Untangling the Social Impact of the Internet: A Large-Scale Survey

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ABSTRACT

This paper examines the Internet’s impact on social relationships: the number of face-to-face friends, hours socializing face-to-face with household members, and the number of name-identifiable neighbors. Data were collected in the year 2000 by telephone interview with 2,096 U.S. households. The findings suggest that the Internet’s effects are too heterogeneous to be captured by a simple model. Any analyses with a simplified model will lead to erroneous conclusions with heterogeneous effects canceling each other out. The findings also suggest that Internet use attenuates the effects of individual demographic characteristics. This implies that social relationships become more equal in the face of the Internet. We speculate that technology, giving equal opportunity to any type of people, contributes to this attenuation.

Keywords

Social impact of the Internet, Social relationships, Large-scale survey, Multivariate statistical analysis
INTRODUCTION

It is now estimated that over half of Americans use the Internet [2, 14]. The Internet is no longer just an esoteric tool used by scientists but a ubiquitous infrastructure for everyday activities of ordinary people. Although it is increasingly obvious that the Internet is changing human life, the specifics of this transformation are not yet clear. In particular, how people’s social relationships are altered is an important question in this modern society, in which diminishing “social capital” is a pressing issue [13]. The focus of this study is the Internet’s impact on traditional face-to-face relationships with friends and family.

The Internet is an ambivalent technology that has both positive and negative influences on human relationships. The Internet makes it easier to keep in touch with friends and family and even to encounter new people. On the other hand, users may spend so much time on the Internet that they have less time for face-to-face communication. Accordingly, empirical, quantitative investigations have resulted in contradictory findings.

The present study aims to untangle the contradictions explicitly assuming the heterogeneity of the Internet’s impact. To address the heterogeneity issues, we, in part, assume that people with different demographic characteristics tend to be affected by the Internet differently. For example, the young use the Internet differently than the old and thus experience a different effect.

This study is based on data collected by the UCLA Center for Communication Policy1, which has been conducting large-scale surveys on the social impact of the Internet. We used data from the year 2000, which is the first year of what will be a long-term panel study. Our focus is on the following social relationship variables: (1) the number of friends seen or spoken to at least once a week, (2) hours spent socializing with household members, and (3) the number of neighbors identifiable by first or last name.

1 http://www.ccp.ucla.edu
HETEROGENEOUS IMPACT

Contradictory Effects of the Internet

The original findings of the Home Net Project of Carnegie Mellon University suggested that Internet use is linked with poor social relationships. This study by Kraut et al. showed that increased Internet use was associated with less family communication, smaller social circles, more loneliness, and more depression [11]. Although the sample used for this study was small and unrepresentative, the longitudinal research design allows the direction of potential causality to be established.

In the follow-up study on the same sample, Kraut et al found that the negative effects had disappeared [10]. Internet use was found to be positively associated with face-to-face communication and local social circles. Kraut et al also showed that several aspects of the Internet’s effects on social relationships are contingent on extroversion/introversion characteristics and perceived social support. After using the Internet, extroverts tended to be more involved in communities and feel less lonely and those with more perceived social support tended to have more family communication.

A large nation-wide survey by Katz and Aspden investigated the Internet’s effect on involvement in social organizations such as religious, leisure and community organizations [7]. The results showed no evidence of a correlation between Internet use and poor social involvement. In addition, the authors showed that long-time Internet users tended to communicate with their family members and friends more frequently than recent adopters. The propensity to make friends on the Internet was shown to depend not on demographics, personality, or social connectedness but on Internet experience. Some long-time users actively make friends online.

The vast literature on the social effects of electronic media can help explain the possible negative impact of Internet use on relationships. Research on computer-mediated communication has been dominated by the “cues-filtered out” perspective [3]. This perspective holds that, since communicative cues such as facial expressions, voice tone and the physical bearings of communicators are filtered out, computer-mediated communications are limited compared to face-to-face communications [4, 16, 18]. Because of the difficulty in presenting socioemotional and equivocal messages through computers, communication becomes formal, task-oriented and
impersonal [5, 6, 12]. In general, it is more difficult to develop close, rich relationships with others behind computer networks as opposed to with those in face-to-face situations [9].

