THE IMPACT OF INTERNET USE ON SOCIABILITY: TIME-DIARY FINDINGS

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ABSTRACT

This article explores the complex ways in which the Internet affects interpersonal communication and sociability. Dynamic new time-diary data identify when and where Internet use impacts face-to-face interactions. Internet use at home has a strong negative impact on time spent with friends and family as well as time spent on social activities, but Internet use at work has no such effect. Similarly, Internet use during weekend days is more strongly related to decreased time spent with friends and family and on social activities than Internet use during weekdays.

These findings offer support for a "displacement" theory of Internet use—time online is largely an asocial activity that competes with, rather than complements, face-to-face social time. However, it is the location and timing of Internet use that determines how interpersonal relationships are affected.

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Recent studies about the affect of Internet use on sociability have polarized into an overly simplistic "bad Internet" versus "good Internet" debate. In one corner are the utopians who believe that the Internet leads to more and better social relationships by creating another medium of communication to friends and family and establishing new relationships through Internet introductions. In the other are the doomsayers who conclude that Internet use can be socially isolating because time on the Internet is often taken at the expense of social activities and face-to-face interpersonal interactions. Clearly, the overall effect of the Internet is not so simple—there are both instances in which the Internet can enhance and inhibit sociability. Using more detailed, reliable and definitive diary data, one is better able to explain the complicated and particular ways in which the Internet affects interpersonal communication and sociability. This article is an attempt to identify when, where and how much Internet use has an impact on measures of sociability.

At the heart of this debate are definitions of sociability. What exactly is meant by sociability and personal interaction? In examining the social consequences of the Internet, the analysis in this article focuses on the primary social environment and face-to-face interactions. This is not meant to trivialize the utility of email (or phone conversations) for staying in touch with both immediate and distant friends and relatives, but it is not yet known how these social benefits compare to primary personal interactions. [1] The benefits of face-to-face social networks for personal well-being are well documented (Wellman and Wortley 1990, Kadushin 1982, among others). To some extent, the Internet and email have transformed definitions of sociability; and this calls attention to the need to understand the qualitative differences between face-to-face interactions and online interactions, as scholars explore the tensions between the potential benefits and possible dangers of new information technologies. However, the concern in this article is with the effect of Internet use on just face-to-face interactions and social activities. This article extends the research of Nie, Erbring and Hillygus (2002) by considering measures of sociability based on (1) the type of activities in which the respondent was engaged, as well as (2) with whom the respondent participated in an activity.[2]

The hypothesis is quite simple: the Internet has created a shift in people's time allocation. The more time they sit in front of a computer screen, the less time they have for interacting directly with family and friends. This "displacement" model holds that time on one activity simply cannot be spent on another activity, since time is a zero-sum phenomenon. Because there are only 24 hours in a day, time spent on one activity must often be traded off against time spent on other activities. Like any activity, time online fundamentally competes with, rather than complements, face-to-face social time.

The alternate hypothesis is that the Internet offers an additional technology for both engaging in social interaction and coordinating social activities. This efficiency hypothesis contends that the Internet makes other activities more efficient, resulting in less stress and more time for social

activities (for example, Franzen 2000). For instance, if an individual is able to shop online more quickly than shopping at a store, it may free up time to spend with friends or family. The data in this article can be used to test whether the net effect of Internet use on sociability more closely adheres to this efficiency hypothesis or to the displacement hypothesis.   If the relationship between time on the Internet and time socializing is positive, the results will support the efficiency hypothesis. The present hypothesis, however, is that the relationship is negative, thus supporting the displacement hypothesis.

PREVIOUS RESEARCH

Existing empirical support can be found for both sides of the debate. One of the earliest surveys examining the social consequences of the Internet was the "Internet and Society" study conducted through the Stanford Institute for the Quantitative Study of Society (SIQSS) in February 2000 (Nie and Erbring 2000) and reprinted in this issue of *IT&Society*. This nationally representative study revealed that Internet users (especially heavy Internet users) report spending *less* time with friends and family, shopping in stores, reading newspapers, and watching television—and *more* time working for their employers at home (without cutting back on hours in the office).[3] That finding concerning the quantity and quality of interpersonal communications and sociability promptly became the focus of further scholarly attention and controversy.[4]

Following this study, at least three other groups—Pew, UCLA, and NPR/Kaiser/Harvard's Kennedy School—conducted nationally representative surveys that also addressed the social implications of increased Internet use. Within the media, the lines of battle were hastily drawn between the two perspectives: the SIQSS and Harvard studies, which find that the Internet can be socially isolating, were pitted against the Pew and UCLA studies, which conclude that Internet use has mainly a positive impact on sociability. Numerous other scholars have jumped into this battle, especially on the side of defending the Internet as a solely positive medium for communication (Uslaner 2000; Robinson *et al.* 2000a and 2000b; Hampton and Wellman 2000; Cole *et al.* 2000; Kraut *et al.* 2001).

