browsing. ‘Hostility’ became heightened with posting of messages to BBSs. Examination of the effect of internet use by purpose showed that ‘hostility’ became heightened with making new friends. As with depression, social internet use affected the development of anger and hostility. As for the effect of the purpose of internet use, greater use of the internet to make new friends caused higher hostility as well. Internet-based interactions, in which nonverbal information is not likely to be communicated, may have caused an increase in feelings of anger or hostility towards the other party even for minor matters (e.g., Weinberg, 2002).

These increased feelings of aggression such as anger were not only a result of interactions with others but also a result of passive behaviour such as browsing and viewing. In the psychological process model of human aggression proposed by Berkowitz (1984), viewing violent contents activates affective states of anger, thoughts of hostility and aggressive motor tendencies, and as a result may promote aggressive behaviour. Therefore, anger and verbal aggression may be increased by simply passively viewing websites containing violent contents. Viewing violent contents on the internet may also increase the possibility that individuals learn aggressive behaviour or develop aggressive attitudes, or become desensitised to violence (Federman, 1998). The internet can be used unidirectionally, like TV. Therefore, the problems with unidirectional media may also arise with the internet.

We also examined the causal relationship in the opposite direction, meaning the effect of aggression on the amount of internet use. We found that children with a high level of verbal aggression used e-mail and browsed websites more and used the internet more frequently for doing homework. The study also showed that children with a higher level of anger used the internet more frequently for doing homework or for making new friends. Therefore, internet use for both social and non-social purposes tended to be higher for children with a higher level of aggression.
4.1.4 Causal relationship between internet use and preference for internet communication

Regardless of the tool or purpose, internet use overall had harmful causal effects on the preference for internet communication. According to the ‘cognitive-behaviour model of pathological internet use’ suggested by Davis (2001), inappropriate cognition such as a preference for internet communication is generated due to a psychopathology or as a result of internet experience. The causal relationship suggested by our study in which internet use strengthens the preference for internet communication is in accordance with the causal chain hypothesised by this model.

Causal relationships in the opposite direction were also found – simply put, children who prefer online to offline communication use the internet for everything they can regardless of tool or purpose. This may be because, regardless of the tool or purpose, children who frequently use the internet come to like online activities more than offline activities, resulting in a further increase in internet use. As a result of this vicious circle, frequent internet use may reach a pathological level, generating problematic behaviour such as academic failure and missing social events.

4.2 Effect size

The findings of this study suggest that daily use of the internet may have harmful effects on children’s depression, aggression and preference for internet communication. However, since the values we estimated for the causal coefficients ($\beta$) are not large, the causal relationship between daily internet use and depression, loneliness, aggression and preference for internet communication might not be particularly strong for 10- to 12-year-old children. Nevertheless, according to Cooper (1989), if an effect larger than $r = .10$ is obtained in the fields of personality psychology, social psychology, or clinical psychology, the effect should not be considered weak. This is because studies conducted in these fields are in general heavily affected by uncontrollable exogenous variables. Therefore, our results can be considered robust to a certain degree, especially for $r > .10$, which corresponds approximately to an effect size of .20 in terms of the more familiar $d$ of Cohen (Dunst et al., 2004).

4.3 Limitations and directions for future research

We empirically identified the causal relationships between the effect of internet use by 10- to 12-year-old children and four psychological variables. There are several limitations, however, in our study.

First, although this study showed that internet use has adverse effects on some psychological variables, there was no direct examination of how and why the adverse effects were generated. To enable more than speculation, we must accumulate empirical findings not only by examining the presence or absence of adverse effects but also by examining the reasons that these adverse effects are generated.

The second limitation concerns content. Although internet usage (e.g., browsing websites) was measured, the contents on the internet to which the children were exposed were not taken into account. As mentioned above, studies have shown that the development of aggression is directly related to the extent of violent contents in the media. Therefore, we should examine the effect of the contents.
The third limitation is related to the measured amount of internet use. For example, the amount of internet use in this study was defined as the total amount of use of the internet with a PC or a mobile phone. Studies have shown, however, that the effect of internet use on psychological variables differs between the two types of use (e.g., Takahira et al., 2006). Therefore, it would be better to examine the effects of internet use with a PC and with a mobile phone separately.

The fourth limitation is related to the method used for measuring the amount of internet use, loneliness, depression, aggression and preference for internet communication. In this study, the participants simply subjectively rated their own perceptions of their affect, cognition and behaviour. Future studies should include controlled experiments designed to measure their responses objectively.

5 Conclusion

Although our study has several limitations, as described above, the results showed that internet use has significant adverse effects on children’s psychological well-being and social behaviour. Social use of the internet mainly aimed at interpersonal communication resulted in increased levels of depression and/or aggression. Nonsocial use of the internet such as website browsing also resulted in increased aggression. As for preference for internet-based communication, it has been suggested that there may be a vicious circle in which internet use, regardless of the tool or purpose, reinforces a preference for internet-based communication, and the reinforced preference for internet-based communication in turn increases the amount of internet use.

However, internet use does not necessarily have only harmful effects on children’s psychological well-being and social behaviour. There is evidence of beneficial effects (e.g., McKenna and Bargh, 2000). Internet use can thus have both harmful and beneficial effects on a child’s social life. Therefore, simply prohibiting or restricting internet use would not necessarily produce good results. A better approach is to develop strategies for reducing the harmful effects while promoting the beneficial ones.

References