Another explanation for possible negative effects of Internet use is that the Internet consumes enormous amounts of time. Time for face-to-face communication is displaced by other activities on the Internet. If family members spend substantial amount of time in front of a computer, face-to-face communications with other family members can decrease. Identity confusion is another possibility. Sometimes a user will make up an identity or even multiple identities that do not necessarily comply with the person’s real life. This may even render virtual space more preferable than one’s everyday physical reality [19]. But the more one feels comfortable in the virtual world, the more depressed he or she can be in the real one.

Possible positive aspects of Internet use can also be explained as easily as negative ones. The Internet can make it easier to keep in touch with friends. With the Internet, information can be transmitted and received with ease at any time of the day to and from any number of friends. In addition, the Internet is a common space to encounter new friends. Users have the potential to “meet” a virtually unlimited number of people through chat rooms, bulletin boards, and other services. Ongoing online relationships can then be formed. Consequently, one’s “social circle” can be considerably expanded.

Despite the findings from previous studies that suggest that online relationships are impersonal and less favorable [5, 9], one study suggests that online relationships simply take longer to develop than those face-to-face and eventually can become as rich [20]. Individuals tend to adjust their behavior in response to limitations of technology by compensating for the loss of nonverbal communicative cues through expressing their emotions in words. The limitations of computer-mediated communication are not absolute and can be compensated for, and even turned into an advantage in some situations.

The Internet can foster openness, self-confidence, and a greater sense of ease and comfort in dealing with others. In electronically mediated communication that hides or camouflages physical appearance and social identity, one tends to be more communicative and revealing of personal information [17, 18]. In this respect, the Internet can even provide opportunities by freeing those who are too depressed to conduct social life in the real world [19].
How to Untangle the Contradiction

Despite prior studies’ rigorous effort to quantitatively explicate the Internet’s effects on human relationships, the findings are contradictory. Even the fundamental question, “Does the Internet enhance or hinder social relationships?” has not been answered. The fundamental limitation of prior research is the assumption that all kinds of people respond to the Internet in an identical way. Since the technology itself has a complex and contradictory nature, it is not realistic to expect that all the individuals face the same potential effects, positive or negative. For example, younger people face different effects from older people. Full-time employees use the Internet differently than those who are unemployed, and thus have different consequences in terms of social relationships.

In the early stages of this study, when we attempted to use a simple model, we could not identify any significant associations, either negative or positive, as previous studies showed [7]. Yet, we did not conclude that the Internet does not affect human relationships. Rather, we considered the possibility that heterogeneous effects were canceling each other out. Based on this assumption, this study tries to untangle the heterogeneous effects for heterogeneous people. More precisely, we pay attention to interaction effects of Internet use and the variables of individual demographic characteristics. It is our hypothesis that the interaction terms might reveal the Internet’s effects.

Another problem with some previous studies is small sample size and unrepresentative sample. Given the heterogeneity, a small sample can only assess specific aspects. While some people experience negative effects, others might experience positive ones. Examining one type of effects on some of the sample ignores the other effect on the rest of the sample. In order to assess the social impact of the Internet, the whole picture should be drawn with a large-scale, broadly sampled data set.
METHOD

Data

This study is based on data collected by the UCLA Center for Communication Policy, which has been conducting large-scale surveys together with worldwide partners. The objective of this project is to follow the social transformation caused by the Internet year-to-year by interviewing the same set of people that equally includes users and non-users. In this study, we use the data from the year 2000, the first year of this project.

