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EFFECTS OF INTERNET USE AND SOCIAL RESOURCES ON CHANGES IN DEPRESSION

We examine how people's different uses of the Internet predict their later scores on a standard measure of depression, and how their existing social resources moderate these effects. In a longitudinal US survey conducted in 2001 and 2002, almost all respondents reported using the Internet for information, and entertainment and escape; these uses of the Internet had no impact on changes in respondents' level of depression. Almost all respondents also used the Internet for communicating with friends and family, and they showed lower depression scores six months later. Only about 20 percent of this sample reported using the Internet to meet new people and talk in online groups. Doing so changed their depression scores depending on their initial levels of social support. Those having high or medium levels of social support showed higher depression scores; those with low levels of social support did not experience these increases in depression. Our results suggest that individual differences in social resources and people's choices of how they use the Internet may account for the different outcomes reported in the literature.

Keywords Depression; longitudinal study; Internet uses; social support; extraversion; interpersonal interaction; social resources

In this article, we show that the ways in which people use the Internet to communicate predicts different changes in their psychological well-being, and that their social resources moderate these changes. Generally, people's communication, social resources, and well-being are closely linked. By social resources we mean the amalgamation of people's social networks, close relationships, community ties, enacted and perceived social support, and extraverted individual orientation. People who communicate more have more social resources, and those with more social resources have better

psychological functioning, lower levels of stress, and greater happiness (Baumeister & Leary 1995). Those with fewer social resources – socially isolated, living alone, lacking a close relationship, having experienced loss of a close relationship, having low levels of real and perceived social support, and being introverted – are more likely to have poor psychological functioning, to feel lonely, and to experience higher levels of depression (Barnett & Gotlib 1988; Bruce & Hoff 1994; Finch & Graziano 2001). These effects can be self-reinforcing because people who are lonely and depressed may spend more time alone or have negative interactions with others (Joiner & Metalsky 2001), or find partners who are themselves symptomatic (Daley & Hammen 2002).

Scholars have offered three main arguments that suggest how Internet use will affect people's psychological well-being. The *social augmentation hypothesis* suggests that communication on the Internet augments people's total social resources by providing an added avenue for everyday social interaction and by enlarging their social network (e.g. Kraut *et al.* 2002). The implication of this argument is that those who use the Internet to communicate with others will gain most value from it, psychologically, and some previous studies of people's time online are consistent with the hypothesis (Katz & Aspden 1997; D'Amico 1998; Cole *et al.* 2000; Lenhart *et al.* 2001; Wellman 2001; Isaacs *et al.* 2002; Katz & Rice 2002; Kraut *et al.* 2002; Quan-Haase *et al.* 2002; Hoffman *et al.* 2004; Boase *et al.* 2006). Nonetheless, the results also can be explained by pre-existing differences between those who did and did not use the Internet. Most of these studies controlled for demographic differences between users and nonusers, but none controlled for pre-existing differences in social resources, such as initial levels of social support (Shklovski *et al.* 2003).

The *social displacement hypothesis* offers a bleaker assessment, that communication on the Internet displaces valuable everyday social interaction with family and friends, with negative implications for users' psychological well-being. Studies of Internet users' time online whose results are consistent with this hypothesis include Kraut *et al.* (1998), Gershuny (2000), Mesch (2001), Nie *et al.* (2002), Shklovski *et al.* (2004), and Sanders *et al.* (2000). Moreover, other evidence suggests that social interactions online are not psychologically interchangeable with social interactions offline, and are less likely than offline interactions to lead to strong ties or enduring social support (Parks & Roberts 1998; Cornwell & Lundgren 2001; Moody 2001; Weiser 2001; Cummings *et al.* 2002; Wolak *et al.* 2003).

The conflicting results from studies examining people's hours online, and changes in the Internet itself, prompted many investigators to wonder if the ways that Internet users spend their time on the Internet are as important to their well-being as the time they spend online (Shaw & Gant 2002; Caplan 2003). For instance, the early Kraut *et al.* 'Homenet' study that began in

1995 examined novices who knew few others online and who may have spent their time perusing the web and communicating with strangers. The Internet today serves a wide range of purposes, which earlier studies did not assess. Perhaps online communications that are better integrated with people's work or home life, and that support their relationships with family and friends, augment or stabilize people's social resources rather than displace them. For example, email among family and friends could encourage socializing together offline (e.g. making plans for a family reunion), increase exchanges of concrete social support (e.g. asking a friend for a homework assignment), and increase competence and self-esteem (e.g. making web pages for work colleagues). These online activities could increase people's closeness to others and sense of belonging. Furthermore, researchers have wondered whether using the Internet for different purposes has augmentation or displacement effects depending on a person's initial social resources (McKenna & Bargh 1998). Kraut *et al.* (2002) found that extraverts were somewhat more likely to use the Internet to communicate with family and friends than were introverts, and they found some support for the notion that using the Internet had augmentation effects for the extraverts in their sample.