There are three main criticisms of much of the existing research, however. First, many ignore the *amount* of Internet use.[5] They simply divide the population into users and nonusers, and then make comparisons of sociability along these lines. It seems inappropriate to assume that users spending one hour per week on the Internet are equivalent to those spending 20 hours on the Internet. Few people would deny the affects of Internet use at the extremes—using the Internet just minutes a day should have little affect on sociability, while spending most of the day online undoubtedly harms offline relationships. Ignoring this variation in an analysis will conceal or dilute the possible effects of Internet use.

A second criticism of these studies is that they are largely limited to bivariate analyses, ignoring the importance of controlling for demographic factors such as education, age, marital status or work status. As argued in Nie (2001) and Franzen (2000), any analysis examining the relationship between Internet use and sociability must include multivariate controls. Bivariate analyses ignore the possibility of spurious correlations between Internet use and sociability. A simple bivariate analysis, for example, could not clarify whether Internet users have more social contacts because of the Internet or because they are more highly educated (given that more highly educated individuals tend to have more social contacts *and* are more likely to be Internet users).

Finally, previous research has been criticized for not adequately measuring Internet use. Most surveys rely on respondent estimates of daily or weekly Internet use, but such estimates are undoubtedly fraught with error (Robinson 2000a). Respondents may give their best guess, but in addition to errors of judgment, such estimates are prone to distortion by social desirability concerns (e.g., individuals might not want to admit watching too much TV or they might want to overestimate time spent on charitable and civic causes). Respondent time estimates may be problematic because individuals do not keep a running tally of the number of minutes or hours spent on particular activities, and certainly not for the specific periods (day/week/month) requested by the researcher.

The analysis reported in this article utilizes a new dataset that overcomes most of these problems by using time diaries to measure Internet use time and other daily activities more directly, and thus may help to reconcile the competing hypotheses by identifying the specific conditions under which Internet use affects sociability.

RESEARCH DESIGN

A unique new survey methodology is used to differentiate amount, location and type of Internet use, thus producing more accurate measurements of respondents' time use. The present research design addresses the problems discussed above through an improved survey instrument and a more complete analysis. Multivariate analyses are used to clarify the relationships between time spent online and time spent socializing.

The survey is based on a time-diary approach. Robinson and Godbey (1997) argue that a judiciously administered time-diary study is necessary to accurately measure time spent on various activities. The diary procedure avoids the problems of a "time estimate" approach by preventing "guesstimate" errors, and by helping to prevent respondents from purposefully distorting activity estimates. Respondents can no longer easily manipulate survey responses to portray themselves in a particular light (e.g., as only moderate TV viewers or as being particularly socially active). With a time-diary approach, respondents

would have to manipulate their entire diary, not just one report of time spent on a particular activity.

SIQSS therefore developed a research design that combines the best of both worlds—the detailed time-use estimates of the diary approach, without the respondent burden of a 24-hour diary. While closely following the basic methodology of phone implemented diary studies, such as those at the University of Maryland, these techniques were adapted to take advantage of the unique methods of Knowledge Networks' survey instrument for online survey administration conducted via the Microsoft Web-TV set top box. In May 2001, Knowledge Networks fielded the first SIQSS Time-Diary Study with a representative sample of approximately 6,000 Americans between the ages of 18 and 64. Appendix A contains a more detailed description of the Knowledge Networks survey.

METHODOLOGY

Like the University of Maryland time diary studies, the SIQSS modified time-diary study asked respondents about their activities "yesterday." Rather than covering the entire day, however, the focus was on six randomly selected hours of the day—one in each of six time blocks (strata): night, early morning, late morning, afternoon, early evening and late evening. The sampling design was structured to collect an even distribution of days of the week across the total sample and of hours over the course of the day for each respondent.[6]

With a six-hour design, the survey is less monotonous than a 24-hour design. Thus, the SIQSS diary is able to go into great detail about the social context of each activity without fatiguing respondents. This also permits more follow-up questions, including information on social context and interaction for each and every primary activity.[7] Engaging a larger sample (n>6000) provides high quality comparable data for each hour of the day. That allows more detailed data about each specific activity, developing a more fine-grained picture of time use that becomes the backbone of this study.

THE DATA

This survey design provides ideal data for examining the fundamental questions regarding the relationship between Internet use and time spent in interpersonal relationships and on social activities. This data allows comparison of when and where the Internet is used, while controlling for various demographic background factors such as education, age, work hours, household composition and for other key activities that might affect the relationship between time online and time on sociability.

Given the detailed diary design, the survey collects much improved data on the main independent variable, time spent on the Internet. Respondents are able to identify Internet/email use as an activity associated with a number of

different main activities (work, education, social time, etc.) and were even prompted about whether some of their activities (reading newspapers, corresponding) were done online.