The respondents in the data were randomly chosen using a national Random Digit-Dial (RDD) telephone sample that employed an Equal Probability Selection Method (EPSEM). An interviewer spoke to a person in the household 18 years or older to obtain a roster of all household members. Then, a computer system randomly chose one of the members 12 years or older to interview. Eight call attempts were made and a household which refused twice was not contacted again. Among 5,127 households contacted, 2,104 completed interviews and 2,096 provided reliable responses (8 responses were excluded in data screening). The interviews were conducted either in English or Spanish.

The sample was representative except in terms of education. The sample contains more highly educated people than the proportion of the national census. Comparing with the national census, we introduce weighting to make sure the analysis can be generalized in the U.S. population.

For the questions of this paper, data pertaining to respondents under 18 years old were not used although the sample contains those above age 12. The analysis method used for adults cannot be applied to those under 18 because there are only a few non-users (21) within the sample of those under 18 (175). Further, many of the variables are not relevant to children.

Social Relationships: Dependent Variables

In this study, we use three measures of social relationship and social involvement. Note that all measures are only of face-to-face relationships. We focus on the transformation of face-to-face relationships caused by the Internet. Our three dependent variables were measured using the following questions.

1. How many friends outside your household do you have that you see or speak to at least once a week?
2. During a typical week, how many hours or minutes do you spend face-to-face with members of your household? (Only those who live with others were asked.)

3. How many neighbors do you know by first or last name?

We transformed the values by natural log after adding one since the distribution was skewed. Extremely large values, which would have an excessively large influence in modeling, make a linearity assumption implausible. Log-transformation alleviates this problem.

**Control Variables**

In order to properly compare users and non-users, a number of control variables need to be included. The literature suggests that Internet use is in large part determined by age and education [2, 14]. Because of the uneven distribution of Internet penetration with respect to age and education, resulting social relationship measures are also biased by these variables. We found a linear relationship of age with our dependent variables and chose to use age as a continuous variable. Education is a 5-point scale measure: (1) less than high school, (2) high school graduate, (3) some college, (4) college graduate, (5) advanced/professional degree.

In addition to age and education, gender might also affect social relationships. Importantly, some studies suggest that Internet use tends to be different for males and females [1, 15]. Although gender is not a causal factor in this case, it might moderate the Internet’s effect as an indirect factor.

Employment status can also affect social relationships. Employed people (either part-time or full-time) have relationships in the workplace, which non-employed people do not. Employment status consists of three dummy variables: employed, non-employed, and retired. Employed includes self-employment and part-time employment. “Between jobs” is classified as non-employed.

Household income is an important variable to predict social relationships although it may not be significant after education is controlled for. Those with a high income would have more resources to actively participate in communities and have broad business and professional connections. More importantly, Internet use might be different for high-income and low-income groups. Household income is measured in a 5-point scale: (1) 0-14,999, (2) 15,000-49,999, (3) 50,000-99,999, (4) 100,000-149,999, (5) 150,000 or over in U.S. dollars.
Marital status implies different life styles and therefore different social relationships. Marital status consists of two dummy variables: married and not-married. Divorced, widowed, separated and cohabiting with a significant other are all included in not-married.

**Interaction Terms**

We use regression analysis to investigate the difference between users and non-users. The dummy variable for Internet use corresponds to the mean difference between users and non-users. That is, a coefficient on this variable corresponds to the difference of means after several alternative factors are controlled for. That is, conceptually,

\[
(\text{Social relationships}) = \beta_0 + (\text{Control variables}) \beta_1 + (\text{Dummy of user}) \beta_2 + \epsilon
\]

This type of simple model and its variants were used in previous studies (e.g., [7]). The problem with this model is that even if several possible variables are controlled for, the main effect \( \beta_2 \) is meaningless since heterogeneous effects are indiscriminately mixed. In other words, if there is a positive effect for some people and a negative one for others, the heterogeneous effects end up being cancelled out.