McKenna and Bargh (1998, 2000) developed a *social compensation hypothesis*, suggesting that using the Internet to meet new people and to participate in online groups has augmentative effects for those with initially impoverished social resources. New relationships and groups online may help compensate for the social resources people lack in the offline world. For instance, those with stigmatized attributes who lack compatible social groups with whom to identify can find such groups online (McKenna & Bargh 1998). By giving such individuals a chance to meet new people and groups online, the Internet provides these individuals with access to additional social support and sources of social identification. The authors argue that the Internet gives people an opportunity to meet people like themselves and to express them openly. Respondents in an experiment said they were better able to express their true selves online than offline, and they tended to project ideal qualities onto their online partners (Bargh *et al.* 2002; McKenna *et al.* 2002).

In sum, the existing evidence suggests that mere hours using the Internet do not have consistent effects on well-being. We propose people's use of the Internet will have quite different effects depending on their social resources and how they use the Internet. Previous researchers have not compared different uses of the Internet and have not controlled for initial levels of social resources and well-being. To investigate these possibilities, we conducted a longitudinal study using state (situational) and trait (personality) measures of respondents' initial social resources and disaggregated measures of their uses of the Internet. These measures allowed us to test alternative hypotheses

about the effects on well-being of Internet use for different purposes. The longitudinal design allowed us to test augmentation, displacement, and compensation hypotheses. Our measure of well-being in this study was depression, a measure predictive of life outcomes and employed in nearly all prior studies of Internet use and well-being.

Method

Respondents

A national sample of US households was contacted using random digit dialing in late 2000. The sampling frame and response rate was calculated from all residential phone numbers, whether answered or not. Those answering were asked to list members of the household, and if they did so were solicited for a university study. They were asked only whether they had Internet access. Subsequently we oversampled those who had Internet access because of our interest in the consequences of Internet use. In our data, 74 percent of the respondents at Time 1 had Internet access. We sent those who agreed to participate on the telephone a cover letter, a consent form, a US\$10 honorarium, and either a paper version of the survey, if they had no Internet access, or a pointer to an electronic version, if they had Internet access. All respondents received up to three follow-up reminders, and Internet users were sent a paper version of the survey with the third reminder. Forty-five percent of respondents who agreed to participate during the telephone screening session eventually completed the survey, producing an overall response rate of 19.3 percent from the initial random digit dialing, and an initial sample of 1,222 respondents. Six months later, we conducted a follow-up survey among those who answered the first survey. Of the 1,222 in the first survey sample, 82.8 percent completed the second survey; 72.3 percent had Internet access.

The survey was administered using a paper and pencil questionnaire for respondents without access to the Internet or who preferred paper, and an online web survey for respondents with access to the Internet. Respondent ages were 13 to 101; 85 percent were adults 19 years or older. The median age was 44 years (50.9 years among those who completed the paper and pencil survey versus 40 years among those who completed the online survey). Forty-three percent were men (40 percent paper; 45 percent online). Eighty-nine percent were Caucasian (91 percent paper; 87 percent online) and 61 percent were married (57 percent paper; 63 percent online). Their median household income was US\$30,000–50,000. Thirty percent had a household income of US\$30,000 or less; 44 percent had a household income between US\$30,000–\$70,000; and 26 percent had a household income of US\$70,000

or more. The mean income of paper survey respondents was US\$20,000 to US\$30,000, and the mean income for the online survey respondents was US\$40,000 to US\$50,000. Compared with US Census data from 2000, the sample was older (median age in the census data population was 35.3 years), had fewer men (49.1 percent in the population as a whole), more Caucasians (75.1 percent in the population as a whole), and fewer poor respondents (median household income in the US population was US\$41,900). Also, the Internet users in the sample were younger and wealthier than non-users, mirroring national trends. These demographic differences indicate that our findings may not generalize to the population as a whole, and may serve better to illustrate phenomena among Internet users as a population subset.

Procedure

The survey was conducted between June 2001 and March 2002. Respondents completed the questionnaire at Time 1, starting in June 2001, and the same questionnaire again six to eight months later at Time 2, via mail or on the Internet. Sixty percent of the respondents completed the surveys online. All measures were collected at both time periods, although for the purposes of this analysis we use only the independent variables at Time 1 only.

Control variables

Respondents indicated their gender, age, marital status (coded as married = 1, not married = 0), race (coded as white = 1, other = 0), and income on the surveys.

Depression

Depression was measured twice using a 12-item version of the CES-D (Radloff 1991). This scale is used to measure feelings of depression and dysphoria in the general population in many psychological studies of depression. Respondents reported how frequently in the past week they had experienced several symptoms of depression including 'I felt that everything I did was an effort', 'My sleep was restless', and 'I felt that I could not shake off the blues even with help from my family or friends'. Scores were averaged across the 12 items, where 1 indicated no days with a given symptom and 4 indicated the respondent experienced the symptoms between five and seven days in the preceding week. This measure is highly reliable (Cronbach's alpha = 0.89).

Social resources

We used three measures of respondents' initial social resources, each corresponding to a different type of social resource. Perceived social support was

used to measure the level of *perceived* social resources; social network size was used to measure the levels of *actual* social resources, and extraversion was used to measure the tendency towards sociality as a personality trait, which may influence levels of actual and perceived social resources.