About one respondent in seven (13%) report using Internet/email as a *main* activity on the diary day. This percentage is larger than the 8% reported by the University of Maryland study, but it is much less than the 50% that report having used the Internet/email at some point yesterday in the usual recall studies.[8] This may be because, unfortunately, the time estimate used in this analysis does not include Internet/email use that occurs incidentally, and therefore is coded as a *secondary activity*. It misses, for instance, individuals who reported talking on the phone as a main activity, but who checked their email briefly at the same time. Examining the secondary activities in the SIQSS data is a substantial task and is planned for future research.

Given the rich and fine-grained nature of the data, there are a variety of different ways to measure sociability. Three measures of sociability are constructed: (1) the number of minutes spent actively engaging or participating in an activity with friends; (2) the number of minutes spent actively engaging or participating in an activity with family[9]; and (3) the number of minutes spent on socializing activities (e.g., visiting, parties, etc.). These variables are quite different measures of sociability. The active engagement measures of time spent with friends or family incorporates any time together whether going to dinner, doing chores, tending to children or anything; it only requires that the respondent was doing the activity with a friend (or family member). The social activity variable, on the other hand, includes only those activities that respondents define as socializing activities (visiting, parties and the like), so that this measure may omit social interactions that occur while, say, watching television, traveling, etc. In other words, the active engagement measure is defined by information about *with whom* the respondent did an activity, while the socializing variable is defined by the information about what activity the respondent did. While there is undoubtedly some overlap, this provides measures of sociability from different angles. The active engagement (with whom) measure should be the most general and complete definition of interpersonal interaction, but the activity-based measure of sociability provides more comparability with previous research. These two types of measures of interpersonal interaction thus serve as the main dependent variables in the analysis of the relationship between Internet use and sociability that follows.

Time use for each of these measures was computed by summing the number of minutes spent on each *as a main activity* across the six diary hours.[10] Table 1 presents the basic distributional characteristics of the main independent variable (time spent using the Internet—at home and at work) and the three main dependent variables (time spent with friends, time spent with family, time on social activities). The mean, median and standard deviation of each measure are shown in *extrapolated* minutes spent over 24 hours.[11]

TABLE 1: DIARY TIMES FOR INTERNET USE, SOCIAL ACTIVITIES AND SOCIAL CONTACTS (IN MINUTES PER DAY)

	Mean	Median	Std. Deviation	*N*
Activities				
Time online at home	21.4	16.9	19.8	6146
Time online at work	3.3	2.9	8.4	6146
Time spent on social activities	57.5	31.5	41.1	6146
With Whom				
Active time with family	281.4	264.1	98.8	6146
Active time with friends	87.3	54.3	54.6	6146

DATA ANALYSIS

Before moving to the multivariate analysis, it is useful to examine the bivariate comparison of the sociability measures between Internet users and Internet nonusers (noting, of course, that this ignores variation in Internet use and fails to control for important demographic characteristics). Table 2 shows that Internet users spend less time on most "typical" social activities, as well as less time doing activities with friends and family.

This basic cross comparison of the data suggests that Internet users are spending less time on social activities and personal interactions, but it is necessary to explore this relationship in a multivariate setting before drawing any conclusions. Moreover, to advance an understanding of the complex affects of the Internet on sociability, it is important to look more closely at *type* of Internet time. It is overly simplistic to look for *one* effect for *all* Internet use. Where and when an individual uses the Internet may be as important as how much he or she uses it. For instance, does time spent using the Internet at home have a greater impact on face time with family members than time spent on the Internet at work?

While the "displacement" hypothesis predicts that Internet use at home has a negative affect on social time with friends and family, the "efficiency" hypothesis predicts no relationship or even a positive relationship between Internet use and sociability, regardless of time or location. The following multivariate regression analysis will help to identify which hypothesis, on average, more closely reflects the observed relationships between Internet use and sociability.

Numerous control variables are included in the analysis to identify the independent effect of Internet use (at home and at work) on the three measures of sociability. Measures of time spent on sleep and time spent on work are included in the analysis because these portions of daily life are fairly fixed. It is expected that Internet use comes disproportionately at the expense of discretionary time that could otherwise be spent in face-to-face social engagement. Time spent on sleep is important because it defines the length of

TABLE 2: DIFFERENCE BETWEEN INTERNET USERS AND NONUSERS
(IN MINUTES PER DAY, FROM YESTERDAY DIARY DATA)

	Non-Internet User (n=5388)	Internet User (n=757)	Difference
Social Activities			
Parties	6.7	1.1	-5.6
Socialize	13.0	12.6	-0.4
Conversation	14.0	9.6	-4.4
Telephone calls	1.3	2.0	0.7
Sports event	2.1	0.1	-2.0
Culture event	1.8	0.7	-1.1
Total	*49.5*	*36.9*	*-12.6*
Religious service/group	1.9	1.2	-0.7
All organizations	6.6	6.1	-0.5
All child care	35.1	19.5	-15.6
With Whom			
Time spent with family	287.4	185.0	-102.4
Time spent with friends	94.2	59.8	-34.3

the conscious day—it expands or contracts the day. In terms of the displacement model, time on sleep reduces the denominator of time available. Work time is an important control because of the potential spurious relationship between time spent working and sociability. For instance, it can be expected that individuals who work more are likely to spend more time on the Internet (at work). Those who work more can also be expected to spend less time with their friends and family. Thus work hours should be included in the regression model in order to identify the direct affect of Internet use on sociability, independent of time spent working.