In order to counteract this, we then include two-way interaction terms that modify the Internet’s effect based on individual background characteristics. The assumption of this study is that people with different characteristics should demonstrate different effects of the Internet. Gender, age, income, education level, employment, and marital status are all assumed to modify the effects of the Internet. Therefore, we include all control variables in the interaction terms. This approach might be challenged since only theoretically derived interactions should be included. This study is, however, a preliminary attempt to assess the Internet’s effects with an exploratory approach and needs to report the results of broader possibility.

Consequently, the model is modified as follows,

\[
(\text{Social relationships}) = \beta_0 + (\text{Control variables}) \beta_1 + (\text{Dummy of user}) \beta_2 + (\text{Mean-adjusted control vars}) \times (\text{Dummy of user}) \beta_3 + \epsilon
\]

We needed to be careful about this coefficient \( \beta_2 \) in this model since an actual effect is a combination of \( \beta_2 \) and \( \beta_3 \). To make \( \beta_2 \) naturally interpretable, we mean-adjusted, or subtracted by mean, control variables in the interaction terms. Thereby, the coefficient \( \beta_2 \) is the effect for a reference category (i.e., female, average age, average education, average income, employed and
not-married). For other categories of people, we calculated the effect by combining the coefficients.

Our hypothesis of heterogeneity of the Internet’s effects can be specifically stated as follows: Some of the variables added in the second model have significant coefficients $\beta_i$ while the coefficient $\beta_2$ in the first model is not significant. This can be tested with the $R$ square change $F$ test in hierarchical regression analysis. If this $F$ statistic is significant, we can conclude the evidence of heterogeneity.

The inclusion of a number of interaction effects may well lead to the problem of multicollinearity. Yet, all the VIFs (Variance Inflation Factors) were suppressed below 10 throughout this study. In addition, we ran separate regression analyses for non-users and users and found almost same results in terms of both coefficient values and their significance$^2$.

$^2$ The difference is due to the homoscedasticity assumption. Separate regressions assume different disturbance variance.
RESULTS

Descriptive statistics and Pearson correlation coefficients of all the variables are shown in Table 1. A brief look suggests that no dependent variables are associated with Internet use although control variables are related to both dependent variables and Internet use. Yet, heterogeneous associations are simply hidden in these correlations.

In Table 2, we report results of three regression analyses for three different dependent variables. First, only control variables were entered in Model I. Coefficients in this model are the mixture of users and non-users. Second, a dummy variable of using the Internet was entered in Model II. Then, the interaction terms were entered in Model III. These models are nested and $R^2$ statistics against Model I are also included in the table.

Heterogeneous Impact

Number of Friends

The first regression on the number of friends is shown in the left side of Table 2. By looking at Model II, we note that the dummy variable for Internet use does not have a significant coefficient. This may lead the reader to a conclusion that Internet use does not predict the number of one’s friends. However, as the hypothesis suggests, we need to pay attention to the interaction terms in Model III, in which the $R^2$ change $F$ statistic is significant.

This result supports the hypothesis that the Internet’s effects are too heterogeneous to be captured by a simple model. And the fact that in Model II the Internet’s effect is non-significant suggests that the heterogeneous effects are simply canceled out. The Interaction terms can disentangle the heterogeneity.

Next, we look closely at the coefficients. The coefficient on the dummy variable for Internet use needs careful interpretation since it is of a reference category (i.e., average age, female, average education, average income, employed and not married). Other categories of people may not have the same result. The significantly negative coefficient on interaction with age indicates that the difference between users and non-users is larger among the young than among the old. Similarly, those who are not employed also tend to have more benefit from the Internet than those who are employed.
Although the coefficient on the dummy for Internet use is not significant, some kinds of people have a significantly positive effect. We can see the statistical significance by redefining the reference category. For example, a 25-year-old male user is likely to have 47% more friends than a 25-year-old male non-user ($b=0.388=ln1.47, p=0.001$). Likewise, a non-employed user tends to have 55% more friends than a non-employed non-user ($b=0.437=ln1.55, p=0.001$).

In contrast, married users have benefits from the Internet canceled out and, in fact, turned into a disadvantage. For example, a 50-year-old married user tends to have 20% fewer friends than a 50-year-old married non-user ($b=-0.224=ln0.80, p=0.021$).

