

Effects of Internet Use and Social Resources on Changes in Depression

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Abstract

In a longitudinal U. S. survey, we examined how people's different uses of the Internet predicted their later scores on a well-known measure of depression and dysphoria, the CES-D. We found, as shown in previous work, that almost all respondents used the Internet for information and for entertainment and escape, and these uses of the Internet had no impact on changes in respondents' level of depression. Those who used the Internet for communicating with friends and family, another almost universal use, showed lower depression scores 6 months later. Only about 20% of the sample used the Internet in a fourth way--to meet new people and talk in online groups. Those who did so showed changes in their depression scores depending on their initial levels of social support. Those having high or medium levels of social support increased their 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 choice of Internet use may account for different outcomes reported in the literature.

Effects of Internet Use and Social Resources on Changes in Depression

In this article, we show that the ways in which people use the Internet predict different changes in their psychological well being. We also show that people's social resources moderate these changes. There is a large body of research pointing to a potential relationship between Internet use, social resources, and psychological well being. Almost everyone's use of the Internet involves communication, and communication is closely associated with people's social resources and psychological well-being. Those whose everyday life involves more communication have more social resources—larger social networks, close relationships, community ties, enacted and perceived social support, and extraverted individual orientation, and they are likely to have better psychological functioning, lower levels of stress, and greater happiness (e.g., Baumeister & Leary 1995; Cohen & Wills 1985).

By contrast, those who communicate little and have fewer social resources—social isolation, living alone, the absence of a close relationship, the breakdown or loss of a close relationship, low levels of real and perceived social support, and introversion—are more likely to have poor psychological functioning, to feel lonely, and to experience higher levels of depression (e.g., Bruce & Hoff 1994; Scheff 2001). For example, loneliness is inversely correlated with social support (Riggio et al. 1993) and positively correlated with depression (Anderson & Arnoult 1985). Having poor personal relationships (Burns et al. 1994; Finch & Graziano 2001; Segrin 1998), low social support (Finch & Graziano 2001), and poor social integration (Barnett & Gotlib 1988) are associated with depressed affect. Introversion also predicts depression (Barnett & Gotlib 1988; Finch & Graziano 2001; Myers & Diener 1995). These effects can be self-reinforcing. Some people who are lonely and depressed may reduce

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their social resources further by increasing their time alone and their negative interactions with others (Hawkey et al. 2003; Joiner & Metalsky 2001) or by finding partners who are themselves symptomatic (Daley & Hammen 2002).

Scholars have offered three major alternative arguments that suggest how Internet use will affect people's psychological well being. The *social augmentation hypothesis* is that social communication on the Internet augments people's total social resources by providing an added avenue for everyday social interaction and a larger social network (Boase et al. 2006; Cole et al. 2000; D'Amico 1998; Hoffman et al. 2004; Isaacs et al. 2002; Katz & Aspden 1997; Kraut et al. 2002; Lenhart et al. 2001; Katz & Rice 2002; Quan-Haase et al. 2005; Wellman 2001). The implication of this argument is that those who use the Internet for communication will gain most value from it, psychologically. Most of the results of previous studies may 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 (Shklovski et al. 2003).

The *social displacement hypothesis* offers a bleaker assessment—that social communication on the Internet displaces valuable everyday social interaction with family and friends, with negative implications for users' psychological well being (Kraut et al. 1998; Gershuny 2000; Mesch 2001; Nie & Hillygus 2001; Shklovski et al. 2004; Sanders et al. 2000). Consistent with this idea, there also is some evidence 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 (Cornwell &

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Lundgren 2001; Cummings et al. 2002; Moody 2001; Parks & Roberts 1998; Weiser 2001; Wolak et al. 2003).

Mixed results from studies examining people's total 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 (e.g., Bargh & McKenna 2004; Caplan 2003; Kraut et al. 2002; Shaw & Gant 2002). The Internet, today, serves a wide range of purposes. People can turn to the Internet for information, communication, entertainment, or commerce. Online activities that are more utilitarian and better integrated with people's school-, work-, or home-life, and that support relationships with family and friends may augment or stabilize people's social resources rather than displace them. For example, email among family and friends could encourage more socializing with them offline (e.g., making plans for family reunion), increase exchanges of concrete social support (e.g., asking grandma to babysit; obtaining homework assignments from a friend), and increase competence and self esteem (e.g., making Web pages for work colleagues). These online activities could increase closeness and the sense of belonging to strong ties (Baumeister & Leary 1985).

Some researchers have argued that whether using the Internet for different purposes has augmentation or displacement effects may depend on a person's initial social resources. Kraut et al. (2002) observed 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. La Rose, et al. (2001) found that those with high self-efficacy and those who did not expect

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to encounter stressful events on the Internet were less likely to suffer ill effects of being online (see also Wastlund et al. 2001).