Perceived social support. We measured perceived social support (Cohen & Wills 1985; Kessler *et al.*, 1992) using the ISEL-12 (Cohen & Hoberman 1983). This self-report scale measures respondents' perceptions of the availability of various types of social support such as practical help ('If I had to go out of town for a few weeks, it would be difficult to find someone who would look after my house or apartment'), advice ('When I need suggestions on how to deal with a personal problem, I know someone I can turn to'), and companionship ('If I decide one afternoon that I would like to go to a movie that evening, I could easily find someone to go with me'). The reliability of this measure assessed by Cronbach's alpha was 0.88.

Social network size. Respondents were asked four questions to determine the size of their social network of friends and family who lived close by and those who did not. The items asked respondents to indicate the number of friends within an hour's drive (mean = 7), number of relatives within an hour's drive (mean = 6.5), number of friends more than an hour's drive away (mean = 4), and number of relatives more than an hour's drive away (mean = 5). The four items were summed to estimate the total social network size with a range of 0 to 120, indicating one measure of the social resources available to the respondent.

Extraversion. We measured individual differences in extraversion (Costa & McCrae 1980) using eight items from the Big Five Inventory (John *et al.* 1991). Respondents were asked to agree or disagree with items such as, 'I am talkative', 'I have an assertive personality', and 'I am outgoing or sociable'. The reliability of this measure assessed by Cronbach's alpha was 0.83.

The three social resources variables should reflect differences in people's social resources but do not measure the same concepts and we did not necessarily expect to see high correlations among them. For example, people with high social support are not necessarily more extraverted than those with low social support, and those who are introverted may have a large social network of family and friends.

Internet uses

We measured how respondents used the Internet for different purposes. All measures of these Internet uses were based on respondents' estimates of the frequency in the previous six months with which they used a computer or

the Internet at home for 27 different purposes such as ‘communicating with friends’, ‘getting the news online’, or ‘playing games’. Respondents responded using seven-point, logarithmic-like Likert-scales, with response components ‘several times a day’, ‘about once a day’, ‘3–5 days per week’, ‘1–2 days per week’, ‘every few weeks’, ‘less often’ and ‘never’. We computed an index of overall Internet use taking the mean of these 27 items.

In preliminary work with a separate dataset, exploratory factor analysis of a similar list of 28 online activities collected in a sample of 446 respondents suggested five main components of Internet use: communication with friends and family, communication to meet people, information uses, commerce, and entertainment (Kraut *et al.* 2002). The national survey for the current article used a modified set of items: we added 11 new items, slightly changed the wording of five items, and excluded nine items that we thought did not reflect typical Internet use at the time of the national survey. Exploratory factor analysis confirmed the logic of the previous five components of Internet use and suggested a sixth health-related category involving Web searches for health information and talking in health related support groups.

We conducted a factor analysis to test whether a multiple-factor model better explained the data than a single-factor one. The single-factor model represents the hypothesis that Internet use is best measured by a single index that taps the frequency with which respondents use the Internet, regardless of their type of use. The input data consisted of the average of a respondent’s use of the Internet for each function across the two surveys (i.e. 922 respondents with Internet access by 27 function matrix). We compared the single-factor model with several multi-factor solutions. The single-factor model, in which all items are presumed to be caused by a single latent variable, was a poor fit to the data (Bentler-Bonett Normed Fit Index = 0.79; CFI = 0.81). By contrast, a six-factor model was a significantly better fit to the data (Bentler-Bonett Normed Fit Index = 0.88; Comparative Fit Index (CFI) = 0.90). A confirmatory factor analysis on a third dataset confirmed the six-factor model as having the better fit (Shklovski *et al.* 2006). It represents the hypothesis that one can distinguish six distinct ways of using the Internet: communicating with friends and family, communicating in online groups and to meet people, retrieving and using information, seeking entertainment or escape, shopping, and acquiring health information or talking about health.

Communicating with family and friends. Items were ‘communicating with someone in your local area’, ‘keeping in touch with someone far away’, ‘communicating with friends’, ‘communicating with relatives’ (Cronbach’s alpha = 0.95).

Communicating to meet people. Items were ‘meeting new people for social purposes’, ‘participating in an online group’ (Cronbach’s alpha = 0.81). In a follow-up survey, we found these two items loaded with similar items: ‘meeting new people for social purposes’, ‘communicating with people you first met online’.

Information. Items were ‘getting the news online’, ‘getting information about local events’, ‘finding information about national or international events’, ‘getting information about movies, books, or other leisure activities’, ‘getting information for a hobby’, ‘getting information for work or school’ (Cronbach’s alpha = 0.95).

Entertainment/escape. Items were ‘killing time’, ‘releasing tension’, ‘overcoming loneliness’, ‘being entertained’, ‘playing games’, ‘listening to music’ (Cronbach’s alpha = 0.94).

We omitted the commerce category from analyses because we had no a priori reason to think it would be related to our hypotheses. We also omitted the health-related category because items referred to both information retrieval and communication in online groups, and thus would not clearly address our hypotheses. Analyses including these components in the models did not change our results.