**Hours Spent with Household Members**

The result is shown in the center of Table 2. Applying the same interpretation, we see that Internet use fails to predict household communication. In both Model II and Model III, $R^2$ statistics are not significant.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>S.D.</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ln(Hours socializing with household members + 1)</td>
<td>2.11</td>
<td>0.910</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 ln(Number of friends to see or speak to at least once a week + 1)</td>
<td>3.08</td>
<td>0.957</td>
<td>0.102***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 ln(Number of neighbors known by name)</td>
<td>1.87</td>
<td>1.02</td>
<td>0.247***</td>
<td>0.097***</td>
<td></td>
</tr>
<tr>
<td>4 Gender (male=1, female=0)</td>
<td>0.440</td>
<td>0.497</td>
<td>0.120***</td>
<td>-0.021</td>
<td>0.007</td>
</tr>
<tr>
<td>5 Age (years)</td>
<td>44.8</td>
<td>16.8</td>
<td>0.129***</td>
<td>0.089***</td>
<td>0.281***</td>
</tr>
<tr>
<td>6 Education level (5-point scale)</td>
<td>2.79</td>
<td>1.11</td>
<td>0.081***</td>
<td>0.090***</td>
<td>0.114***</td>
</tr>
<tr>
<td>7 Household income (5-point scale)</td>
<td>2.33</td>
<td>0.899</td>
<td>0.051*</td>
<td>0.023</td>
<td>0.135***</td>
</tr>
<tr>
<td>8 Not employed</td>
<td>0.159</td>
<td>0.366</td>
<td>-0.101***</td>
<td>-0.002</td>
<td>-0.026</td>
</tr>
<tr>
<td>9 Retired</td>
<td>0.177</td>
<td>0.382</td>
<td>0.113***</td>
<td>0.099***</td>
<td>0.146***</td>
</tr>
<tr>
<td>10 Married</td>
<td>0.522</td>
<td>0.500</td>
<td>-0.055*</td>
<td>0.151***</td>
<td>0.182***</td>
</tr>
<tr>
<td>11 User (use=1, non-user=0)</td>
<td>0.650</td>
<td>0.477</td>
<td>0.022</td>
<td>-0.041</td>
<td>-0.029</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>-0.052*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.042</td>
<td>0.019</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0.106***</td>
<td>-0.018</td>
<td>0.399***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>-0.174***</td>
<td>-0.126***</td>
<td>-0.134***</td>
<td>-0.171***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>-0.047*</td>
<td>0.677***</td>
<td>-0.041</td>
<td>-0.167***</td>
<td>-0.201***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0.034</td>
<td>0.062**</td>
<td>0.070***</td>
<td>0.310***</td>
<td>0.016</td>
<td>-0.076***</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>0.085***</td>
<td>-0.358***</td>
<td>0.330***</td>
<td>0.281***</td>
<td>-0.077***</td>
<td>-0.312***</td>
<td>-0.032</td>
</tr>
</tbody>
</table>

*p<.05, **p<.01, ***p<.005 (two-tailed test); Missing values pair-wise deleted
† Including the respondent
Even when we redefined the reference category to other ages, we could not find significant association. Most of the categories of people, with various education, income, employment and so on, did not have significant effects.

**Number of Neighbors**

The regression of the number of neighbors recognizable by first or last name also appears to show no effect of the Internet. Neither $R^2$ square change $F$ statistics of Model II and Model III are significant. Yet, the coefficient on the interaction term between education level and Internet use is significantly negative. This requires careful examination since the $F$ statistic is likely to be non-