McKenna & Bargh (1998, 2000) developed a *social compensation hypothesis*—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 themselves 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 on the Internet do not have consistent effects on well being. We propose that different uses of the Internet may have quite different effects depending on people's social resources and how they use the Internet. Previous researchers have not compared all uses of the Internet nor controlled for initial levels of social resources and well being. To investigate these possibilities, we conducted a longitudinal study using state and trait measures of respondents' initial social resources and disaggregated measures of their use of the Internet to test alternative hypotheses about the effects on well being of using the Internet use for different purposes. The longitudinal design allowed us to test augmentation, displacement, and compensation hypotheses. Our measure

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of well being in this study was depression, a measure predictive of life outcomes and one employed in nearly all studies of Internet use and well being.

Method

Respondents

A national sample of U. S. households was contacted using random digit dialing in 2000. Those answering were asked to list members of the household, and, if they did so, they 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, seventy-four 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 \$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 got 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% from the initial random digit dialing, and a sample at time 1 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% completed the second survey; 72.3% had Internet access.

Data collection was completed via two modes – a paper and pencil questionnaire for those respondents without access to the Internet or who preferred paper, and an online web survey for those respondents with access to the Internet. Respondent ages ranged from 13 to 101, with 85% being adults (19 years or older). The median age was 44 years (50.9 years

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among who completed the paper and pencil survey versus 40 years among those who completed the online survey). Forty-three percent were men (40% paper; 45% online). Eighty-nine percent were Caucasian (91% paper; 87% online) and 61% were married (57% paper; 63% online). Their median household income was US\$30,000 – 50,000). Thirty percent had a household income of US\$30,000 or less; 44% had a household income between US\$30,000-\$70,000; and 26% had a household income of US\$70,000 or more. The mean income for the paper survey respondents was between US\$20,000 and US\$30,000 and the mean income for the online survey respondents was between US\$40,000 and US\$50,000. Compared to US Census data from 2000, the sample in this research was older (median age in the population was 35.3 years), and contained fewer men (49.1% in the populations as a whole), more Caucasians (75.1% in the populations as a whole), and fewer poor respondents (median household income in the U.S. population was US\$41,900). In addition, the Internet users in this sample were younger and wealthier than non-users, mirroring national trends.

Procedure

The survey was conducted between June 2000 and March 2002. Respondents completed the questionnaire at Time 1, starting in June 2001 and again six to eight months later at Time 2, via mail or on the Internet. Sixty percent of the respondents completed the surveys online.

Control variables

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

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Depression

Depression was measured twice using a 12-item version of the CES-D (Radloff 1991). This scale is responsive measure used to measure depression and dysphoria in the general population and is used 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 measures, with 1 indicating no days with these symptoms and a 4 indicating experiencing the symptoms between 5 to 7 days in the preceding week.

Although the CES-D can be a reliable indicator of clinical depression, the mean of 1.7 (std=.5) in this sample, indicating that respondents experienced a typical symptom fewer than twice a week, suggests that in this sample the CES-D represents dysphoria or depressive affect, not clinical depression. This measure is highly reliable (Cronbach’s alpha = .89).

Social Resources

We used three measures of respondents’ initial social resources, each corresponding to a different type of social resource. Social network size was used to measure the levels of *actual* social resources, perceived social support was used to measure the levels of *perceived* 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

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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 .88.

Social network size. Respondents were asked a series of four questions to determine the size of their social network. These questions asked respondents to indicate the number of friends and number of relatives within an hour’s drive and more than an hour’s drive away. These four items were summed to estimate social network size, which indicates one measure of the social resources available to the respondent.

Extraversion. We measured individual differences in extraversion (Costa & McCrae 1980) using 8 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 .83.

These 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. People with high social support are not necessarily more extraverted than those with low social support. Introverted people may still feel connected to their local communities.

Internet Uses

A major independent variable for this research was the extent to which respondents used the Internet for different purposes. All measures of this variable were based on respondents’ estimates of the frequency with which they used a computer or the Internet at

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home for 27 different purposes in the previous six months, such as “communicating with friends,” “getting the news online,” or “playing games.” Respondents responded using 7-point, logarithmic-like Likert-scales, with response components ranging from “several times a day,” “about once a day,” “3-5 days per week,” “1-2 days per week,” “every few weeks,” and “less often” to “never.” We computed an index of overall Internet use taking the mean of these 27 items.

In preliminary work, exploratory factor analysis of a similar list of 28 online activities collected in a sample of 446 respondents suggested 5 components of Internet use:

communication with friends and family, communication to meet people, information uses, commerce, and entertainment. The national survey for this article used a modified set of items: We added eleven 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 5 components of Internet use and suggested a 6th health-related category involving Web searches for health information and talking in health related support groups.