Time spent watching TV is included in the regression model as an interesting comparison, because Internet and TV use have often been thought of as equivalent or substitutable uses of time. Most previous studies have found a negative relationship between TV time and Internet time (which is also observed in this data—correlation of   -0.27). This, in and of itself, casts some doubt on the efficiency hypothesis. If Internet use has the effect of giving people *more* leisure time (to spend with friends and family), then it should also give people more time to watch TV—the number one leisure activity of Americans.

At the same time, it is necessary to control for basic demographic characteristics which might be related to both Internet use and sociability and could thus distort the observed relationship. The regression models, therefore, control for marital status, gender, age, education, race/ethnicity, number of

children, single parenthood and living alone. Table 3 presents the findings from the multivariate regression analysis of effect of Internet use, differentiated by use at home and use at work, on time spent with friends, family and on social activities. [12]

It is immediately apparent from Table 3 that time spent on the Internet "at home" is significantly, negatively related to time spent with family and friends and on social activities. However, the amount of Internet use at work does not have a significant impact on sociability once the number of hours spent at work (for pay) has been taken into account. This is consistent with the displacement hypothesis. Home is the critical environment where users face the direct tradeoff between Internet/email use and actually "being with" family. For every hour spent on the Internet at home, the model suggests, individuals are spending an average of almost 30 fewer minutes with their family. This means that time online at home is coming at the expense of time with family, not just time on sleep, TV or other asocial activities. The relationship is identical, though substantively weaker, for time spent with friends and for time spent on social activities.

The results also verify that the statistical controls, while predictable and interesting in their own right, do not eliminate the underlying "displacement" relationships between amount of Internet use yesterday and the amount of active face-to-face time. As might be expected, men are significantly less likely to spend time with family than women (and more time with friends and on social activities). Married people and single parents spend more time with family, but less time with friends and on social activities. Moreover, individuals living alone are less likely to spend time with family, friends and on socializing. Even though the analysis is limited to those under age 65, age still reduces face-to-face interactions with family members, friends and social activities. Turning to the other time controls, time spent on sleep, work and TV watching, as expected, has a negative relationship with all measures of sociability

These findings concur with the earlier findings of the SIQSS and the Kennedy School studies. However, they are now based on more detailed and robust data. Time can be reallocated—from time spent with friends, family or on social activities to time spent on the Internet—but not expanded; it is indeed like a hydraulic system, where increases in activity in one area reduce time available for other activities.

INTERNET USE AND LEISURE: WEEKDAYS VERSUS WEEKENDS

While the above analysis provides new insights regarding the impact of location of Internet use on sociability, when the Internet is used may also provide an important distinction. For most people, the weekend typically holds many more discretionary moments in the day, in which individuals can choose how they wish to spend their time and with whom they wish to spend it. If the

TABLE 3: HOME/WORK INTERNET USE AND SOCIAL CONTACT/ACTIVITIES

Diary Minutes	Time on Social Activities		Active Time w/Family		Active Time w/Friends	
	b	**t-stat**	**b**	**t-stat**	**b**	**t-stat**
(Constant)	219.68	29.10 ***	596.90	39.28 ***	299.47	27.12 ***
Background Factors						
Education	0.10	0.61	0.36	1.10	0.03	0.13
Male	2.00	2.35 *	-8.24	-4.80 ***	5.50	4.41 ***
Married	-5.77	-4.56 ***	27.65	10.86 ***	-8.52	-4.61 ***
African-American	-2.56	-1.88	-5.64	-2.05 *	1.64	0.82
Hispanic	-0.46	-0.31	-2.11	-0.71	-2.60	-1.21
Asian and other	-1.43	-0.74	-5.03	-1.30	-1.49	-0.53
Age	-0.36	-1.45	0.83	1.68	-1.12	-3.11 **
Age square	0.00	0.73	-0.01	-2.28 *	0.01	2.22 *
Number of children	-1.70	-3.30 ***	1.08	1.04	-2.15	-2.86 **
Weekday	-34.19	-24.73 ***	-89.43	-32.15 ***	-34.22	-16.93 ***
Living alone	-1.66	-1.17	-23.85	-8.33 ***	-4.85	-2.33 *
Single parents	-3.22	-1.82	8.76	2.46 *	-1.49	-0.58
Time Factors						
TV time	-0.18	-18.77 ***	0.01	0.39	-0.19	-13.51 ***
Sleep time	-0.13	-13.22 ***	-0.36	-17.83 ***	-0.21	-13.95 ***
Work time	-0.14	-22.19 ***	-0.40	-30.78 ***	-0.13	-13.97 ***
ONLINE AT HOME	-0.13	-5.74 ***	-0.48	-10.94 ***	-0.18	-5.67 ***
ONLINE AT WORK	0.05	0.96	0.18	1.71	-0.03	-0.34
Adjusted R Square	0.44		0.60		0.26	
F	261.24		499.53		119.63	
N	5738		5738		5738	
* * p <.05, ** p <.01, ***p <.001*						