![Table 2: Regression analyses](image)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent variables</th>
<th>$\ln$(Number of friends to see or speak to at least once a week + 1)</th>
<th>$\ln$(Hours socializing with household members per week + 1)</th>
<th>$\ln$(Number of neighbors known by name + 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intercept</strong></td>
<td></td>
<td>1.591***</td>
<td>1.547***</td>
<td>1.096***</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (male=1, female=0)</td>
<td></td>
<td>0.219***</td>
<td>0.218***</td>
<td>0.203***</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td>0.006***</td>
<td>0.006***</td>
<td>0.014***</td>
</tr>
<tr>
<td>Education (5-point scale)</td>
<td></td>
<td>0.047*</td>
<td>0.038</td>
<td>0.084*</td>
</tr>
<tr>
<td>Household income (5-point scale)</td>
<td></td>
<td>0.047</td>
<td>0.041</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not employed</td>
<td></td>
<td>-0.114</td>
<td>-0.107</td>
<td>-0.299***</td>
</tr>
<tr>
<td>Retired</td>
<td></td>
<td>0.132</td>
<td>0.140</td>
<td>-0.035</td>
</tr>
<tr>
<td>Married</td>
<td></td>
<td>-0.166***</td>
<td>-0.165***</td>
<td>0.071</td>
</tr>
<tr>
<td><strong>Internet use</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User (user=1, non-user=0)</td>
<td></td>
<td>0.075</td>
<td>0.158</td>
<td>-0.102</td>
</tr>
<tr>
<td><strong>Interactions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Gender) × (User)</td>
<td></td>
<td>0.021</td>
<td>-0.063</td>
<td>0.006</td>
</tr>
<tr>
<td>(Age – 44.8) × (User)</td>
<td></td>
<td>-0.011**</td>
<td>0.004</td>
<td>0.002</td>
</tr>
<tr>
<td>(Education – 2.79) × (User)</td>
<td></td>
<td>-0.063</td>
<td>-0.057</td>
<td>-0.152***</td>
</tr>
<tr>
<td>(Income – 2.33) × (User)</td>
<td></td>
<td>0.050</td>
<td>-0.055</td>
<td>0.036</td>
</tr>
<tr>
<td>(Not employed) × (User)</td>
<td></td>
<td>0.278*</td>
<td>-0.105</td>
<td>-0.072</td>
</tr>
<tr>
<td>(Retired) × (User)</td>
<td></td>
<td>0.170</td>
<td>0.004</td>
<td>-0.117</td>
</tr>
<tr>
<td>(Married) × (User)</td>
<td></td>
<td>-0.327***</td>
<td>0.061</td>
<td>0.027</td>
</tr>
<tr>
<td>$R^2$</td>
<td></td>
<td>0.053</td>
<td>0.054</td>
<td>0.070</td>
</tr>
<tr>
<td>$F$</td>
<td></td>
<td>13.8***</td>
<td>12.4***</td>
<td>8.60***</td>
</tr>
<tr>
<td>$N$</td>
<td></td>
<td>1741</td>
<td>1741</td>
<td>1741</td>
</tr>
<tr>
<td>$F$ ($R^2$ change against Model I)</td>
<td></td>
<td>2.04</td>
<td>3.87***</td>
<td>2.61</td>
</tr>
</tbody>
</table>

*p<.05, **p<.01, ***p<.005; Ordinary least square estimation; All coefficients are unstandardized
† Reference category
significant because of the relatively large number of entered interaction terms. When only this interaction term with education is entered, the $F$ statistic against Model I becomes significant ($F=4.914$, $p=0.007$). This result leads to the conclusion that there is population heterogeneity at least in terms of education level.

The significantly negative interaction effect of education suggests that the number of name-recognizable neighbors is associated with Internet use positively for those with low education and negatively for those with high education. For example, users with an education of less than high school tend to know 36% more neighbors than non-users with the same level of education ($b=0.307=ln1.36$, $p=0.024$). On the other hand, although non-significant, users with an advanced degree know fewer neighbors than non-users with the same level of education ($b=-0.300=ln0.74$, $p=0.061$).

**Attenuation by Internet Use**

We reported above the results showing that the Internet’s effect is contingent on individual demographic characteristics. Here, we assess the pattern of these contingent effects by closely looking at each main effect and its interaction effect.