Descriptive statistics and correlations among the control variables, social integration variables, the category Internet use variables, and depression are described in Table 1. The variable indicating use of the Internet for the purpose of meeting new people was highly skewed, so we used the log of this variable in analyses.

Data analysis strategy

Our primary research question is about how using the Internet at Time 1 changed respondents’ levels of depression at Time 2. To examine change in depression, we used ordinary least squared regression analysis with a lagged dependent variable, as recommended by Cohen and Cohen (1983, pp. 413–427). Our analysis predicts respondents’ level of depression at Time 2 from control variables including their initial level of depression, respondents’ Internet uses, and social resources, all measured at Time 1 (six months earlier). Because the initial level of depression is included in the analysis, the dependent variable measures depression at Time 2 adjusted for depression at Time 1. This dependent variable necessarily has a zero correlation with initial levels of depression. Therefore, the effects of Internet use and social resources in these analyses should be interpreted as estimates of their effects on *changes* in depression, controlling for regression towards the

TABLE 1 Means/percentages and correlations among variables used in this study ($N = 1,045$)

<i>no.</i>	<i>variable</i>	<i>mean</i>	<i>sd</i>	1	2	3	4	5	6	7	8	9	10	11	12	13
control variables																
1	male	43%		1.00												
2	age	44	17	0.02	1.00											
3	white	89%		0.06	0.11	1.00										
4	married	61%		0.08	0.21	0.14	1.00									
5	income	US\$30–50K	US\$20K	0.05	0.07	0.10	0.38	1.00								
6	depression – time 1	1.72	0.53	–0.06	–0.13	0.02	–0.15	–0.18	1.00							
7	depression – time 2	1.73	0.55	–0.09	–0.14	–0.03	–0.10	–0.17	0.58	1.00						
internet use																
8	internet: information	2.63	1.45	0.15	–0.31	–0.02	–0.02	0.25	0.00	0.03	1.00					
9	internet: entertainment/escape	2.50	1.57	0.10	–0.39	–0.04	–0.16	0.08	0.19	0.15	0.62	1.00				
10	internet: friends & family	2.93	1.66	0.00	–0.27	0.01	–0.10	0.26	–0.01	–0.02	0.68	0.60	1.00			
11	internet: meet people	0.16	0.41	0.08	–0.30	–0.06	–0.20	–0.03	0.15	0.19	0.40	0.54	0.43	1.00		
social resources																
12	perceived social support	4.02	0.72	–0.04	–0.13	–0.01	0.10	0.13	–0.37	–0.26	0.11	–0.04	0.18	–0.03	1.00	
13	social network size	20	17	0.03	–0.08	0.10	0.03	0.02	–0.14	–0.11	0.06	0.04	0.12	0.01	0.26	1.00
14	extraversion	3.36	0.80	–0.05	–0.16	–0.03	0.01	0.07	–0.22	–0.11	0.11	0.08	0.18	0.08	0.35	0.20

Notes: Depression scores are an average of 12 items in the CES-D; the scales range from 1 (no days with symptoms) to 4 (symptoms 5 to 7 days in the preceding week). Perceived social support is the average on the ISEL-12 item scale with options ranging from 1 (strongly disagree) to 5 (strongly agree). Internet uses are measured with seven-point scales from 1 (never) and 7 (several times a day). Social network size is the sum of friends and relatives living close and far. Extraversion is the average of eight five-point scale items from the Big Five extraversion scale.

mean and the cross-sectional association of Internet use and social resources variables at the first time periods.

To test the augmentation and displacement hypotheses, we were interested in the effect of components of Internet use on depression at Time 2 (controlling for depression at Time 1). The augmentation hypothesis would lead us to expect a negative relationship between using the Internet to communicate with family and friends at Time 1 with depression later, at Time 2, indicating reduced depression. The displacement hypothesis would lead us to expect the opposite: use of the Internet to meet new people would increase depression at Time 2. The social compensation hypothesis would lead us to expect a two-way interaction effect of social resources measures and components of Internet use. Those having low levels of social support should experience reduced depression if they used the Internet to meet people online.

Results

We first conducted analyses to describe respondents' different uses of the Internet. As shown by the means in Table 1, communicating with family and friends and getting information were respondents' most frequent uses of the Internet. Further inspection of the data indicated that over 80 percent of Internet users used the Internet for these purposes at least every few weeks. Over 60 percent used the Internet for entertainment and escape at least every few weeks, and a minority, just 20 percent, used the Internet to meet people at least every few weeks. We conducted a separate regression analysis, using demographic controls and measures of social resources to predict the four different components of Internet use. To control for overall propensity to use the Internet when predicting use of the Internet for a specific purpose (e.g. entertainment/escape), we included in the equations all the other category uses of the Internet (i.e. information, communicating with friends and family, communicating to meet people; see Table 2).