displacement model is correct, the amount of home use of the Internet should have its strongest impact on time spent with both friends and family on weekends, when people have more freedom to choose what they wish to do and with whom, if anyone, they wish to spend their time. [13] Table 4 reports the regression results for the weekend analysis, and Table 5 reports the regression results for the weekday analysis.

The relationship between time spent on Internet/email at home on the weekend and time spent with family is the strongest observed so far: the coefficient is -0.69 (see Table 5). This means that for every hour spent online, there is a corresponding 41 minutes less spent with family members. While this number is substantively small for the average respondent (with an average of only 25 minutes spent on the Internet it results in 15 fewer minutes with family), it is quite easy to see that for heavy Internet users this effect is quite profound. The weekday regressions, too, find that time spent on the Internet at home has a strong, significant, and negative influence on time spent with family members; but the strength of the relationship is only about half of what it is on weekends, once again offering support for the displacement hypothesis.[14]

TABLE 4: ANALYSIS OF WEEKDAY INTERNET USE

Diary Minutes	Time on Social Activities		Active Time w/Family		Active Time w/Friends	
	b	**t-stat**	**b**	**t-stat**	**b**	**t-stat**
(Constant)	150.92	19.27 ***	449.72	26.08 ***	225.67	18.80 ***
Background Factors						
Education	0.12	0.74	0.44	1.24	-0.11	-0.44
Male	2.29	2.64 **	-8.09	-4.24 ***	4.47	3.37 ***
Married	-5.43	-4.26 ***	25.06	8.93 ***	-6.74	-3.45 ***
African-American	-1.89	-1.32	-4.93	-1.57	1.51	0.69
Hispanic	-1.83	-1.20	-3.12	-0.93	-1.91	-0.81
Asian and other	-2.57	-1.33	-4.98	-1.17	-3.18	-1.07
Age	-0.22	-0.86	0.44	0.80	-0.68	-1.76
Age square	0.00	0.57	-0.01	-1.39	0.00	1.05
Number of children	-0.96	-1.85	0.97	0.85	-2.14	-2.69 **
Living alone	-0.76	-0.54	-22.66	-7.27 ***	-3.48	-1.60
Single parents	-3.31	-1.84	10.20	2.58 **	1.00	0.36
Time Factors						
TV time	-0.15	-14.34 ***	0.09	4.08 ***	-0.17	-10.91 ***
Sleep time	-0.11	-10.03 ***	-0.31	-13.29 ***	-0.17	-10.45 ***
Work time	-0.11	-17.02 ***	-0.31	-21.68 ***	-0.10	-10.24 ***
ONLINE AT HOME	-0.10	-4.69 ***	-0.39	-8.32 ***	-0.12	-3.70 ***
ONLINE AT WORK	0.04	0.87	0.11	1.05	-0.04	-0.56
Adjusted R Square	0.10		0.23		0.07	
F	29.61		76.71		19.12	
N	4092		4092		4092	

Note:
  * *p <.05, ** p <.01, ***p <.001*

CONCLUSION

Results from America's first online time diary survey offer strong support for the "hydraulic" or displacement hypothesis—and no evidence to support the efficiency hypothesis. On average, the more time spent on the Internet at home the less time spent with friends, family and on social activities; in contrast, Internet use at work has little effect on sociability. Similarly, Internet use during the weekends is more strongly related to decreased time interacting and socializing than Internet use during weekdays, for it is during this time when Internet and email use competes most directly with time spent in face-to-face interactions with others.

Internet use and sociability were examined from a number of different angles, with invariable support for the displacement hypothesis. Of the different measures of sociability, the active engagement measure appears to best capture interpersonal interaction. The social activity variable is just one subset of face-to-face interaction, and it likely captures time with friends more than time with family. For instance, parents undoubtedly spent less time on "socializing" activities such as