We found that main effects tend to be attenuated by their interaction effects. Most main effects and interaction effects have opposite signs. For the number of friends, significant main effects of age, education and not-employed are attenuated by their corresponding interaction effects. For hours of communication with household members, significant main effects of age and education level have interaction effects in the opposite sign. For the number of neighbors, main effects of age and education level are attenuated. Some examples of the attenuation are illustrated in Figure 1.
There are several important exceptions. First, in the first regression on the number of friends, gender’s effect is not attenuated but marginally reinforced ($b=0.021$, $p=0.821$). Gender in other regressions does not show attenuation, either. This suggests that gender is not sensitive to Internet use and users and non-users have the same tendency with respect to gender.

Second, in the last regression on the number of neighbors, marital status has its main effect reinforced but only marginally ($b=0.027$, $p=0.794$). Marital status appears insensitive to Internet use as well. Interestingly, for the number of one’s friends, marital status has opposite effects for non-users and users. While married non-users tend to have slightly more friends, married users tend to have significantly fewer friends.

In order to avoid the uncontrolled problems of multicollinearity, we confirmed the results with separate regressions for users and non-users. The attenuation of main effects was seen in separate regressions of users and non-users. As we mentioned earlier, the estimates were almost the same in interaction analysis and in separate regressions. The significant coefficients among non-users become less than those among users.

It is important to remind readers of the limitation of this analysis. The findings are based on the cross-sectional comparison between users and non-users. The comparison by no means proves the causality. Yet, it is also important to understand that we controlled some important factors. The analysis thus shows the difference between users and non-users of the same gender, the same age, the same level of education, the same level of household income, and so on. The statistically significant difference of the same type of people who only differ in terms of Internet use suggests something we had not expected.
DISCUSSION

The analysis shows that the Internet’s effects appear to be marginal at first sight, but, in fact, are simply hidden. Effects of the Internet on the number of friends and neighbors are proven to be heterogeneous.

We do not suggest that the impact of the Internet is either positive or negative; nor do we claim that it is neutral. The central contention of this study is that the Internet’s effects are contingent and complex. Any study on the social impact of the Internet must be carefully designed. Analyses with a simple model sometimes lead to erroneous conclusions arrived at through estimating the average across distinct populations. Studies with limited samples may also reach biased conclusions by capturing only limited aspects of heterogeneous effects.

The number of hours of face-to-face communication with household members are shown to have no association with Internet use. This can be explained by the fact that relationships in a household are typically stronger than other types of relationships such as those with friends and neighborhoods. Therefore, the Internet does not significantly affect household communication. Household communication is thought to be affected more by various individual factors such as the presence of children, type of job of household members, and family tradition. Compared to these factors, it is not plausible that the Internet alters household communication structure.

It was also found that Internet use could predict to a significant degree the number of friends one has, but mainly for young people. This is probably because the young have more dynamic and fleeting relationships and are more susceptible to the new communication media. Further, the young tend to use the Internet more creatively than the old (i.e., chat-rooms, instant messaging and MUDs). These kinds of use facilitate encounters with new people as well as communication with existing friends.

Marital status was found to have a complex impact on the number of one’s friends. Married non-users tend to have slightly more friends than unmarried non-users, but married users tend to have fewer friends than unmarried users. The Internet seems to turn the positive effect of marriage on the number of one’s friends into a disadvantage. It can be hypothesized that since married people have more time with family and less time with friends, their friendship relationships are more vulnerable. Consequently, married people, who tend to have more friends through
associations with family members, are likely to have less time with their friends if they spend more time on the Internet.

In the second half of our analysis, we revealed the interesting finding that disparities in social relationships among non-users are reduced among users. The literature suggests that electronically mediated communication fosters equal participation since social contextual factors such as title, gender, and age are hidden [8]. Discrepancies in social status evident among non-users disappear or decrease among users. The most striking examples are the effect of age and employment on the number of one’s friends and education on the number of one’s neighbors. Those who had fewer social relationships can now have more with the Internet.