The analyses in Table 2 show that demographic differences in gender, age, and income were associated with each use of the Internet, controlling for other uses. Men were more likely to use the Internet to find information whereas women were more likely to use the Internet to communicate with family and friends. Younger people were more likely to use the Internet to find information, for entertainment/escape, and to meet people. Those who were married were less likely to use the Internet for communicating with friends, family, or meeting new people. Wealthier people were more likely to use the Internet to find information and communicate with family and friends whereas poorer people were more likely to use it for entertainment/escape and to meet people. These demographics are consistent with

TABLE 2 Predicting different uses of the internet from respondent demographics and social resources

<i>variable</i>	<i>internet: information</i>				<i>internet: entertainment/ escape</i>				<i>internet: family & friends</i>				<i>internet: meet people</i>			
	<i>Beta</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Beta</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Beta</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Beta</i>	<i>SE</i>	<i>t</i>	<i>p</i>
intercept	0.59	0.27	2.17	*	2.47	0.28	8.75	***	-1.01	0.30	-3.34	***	0.09	0.09	0.95	
male	0.36	0.07	5.44	***	0.12	0.07	1.7		-0.39	0.07	-5.21	***	0.05	0.02	2.15	*
age	-0.01	0.00	-2.7	**	-0.02	0.00	-6.58	***	0.00	0.00	1.16		0.00	0.00	-3.09	**
white	-0.09	0.11	-0.87		0.01	0.12	0.1		0.21	0.12	1.7		-0.03	0.04	-0.83	
married	0.11	0.07	1.43		0.01	0.08	0.12		-0.35	0.08	-4.23	***	-0.06	0.03	-2.36	**
income	0.05	0.02	3.19	***	-0.03	0.02	-1.67		0.10	0.02	5.58	***	-0.01	0.01	-2.02	*
perceived social support	0.03	0.05	0.53		-0.26	0.05	-4.83	***	0.25	0.06	4.47	***	-0.03	0.02	-1.72	
social network size	0.00	0.00	-1.26		0.00	0.00	1.13		0.00	0.00	2.25	*	0.00	0.00	-1.51	
extraversion	-0.01	0.04	-0.16		-0.01	0.05	-0.19		0.07	0.05	1.47		0.02	0.02	1.38	
internet: information					0.32	0.03	9.46	***	0.50	0.03	15.09	***	0.00	0.01	-0.22	
internet: entertainment/escape	0.28	0.03	9.46	***					0.29	0.03	8.69	***	0.09	0.01	9.24	***
internet: family & friends	0.40	0.03	15.09	***	0.27	0.03	8.69	***					0.05	0.01	5.02	***
internet: meet people	-0.02	0.10	-0.22		0.94	0.10	9.24	***	0.55	0.11	5.02	***				

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

cross-sectional findings in other national surveys (Pew 2004). Use of the Internet for information seeking purposes was associated with being male, young, and having a high income. Use of the Internet for escape and entertainment was associated with being young and having low social support. Communicating with family and friends was associated with being female, unmarried, and having high levels of social support and large social networks. By contrast, meeting new people online was correlated with being male, young, unmarried and having low income.

We also found that better social resources (perceived social support, social network size, and extraversion) were associated with using the Internet to communicate with family and friends. By contrast, poor social resources of different types were associated with other uses of the Internet. People who reported less social support used the Internet for entertainment/escape and to meet people. Those with smaller networks used the Internet for information and to meet new people. These results are consistent with the arguments of the social compensation hypothesis – that those who lack social support in their real lives may seek solace and new people on the Internet.

We conducted a cross-sectional regression analysis, using only variables from Time 1, to establish baseline levels of depression at Time 1 for our participants. We found that being female, younger, white, and poorer was correlated with more depression at Time 1. Also, using the Internet for entertainment/escape was very significantly correlated with higher depression, whereas using the Internet for communicating with friends and family was correlated with lower depression scores. Using the Internet for information or to meet new people was uncorrelated with depression scores at Time 1.

Predicting changes in depression

We examined how people's initial levels of social resources predicted changes in their levels of depression, or moderated how uses of the Internet did so. Table 3 consists of three linear models predicting depression at Time 2 from demographic characteristics (gender, age, race, marital status, and income) and overall Internet use and its components at Time 1. To determine whether use of the Internet has different effects for people differing in initial in social resources, we included interactions with perceived social support (one of the social resource variables) in the last model in Table 3. Depression at Time 1 is used as a control, so the model is predicting changes in depression.

The first model in Table 3 utilizes the index of overall Internet use at Time 1 in an analysis that includes demographic variables. By comparing this model to subsequent models in which Internet use is decomposed into its components, we can determine whether an aggregate measure of Internet