TABLE 5: ANALYSIS OF WEEKEND INTERNET USE

Diary Minutes	Time on Social Activities		Active Time w/Family		Active Time w/Friends	
	b	t-stat	b	t-stat	b	t-stat
(Constant)	291.94	16.71 ***	710.13	23.11 ***	384.64	15.73 ***
Background Factors						
Education	-0.07	-0.17	-0.24	-0.35	0.38	0.68
Male	0.27	0.13	-11.42	-3.21 ***	7.10	2.51 *
Married	-7.02	-2.31 *	33.01	6.16 ***	-14.13	-3.31 ***
African-American	-3.19	-1.05	-8.96	-1.68	2.57	0.60
Hispanic	2.30	0.69	-0.54	-0.09	-4.50	-0.97
Asian and other	1.54	0.33	-4.44	-0.54	3.22	0.49
Age	-0.89	-1.55	1.01	1.00	-2.42	-3.03 **
Age square	0.01	0.78	-0.02	-1.26	0.02	2.50 *
Number of children	-3.10	-2.51 *	2.89	1.33	-1.76	-1.02
Living alone	-3.20	-0.91	-26.78	-4.32 ***	-8.40	-1.70
Single parents	-3.97	-0.95	3.70	0.50	-9.25	-1.58
Time Factors						
TV time	-0.26	-11.64 ***	-0.13	-3.37 ***	-0.24	-7.54 ***
Sleep time	-0.20	-8.57 ***	-0.48	-11.98 ***	-0.29	-9.11 ***
Work time	-0.23	-14.42 ***	-0.63	-22.71 ***	-0.21	-9.40 ***
ONLINE AT HOME	-0.16	-2.65 **	-0.69	-6.65 ***	-0.36	-4.37 ***
ONLINE AT WORK	-0.03	-0.14	0.19	0.47	-0.18	-0.57
Adjusted R Square	0.18		0.34		0.11	
F	23.48		53.39		13.79	
N	1645		1645		1645	

Note:
 * p <.05, ** p <.01, *** p <.001

parties or theatre, but that hardly means that they are spending less time in interpersonal interactions. In fact, most studies of social networks find that married individuals have stronger social support systems than single people.

These findings confirm that the quantity of face-to-face interpersonal interaction is affected by how an individual uses and distributes his or her time during the day. Future research should compare traditional interactions with cyber interactions to evaluate the extent to which the social value of this new form of communication compensates for the potential negative consequences. But in studying these social benefits, researchers must acknowledge that the Internet *also* has the potential to hold social detriments.

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APPENDIX A
KNOWLEDGE NETWORKS METHODOLOGY

The data used in this analysis were collected by Knowledge Networks using a new time-diary methodology that needs further explanation. In order to overcome the fact that close to half of all Americans did not have access to the Internet at the time of the study, Knowledge Networks provides representative national samples with Internet equipment in exchange for participation in surveys. Respondents in the Knowledge Networks (KN) panel are randomly recruited through Random Digit Dial (RDD) sampling methods on a quarterly-updated sample frame consisting of the entire U.S. telephone population and are provided with WebTV equipment. All telephone numbers have an equal probability of selection, and sampling is done without replacement. Although this sampling technique entails the coverage error of excluding households without telephones (less than 5% of population), this approach has significantly broader coverage than sampling techniques that draw only from computers users with Internet access (e.g., Harris Interactive).

Before the initial telephone calls are made, households in the RDD sample with listed addresses are sent letters describing the proposed exchange relationship. During the initial RDD telephone interview, respondents are told they have been selected to participate in an important national study, and they will be given a WebTV receiver that will allow them free access to the Internet if they will answer brief surveys on their television. It is emphasized that confidentiality and privacy are always upheld and that no other household can replace theirs. Respondents are immediately polled regarding the extent to which members of their households are experienced with the Internet and proficient with computers.

Once the WebTV equipment is installed in their homes, respondents are asked to respond to some profile surveys that record the key attributes of each household member. For example, respondents are asked about their gender, date of birth, ethnicity, education, income, etc. All adults (aged 18 and older) of the selected household are asked to respond to surveys via WebTV. Each member is sent one short survey per week, usually not taking more than 15 minutes to complete. In rare instances when panel members are asked to respond to longer surveys, they would be given a week off or some other form of incentive. Respondents can respond to the surveys at any time at their convenience, and are permitted to stop before they complete the survey, and return to it at a later time. Respondents who fail to respond to eight consecutive surveys will have the WebTV receiver removed from their homes. Detailed information on the methodology can be found at www.knowledgenetworks.com.

APPENDIX B
DIARY SURVEY DESIGN

The time diary survey was structured such that respondents were asked about their **main** activities during six randomly selected hours, distributed over the course of the previous day ("yesterday"). Respondents could select from a list of 13 main activities (or enter one of their own).   These activities and the definitions provided are listed in Table 6.

Respondents were then asked to identify their **specific** activity categorized under the main activity they selected. For instance, if they selected Housework as their main activity they were asked to select among the following specific activities: Cooking, Kitchen Cleanup, Laundry, Repairs, Yard Work, Internet/Email, Telephone Calls, Plant/Pet Care, Paperwork, Organize/Unpack, Other (*user defined).*

For each of the main activities, Internet/Email, Telephone and Computer Work were included as options. This picks up Internet use whether that use was, say, educational, professional, or simply recreational.