This may possibly be due to the indiscriminate nature of the technology. On the Internet, all kinds of people have equal opportunities: a high school student and a business executive can meet on equal terms. In general, those who do not go to school or have a job have fewer friends since they lack social circles within a classroom or a workplace. The Internet, which provides more communication possibilities, can compensate for their lack of opportunity.

This does not directly explain this phenomenon of Internet use since the relationships measured in this study were face-to-face or local. But, we can expect that the Internet makes users inherently more social simply by associating them with more people. Turkle suggests the ‘ventilator effect’—those who are isolated can have a chance to change themselves on the Internet and subsequently in real life [19]. Once one gets social on the Internet, he or she can also be social in the real world. The Internet also makes it easier to maintain existing relationships. In addition, other studies report that one often gets to meet face-to-face with friends originally met online [7].

Another possible explanation is that those who have many relationships in either school or the workplace tend to have less time to spend with others if they spend much time on the Internet. If a student goes to a computer screen right after a class, he or she loses the opportunity to meet other students. The same holds for a worker in the workplace. This explanation can be extended to account for the attenuation of education effect on the number of neighbors one knows. While a more educated person tends to know more neighbors in general, Internet use reduces time and opportunity to stay with neighbors as he or she goes home and surfs on the Internet.

Finally, the attenuation effect runs counter to the findings of the follow-up study of the Home Net Project [10]. That study found that Internet use widened the original disparities in social circles between extroverts and introverts. If they use the Internet, extroverts tend to develop higher
levels of community involvement and those with more perceived social support tend toward a higher degree of family communication. These findings suggest a reinforcement of the aforementioned disparity.

However, Kraut et al.’s analysis on the differential effects with respect to extroversion/introversion characteristics and perceived social support [10] implies heterogeneity of the Internet’s effects. In our study, we did not find heterogeneity of the Internet’s effect on family communication when we used demographic characteristics as interacting variables. Kraut et al.’s result suggests that perceived level of social support can explicate the heterogeneity.
CONCLUSION

This paper examined how Internet use is associated with social relationships. It was shown that the Internet’s impact is too heterogeneous to be captured by a simple model. A simple model assuming homogeneous effects may easily lead to erroneous conclusions with heterogeneous effects canceling each other out. Our analysis revealed that Internet use attenuates the significant associations of individual background variables and social relationships. Disparities in social relationships among non-users become smaller for users. That is, the Internet makes social relationships more equal.

Although this paper discussed several possible interpretations of our findings, we did not reveal the causal mechanisms behind the phenomena. As a next step, these mechanisms should be explored and the phenomenon we did reveal should be tested for in other settings.

As a final remark, we need to note the limited nature of our findings. Since our data are not longitudinal and we did not conduct a randomized trial, our analyses do not strictly imply causality. The cross-sectional comparison between users and non-users is limited to suggest the causality even though important control variables are included. We are now collecting the second year data. With multiple year data on the same sample, we will be able to examine issues of causality more rigorously.

We should also state that the social relationships operationalized in this study are simple, and arguably rather shallow. For example, even if the number of one’s friends increases, each connection may have become weaker. Therefore we could not say in this instance that the Internet enhances social relationships. Some important aspects of relationships such as strength, affect, and attachment should be explored in more detailed studies.

The relationships this study focused on were all face-to-face relationships. The Internet’s impact can be expected mostly on friendship established and maintained over the Internet. The change in face-to-face friendship may be compensated by new online relationships. Since we chose to compare users and non-users, it was difficult to study online relationships in the same way. Yet, as this question is important, we need to extend our analysis in a future study.

Finally, we untangled only one aspect of heterogeneity, i.e., that relating to demographic variables. Other aspects of heterogeneity should be examined, particularly relating to heavy and
light Internet usage and other media usage patterns. These points will be addressed in future studies.
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