TABLE 3 Linear models predicting depression (Time 2) from perceived social support, components of internet use and their interactions

variable	overall internet use				components of internet use				adding perceived social support interactions			
	beta	se	t	p	Beta	SE	t	p	Beta	SE	t	p
intercept	1.78	0.05	32.68	***	1.78	0.05	32.81	***	1.77	0.05	32.64	***
male	-0.07	0.03	-2.22	*	-0.09	0.03	-2.73	**	-0.09	0.03	-2.69	**
age	0	0	-1.58		0	0	-1.41		0	0	-1.66	t
white	-0.03	0.05	-0.58		-0.02	0.05	-0.34		-0.01	0.05	-0.27	
married	0.05	0.04	1.32		0.04	0.04	1.21		0.05	0.04	1.3	
income	-0.02	0.01	-2.57	**	-0.01	0.01	-1.72	t	-0.01	0.01	-1.85	t
depression (time 1)	0.6	0.03	18.34	***	0.59	0.03	17.59	***	0.57	0.04	15.8	***
perceived social support									-0.05	0.03	-2.07	*
internet: overall use	0.03	0.02	1.76	t								
internet: friends & family					-0.04	0.01	-2.53	**	-0.03	0.01	-2.04	*
internet: information					0.03	0.02	1.51		0.03	0.02	1.66	t
internet: meet people					0.17	0.05	3.42	***	0.16	0.05	3.22	***
internet: entertainment/escape					0	0.02	0.16		0	0.02	-0.25	
social support x internet: friends & family									0.01	0.02	0.48	
social support x internet: information									-0.04	0.03	-1.54	
social support x internet: meet people									0.17	0.08	2.16	*
social support x internet: entertainment/escape									-0.02	0.02	-0.76	

^t $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

use predicts changes in depression, or whether particular components of Internet use predict these changes. As shown in Table 3, respondents' demographic characteristics predict their depression scores. In particular, women reported greater increases in depression than men and poorer people reported greater increases in depression than wealthier people. There is also a nonsignificant trend for younger people to increase depression more than older people. Because these results are consistent with the prior literature (e.g. on gender, see Mirowsky & Ross 1995; on income, see Conger *et al.* 1999; on age, see Mirowsky & Ross 1992) and because they recur in the other models, we do not discuss these results further.

The main effect of overall Internet use has a marginally significant ($p = 0.06$) positive relationship with depression. That is, compared with people who did not use the Internet at Time 1 or used it infrequently, people who used the Internet frequently for a wide variety of purposes reported somewhat more depression from Time 1 to Time 2. This model accounts for 35 percent of the variance.

Effects of components of Internet use

Our second step in the analysis, reflected in Model 2 in Table 3, was to examine four specific components of Internet use: communication with friends and family, communication to meet people, getting information, and entertainment/escape. This model explains 36 percent of the variance, an additional 1 percent over the previous model. An examination of Model 2 shows that using the Internet for information or entertainment/escape was not associated with changes in depression, suggesting these Internet uses have few social psychological consequences.

The augmentation hypothesis led us to expect that use of the Internet for communication would be associated with declines in depression, and we found support consistent with this idea, but only when online communication was with family and friends. The significant negative relationship between use of the Internet to communicate with friends and family and depression at Time 2 indicates that this use was associated with reduced depression as shown in Figure 1. This result suggests that using the Internet to talk with close ties prompts improved psychological well-being, just as shown in the literature on offline communication with close ties.

We found a different main effect of using the Internet for meeting new people and talking in online groups – presumably much weaker ties than friends and family. Those who used the Internet to meet new people showed significantly more depression at Time 2, as shown in Figure 1. This finding supports the displacement hypothesis, that communicating online can have deleterious effects, but only when communication is with weak ties. Although we have no direct evidence of the process, the results are

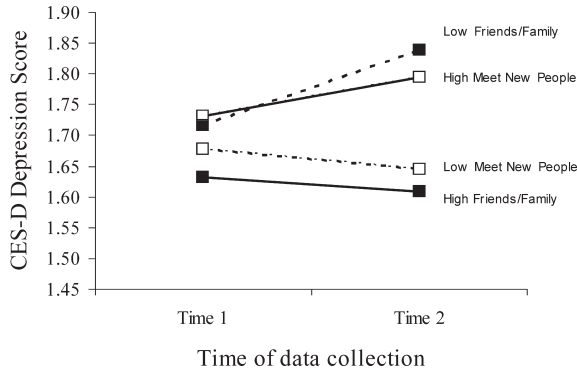


FIGURE 1 Predicted depression based on time and use of the internet to meet new people or communicate with friends and family.

Note: Low internet use scores reflect the 10th percentile of use at Time 1. High Internet use scores reflect the 90th percentile of use at Time 1.

consistent with the idea that using the Internet to meet new people and talk in online groups may displace communication with strong ties in one's life, thereby leading to reduced social resources and increased depression.

Moderating effects of initial social resources. From the social compensation hypothesis, we predicted that individuals' levels of social resources would moderate the effects on depression of using the Internet to communicate. To test this hypothesis, we added the main effect of perceived social support at Time 1 and interactions of perceived social support with the Internet use variables from Model 2. Model 3 in Table 3 shows this analysis. The addition of the interactions improved the fit of the models slightly, explaining between 37 percent and 38 percent of the variance.