The respondents were then asked **how long** the activity lasted (10 min to 20 min to 1 hour or more), **where** the activity took place (home, other's home, office/factory, vehicle, store, outdoors/park, school, restaurant/bar, theatre/stadium, other), and **with whom** the activity was performed (whether alone, with other people present but not participating, or with others participating—and in addition, the specific individuals participating: spouse, children, other family, roommates, friends, business associates, strangers or other).

Respondents were finally asked if they did **anything else** at the same time as this (*primary*) activity. Respondents were provided with a check list of 21 (*secondary*) activities (including user-defined *other*) and were asked to identify any or all secondary activities they did at the same time as the main activity. After each sampled hour, respondents were shown their completed diary form based on their answers, to ensure that their results were accurate.

After finishing these questions for each of the activities recorded in their six selected hours, respondents were then asked a series of follow-up questions including estimates of the amount of Internet use, the content and number of emails (personal vs. work related), their types of Internet use (e.g., type of websites browsed), their amount of TV watching, sleep and social interactions. Besides providing supplemental information, these follow-up questions provided an additional measure of the independent and dependent variables (and analysis were replicated using these measures with identical results)—as well as proving an accuracy check for their time-diary estimates. For sample diary screens, see NieHillygusAppendixB.doc.

TABLE 6: MAIN ACTIVITIES

Main Activity	Definition
Work (for pay)	Any work or business activity
Education	In class, doing homework, other school activities
Housework	Cleaning, chores, cooking, home finances
Child Care	Feeding, clothing, playing with children
Errands/Shop	Groceries, appointments, offices
TV/Internet/Media	Watch TV, Internet/Email, read
Social Outing	Socializing, parties, events, movies
Recreation/Hobby	Sports, fitness, outdoors, hobbies, games
Organizations	Church, volunteer or club activities
Travel	All traveling and commuting (including walking)
Eat	Meals or snacks
Dress/Wash	Dress, shower, bathe, groom
Sleep	Sleep, nap or doze
Other	*User Defined*

APPENDIX C
REPLICATION WITH "ESTIMATED" INTERNET USE

For comparability with the first Internet study, the results are replicated using the follow-up measure of Internet use in which respondents are asked to estimate the number of hours and minutes spent on the Internet and Email yesterday. The results are reported in Table 7. The relationship between estimated time online and time spent with family, friends, and on social activities remains negative and significant, though the relationship is not quite as crisp as those reported in Table 3 (generally weaker relationships on the coefficients and slightly smaller *R*-squared values).

TABLE 7: ANALYSIS WITH ESTIMATED INTERNET TIME (FOLLOW-UP MEASURE)

Diary Minutes	Active Time w/Family		Active Time w/Friends		Time on Social Activities	
	b	**t-stat**	**b**	**t-stat**	**b**	**t-stat**
(Constant)	532.54	13.70 ***	372.96	13.23 ***	208.05	11.82 ***
Background Factors						
Education	1.90	1.58	0.26	0.30	0.64	1.16
Male	-32.11	-5.02 ***	19.15	4.13 ***	8.15	2.82 **
Married	100.85	10.65 ***	-27.82	-4.05 ***	-15.33	-3.57 ***
African-American	-19.05	-1.86	7.06	0.95	-4.90	-1.06
Hispanic	-11.56	-1.05	-8.61	-1.07	-11.78	-2.35 *
Asian and other	-21.98	-1.52	-6.19	-0.59	-2.48	-0.38
Age	2.21	1.20	-4.41	-3.30 ***	-1.76	-2.10 *
Age square	-0.04	-1.80	0.04	2.39 *	0.01	1.48
Number of children	4.77	1.23	-7.75	-2.77 **	-6.37	-3.64 ***
Weekday	-93.46	-12.90 ***	-36.81	-7.01 ***	-32.79	-9.99 ***
Living alone	-82.28	-7.71 ***	-17.55	-2.27 *	-2.25	-0.47
Single parents	30.98	2.33 *	-1.29	-0.13	-4.93	-0.82
Time Factors						
TV time	0.00	0.05	-0.18	-11.87 ***	-0.15	-15.28 ***
Sleep time	-0.32	-18.19 ***	-0.17	-13.08 ***	-0.08	-10.15 ***
WORK TIME	-0.37	-30.91 ***	-0.12	-13.45 ***	-0.10	-19.14 ***
ONLINE TIME (EST.)	-0.29	-7.77 ***	-0.13	-4.87 ***	-0.04	-2.19 *
Adjusted R Square	0.29		0.09		0.13	
F	150.60		36.44		53.20	
N	5738		5738		5738	

Note:
    * p <.05, ** p <.01, ***p <.001

APPENDIX D
REPLICATION FOR TIME ON ORGANIZATIONS AND TIME ON CHILD CARE

The analysis was also replicated for two other measures of sociability: time spent on organization activities and time spent on child care. The results for this analysis can be found in Table 8. Once again, the results find a significant, negative relationship between time spent on the Internet at home and the dependent variables. The results are substantively smaller than the results found in previous analysis, but they nonetheless offer support for the displacement hypothesis.