Perceived social support main effects show that, as expected, perceived support has a negative association with changes in depression; respondents with less perceived social support at Time 1 showed increases in their depression scores at Time 2. In addition, the interaction between perceived social support and using the Internet for meeting people is significant. This interaction shows that using the Internet to meet new people is associated with larger increases in depression for those with more perceived social support but a reduced effect and even a decline in depression for those with the lowest levels of perceived social support (see Figure 2). This finding suggests a revision of the displacement hypothesis to accommodate social compensation. Overall, people with high levels of social support show marked increases in their depression scores if they use the Internet to meet people and talk in online groups, suggesting neglect of their close ties to seek out new ones (that is, displacement). However, consistent with the

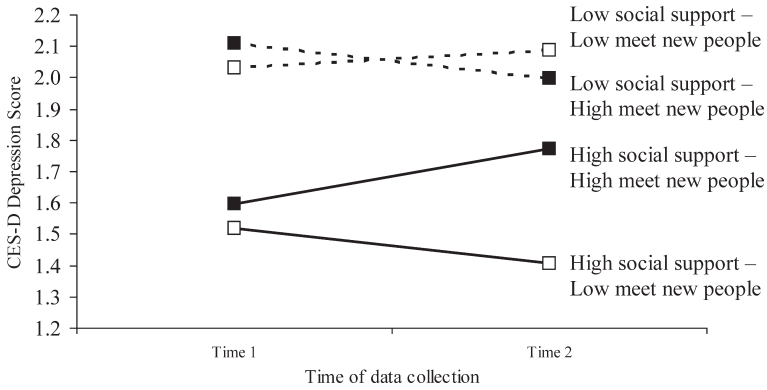


FIGURE 2 Changes in depression predicted by use of the internet to meet people and level of social support.

Note: The graph represents the expected changes in C-DES depression scores, from the model described in Table 3. Points represent changes for people with high levels of perceived social support (90th percentile at Time 1) and low perceived social support (10th percentile at Time 1) among those who were high users of the internet for meeting new people (90th percentile) or who did not use the internet to meet new people.

arguments behind the social compensation hypothesis, those with lower levels of social support, with presumably fewer strong relationships to neglect, do not suffer these consequences. Those with the lowest levels of social support (bottom quartile) who use the Internet to meet new people show improvements in their depression scores. Given that only 20 percent of the sample reported using the Internet to meet people and talk in online groups, this means that less than 3 percent of the sample – those with very low social support – experienced improved depression scores consequent to this use of the Internet.

We conducted similar analyses using our two other measures of social resources. Table 4 shows these analyses of the moderating impact of people’s social network size and extraversion. The pattern of results was similar to that of perceived social support. Generally, greater use of the Internet to meet people was associated with increases in depression among those who initially reported higher levels of social support, but not among those who initially reported the least social support.

Discussion

The Internet offers connections to others and convenient, sometimes unique information and entertainment or escape. We argued that the social effects of

TABLE 4 Linear models predicting depression (Time 2) from social network size or extraversion, components of internet use and their interactions

<i>independent variables</i>	<i>adding social network size interactions (model 1)</i>			<i>adding extraversion interactions (model 2)</i>		
	<i>Beta</i>	<i>t</i>	<i>p</i>	<i>Beta</i>	<i>t</i>	<i>p</i>
intercept	1.78	32.77	***	1.78	32.97	***
male (0 = female; 1 = male)	-0.09	-2.69	**	-0.10	-2.83	**
age	0.00	-1.60		0.00	-1.32	
white (0 = minority; 1 = white)	-0.02	-0.44		-0.02	-0.44	
married (0 = not married; 1 = married)	0.05	1.31		0.04	1.10	
income	-0.01	-1.87	t	-0.02	-1.98	*
depression (time 1)	0.60	17.69	***	0.59	17.30	***
social network size (model 1) or extraversion (model 2)	0.00	-0.58		0.01	0.56	
internet: friends & family	-0.03	-1.94	*	-0.04	-2.61	**
internet: information	0.02	1.17		0.03	1.75	t
internet: meet people	0.15	3.02	**	0.13	2.47	**
internet: entertainment/escape	0.00	0.12		0.00	0.30	
social network size (model 1) or extraversion (model 2) x internet: friends & family	0.00	-0.53		0.00	0.18	
social network size (model 1) or extraversion (model 2) x internet: information	0.00	1.74	t	0.00	-0.21	
social network size (model 1) or extraversion (model 2) x internet: meet people	0.01	2.98	**	0.22	3.33	***
social network size (model 1) or extraversion (model 2) x internet: entertainment/escape	0.00	-2.25	*	-0.03	-1.42	

^t $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

using this technology depend on people's ways of using the Internet and on their existing social resources. Our longitudinal analyses of respondents' changes in depression support this general argument. Respondents' overall use of the Internet was associated with only small changes in their well-being. Uses of the Internet other than direct communication, that is, for entertainment/escape and acquiring information, had no discernible consequences for well-being (although those with higher levels of depression were highly likely to use the Internet for entertainment and escape). By contrast, using the Internet for two forms of communication was associated with changes in depression and may have caused these changes. A very frequent purpose of using the Internet was for communicating with friends and family. People who used the Internet for this purpose not only tended to have less depression in the first place but also experienced subsequent declines in depression. A much less frequently reported purpose was using the Internet to meet people, but doing so was associated with increases in depression. These increases were especially evident among those with higher initial levels of social support and not evident among those with low support. Those who had very low levels of social resources and used the Internet to meet people only accounted for about 3 percent of the sample, and some of these people experienced reduced depression.

Our study provided tests of three hypotheses related to social resources and the social impact of the Internet. The social augmentation hypothesis led us to expect those who communicate online to experience reduced depression, and we found support for this hypothesis when communication was with family and friends. The displacement hypothesis led us to expect that Internet users who use the Internet to communicate would experience increased depression. We found support for this hypothesis only when communication was to seek new people or talk in online groups. The social compensation hypothesis (McKenna & Bargh 1998) led us to expect that people who used the Internet to meet people online with poor initial offline social resources would benefit from this use. Our results are consistent with this hypothesis. In our study, those who had smaller social networks, less initial perceived social support, and who were more introverted did not experience the same levels of increased depression as did those with higher levels of social resources, but neither did we find evidence of declines in their levels of depression when they used the Internet to meet people except among those with the lowest levels of social resources.

The displacement and social compensation results merit further investigation. One might ask what 'meeting new people' online and 'talking in online groups' really meant to our respondents. Were these respondents (who tended to be young, extraverted, less wealthy than average, and with smaller social networks of close ties) looking for romance outside their committed relationships? Were they looking for people with whom to share

stigmatized common interests, as McKenna and Bargh (1998) argue? We suspect some of our respondents did not define 'meeting new people' as ordinary chatting online, or social networking. To sort among the alternative explanations for our data will require more examination of the processes that ensue when people use the Internet for different purposes.

In addition, this study does not differentiate between social support received offline and online. Our measure of perceived social support includes items asking about types of support that require geographic proximity such as practical or companionship, but also includes items that ask about social support such as advice and emotional support, which do not require geographic proximity. The measure of social network size also did not ask explicitly about online friends, although they could have been counted among friends in the social network items. Measuring online support and friends depends on how our respondents classify their online acquaintances. Further investigation is needed to determine whether computer-mediated support is perceived and affects people differently than offline support.

We cannot insure causality based on the statistical analyses we used in this study. Inferring causation depends upon accepting several strong assumptions. However, we believe these longitudinal analyses provide clearer evidence of causation than do cross-sectional analyses using the same variables (Singer & Willet 2003). Most of the claims, positive and negative, about the impact of the Internet are based on evidence from cross-sectional surveys, comparing individuals who have Internet access with those who do not have it, comparing heavier users of the Internet with lighter users, or comparing earlier adopters with later users. Most of this work also controlled only for demographic variables that themselves are indirect causes of depression, social resources, or other outcomes of interest (e.g. Robinson *et al.* 2000).

In our analyses, we controlled for measures of social resources that might be associated with both Internet use and depression. In addition, when testing for the effect of any particular type of Internet use, we controlled for other Internet uses, thus controlling for respondents' general propensity to use the Internet. Even with these precautions, however, cross-sectional analyses invariably under-control for potentially confounding variables. Because of errors in measurement, they under-control for variables included in the statistical models and invariably exclude some potentially relevant variables. Longitudinal analyses are less subject to these biases from uncontrolled third variables. Because the same individuals are measured multiple times, individuals' stable characteristics, such as demographic characteristics and stable personality traits, are automatically controlled when assessing change in an outcome. As a result, it is primarily variables that change with time that remain as threats to inferring causation.

We have shown that the effects of using the Internet depend upon how it is used and that personal characteristics affect the relationship between Internet

use and depression. This demonstration could help explain the widely disparate results in previous research. This research builds upon our previous work on the effects of Internet use by considering the preexisting social resources of Internet users and disaggregating Internet use into different types of use.

Although the discussion to this point has focused on the substantive contribution of this work, there are methodological contributions as well. This research demonstrates the importance of conducting longitudinal panel research when examining the impact of new technology. As we have shown here, conclusions are substantially different depending upon whether one examines the cross-section associations of Internet use and depression or the longitudinal association of Internet use and changes in depression. Moreover, this research demonstrates the value of decomposing Internet use into its components. The Internet is a composite technology with a wide range of uses, sharing some features of television, the newspaper, and the telephone. When looked at as an aggregate, overall Internet use was not associated with changes in depression, but the different ways people used the Internet made a difference in their outcomes. Our method at once avoids technological determinism and includes consideration of base rates.

Finally, our study shows the importance of accounting for individual differences in studies of the social impact of technology. Who you are and who you are interacting with matters a great deal when it comes to the psychological consequences of Internet use. People communicating with friends and family on the Internet showed reduced depression whereas participants communicating to meet new people showed increased depression, especially those with higher levels of initial social resources. Our results also demonstrate that people's social resources not only influenced their well-being apart from their use of the Internet but also systematically interacted with their choices of how to use the Internet and with its effects. In that respect, our study shows how changes in the technologies people use in everyday life can be integrated with research in personality and individual differences.

Acknowledgements

The authors thank Vicki Helgeson and Irina Shklovski for their advice and help. This study was supported by NSF grant #IIS-0208900.

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