TABLE 8: TIME ON ORGANIZATIONS AND CHILD CARE ACTIVITIES

Diary Minutes	Time on Organization		Time on Child Care	
	b	**t-stat**	**b**	**t-stat**
(Constant)	42.38	10.90 ***	85.62	13.03 ***
Background Factors				
Education	0.19	2.31 *	0.13	0.92
Male	0.68	1.55	-5.70	-7.69 ***
Married	1.88	2.89 **	6.81	6.19 ***
African-American	3.48	4.95 ***	0.02	0.02
Hispanic	-1.05	-1.38	1.28	0.99
Asian and other	-0.11	-0.11	-0.10	-0.06
Age	0.05	0.40	0.22	1.04
Age square	0.00	-0.09	-0.01	-2.49 *
Number of children	0.07	0.25	2.47	5.51 ***
Weekday	-7.57	-10.64 ***	26.43	21.98 ***
Living alone	0.41	0.56	1.67	1.35
Single parents	0.55	0.60	3.29	2.13 *
Time Factors				
TV time	-0.04	-7.44 ***	-0.08	-9.42 ***
Sleep time	-0.03	-6.61 ***	-0.07	-7.51 ***
Work time	-0.03	-9.81 ***	-0.09	-16.36 ***
ONLINE AT HOME	-0.04	-3.37 ***	-0.10	-5.10 ***
ONLINE AT WORK	0.06	2.10 *	-0.01	-0.29
Adjusted R Square	0.13		0.14	
F	51.50		56.34	
N	5738		5738	
Note:				
* * p <.05, ** p <.01, *** p <.001*				

ENDNOTES

[1] Preliminary studies suggest that although email may promote some types of contact with friends and family, virtual contact may be more superficial than that which occurs in more personal settings (Pew 2000). Forwarding a joke to a friend or family member does not have the same communicative value as engaging in a discussion about the latest news of the day.

[2] In Nie, Erbring and Hillygus (*forthcoming*), the analysis relies solely on measures based on the "with whom" information in the time diary.

[3] An Internet user was defined as a respondent with Internet access, either inside the home, at work, at school or another location. A "heavy" Internet user was one who spent at least five hours per week on the Internet.

[4] The findings were consistent with the research of an earlier longitudinal panel study (Kraut *et al* 1998) which found greater use of the Internet was associated with declines in participants' communication with family members in the household, declines in the size of their social circle and increases in their depression and loneliness.

[5] There are some exceptions in this regard (Nie and Erbring 2000, Wellman *et al.* 2001).

[6] The sampling time blocks were Hour 1: midnight-5am; Hour 2: 6-9am; Hour 3: 10am-1pm; Hour 4: 2-5pm; Hour 5: 6-8pm; Hour 6: 9-11pm

[7] The questionnaire asks how long the activity lasted, where the activity took place, with whom the respondent did the activity and if the respondent was doing anything else at the same time. See *Appendix C* for more detailed description of the survey questionnaire.

[8] Two different hypotheses about the differences in the measures are possible: (1) the follow-up measure relies on summary recall and thus is susceptible to all of the estimation problems, such as over reporting, that has already been mentioned; however, (2) this diary measure may underestimate time spent on the Internet because respondents choose main activity by substance rather than by mode. In other words, individuals who were, say, doing research on the Internet must choose between reporting their activity as research or reporting it as Internet use, not both. Improved estimates of such Internet use should be expected in future surveys.

[9] The respondent replied that "Others participated in the activity with me" (rather than "I did the activity alone" or "Others were around but did not participate") and then selected "Spouse, children or other family" (or "Friends") as the individuals that participated in the activity.

[10] For ease of interpretation, all diary measures are reported as 24-hour estimates. Estimates of the 18 hours not selected for each of the respondents are obtained through imputation of the missing data. Assuming a multivariate normal distribution for the activity times by hour, the follow-up questions, and the demographics, the corresponding likelihood function is maximized using the EM (expectation-maximization) algorithm as implemented in SPSS' MVA function.

[11] Because Internet/email is used as an independent variable in the multivariate analysis, time spent on Internet/email when coded in the social activity, organization or childcare categories were excluded. This time accounted only for a minimal amount of total time on Internet/email.

[12] For comparison, analyses were also replicated using recall estimates from the follow-up questions (see *Appendix C)* as an alternative measure of Internet use; the analysis was also replicated on two other measures of sociability: time spent on organizations and time spent on child care (see *Appendix D*). All three of these replications find support for the displacement hypothesis.

[13] It should be remembered that weekday vs. weekend was used as a dichotomous variable in the prior analyses so as not to distort or bias the results. But using a dummy variable as a control averages out its impact across the sample. Here one is looking for structural changes in the strength of the relationship by splitting the sample weekday vs. weekend.

[14] Similarly, the analysis was replicated for time of day (evening Internet use vs. daytime Internet use). Primetime (6-8pm) Internet use has a much stronger affect than Internet use during the rest of the day.