We conducted confirmatory factor analysis to test whether a multiple-factor model better explained the data than a single-factor one (Shklovski et al. 2003). 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 to 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

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data (Bentler-Bonett Normed Fit Index=.79; CFI = .81). By contrast, a six-factor model was a significantly better fit to the data (Bentler-Bonett Normed Fit Index=.88; Comparative Fit Index (CFI) = .90). 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 = .95).

Communicating to meet people. Items were “meeting new people for social purposes,” “participating in an online group” (Cronbach’s alpha = .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 = .95).

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

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because items referred to both information retrieval and communication in online groups.

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 usage of the Internet for the purpose of meeting new people was highly skewed, so we used the log of this variable in analyses.

Insert Table 1 about here

Data analysis strategy

Our primary research question is about how using the Internet changed respondents' levels of depression. To examine change in depression, we used ordinary least squared regression analysis with a lagged dependent variable, as recommended by Cohen & Cohen (1988, pp 413-427). This analysis predicts respondents' level of depression at Time 2 from control variables including their initial level of depression, measures of internet use and measures of social resources, all measured at Time 1. Because the initial level of depression is included in the analysis, the dependent variable in these analyses is 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 mean and the cross-sectional association of Internet use and social resources variables at the first time periods.

In this research we were interested in the effect of components of Internet use on depression at time two to test the augmentation and displacement hypotheses. The

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augmentation hypothesis would lead us to expect a negative relationship between using the Internet to communicate with family and friends with depression at time two, 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 two. 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 in Table 1, communicating with family and friends and getting information were respondents' dominant uses of the Internet. Over 80% of Internet users used the Internet for these purposes at least every few weeks. Over 60% used the Internet for entertainment and escape at least every few weeks, and a minority, just 20%, 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).

Insert Tables 1 and 2 about here

The analyses in Table 2 show that demographic differences in gender, age, and income predicted each use of the Internet, controlling for other uses. Men were more likely to

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use the Internet to find information and for entertainment/escape 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 and for entertainment/escape and to meet 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 demographic are consistent with cross-sectional findings in other national surveys (Pew, 2004).

We also found that better social resources (perceived social support, social network size, extraversion) predicted using the Internet to communicate with family and friends. By contrast, poor social resources of different types predicted 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 solice and new people on the Internet.

We then conducted a cross-sectional regression analysis, using only variables from time 1, to establish baseline levels of depression at time 1 for our participants. Table 3 shows these results. 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.) These results indicate that those using the Internet to communicate with friends and

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family started out in our sample with less depression than those who did not, whereas those who use the Internet for entertainment/escape started out in our sample with more depression.

Insert Table 3 about here

Predicting Changes in Depression

We next examined how people's initial levels of social resources affected changes in depression. Table 4 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 if use of the Internet has different effects for people differing in initial in social resources, we included interactions with perceived social support in the last model in Table 4. Depression at time 1 is used as a control, so the model is predicting changes in depression.

Insert Table 4 about here

The first model in Table 4 utilizes the index of overall Internet use 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 use predicts changes in depression, or whether particular components of Internet use predict these changes. As shown in Table 4, 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 more than older people. Because these results are consistent with the prior literature (e.g., on

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gender, see Mirowsky & Ross 1995; on income, see Conger et al. 1999; on age, see Mirowsky & Ross 1992) and because they recur in each of the other models, we will not discuss these results further.

The main effect of overall Internet use has a marginally significant ($p = .06$) positive relationship with depression. That is, compared to 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 larger increases in depression from time 1 to time 2. This model accounts for 35% of the variance.

Effects of Components of Internet Use

Our second step in the analysis, reflected in Model 2 in Table 4, was to decompose Internet use into its four components: communication with friends and family, communication to meet people, retrieve/use information, and entertainment/escape. This model explains 36% of the variance, an additional 1% over the previous model. An examination of model 2 shows, first, that using the Internet for information or entertainment/escape was not associated with changes in depression, suggesting that these uses of the Internet have few social psychological consequences.

We had expected that use of the Internet for communication with friends and family would be associated with declines in depression (augmentation hypothesis), and we found support for this idea. 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.

Insert Figure 1 about here

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The association of using the Internet for meeting new people online, however, shows the opposite effect: people who did so show significantly more depression at time 2. This finding supports the displacement hypothesis, that seeking to meet new people online may displace communication with strong ties in one's life. On average, those who used the Internet to meet new people got worse, as shown in Figure 1.

Insert Figure 1 about here

Moderating effects of initial social resources. From the social compensation hypothesis, we predicted that individuals' levels of social resources would moderate the effects of social Internet uses on depression. To test this hypothesis, we added the main effect of perceived social support and interactions of perceived social support with the Internet use variables from model 2. Model 3 in Table 4 shows this analysis. The addition of the interactions improved the fit of the models slightly, explaining between 37 and 38% 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 with some declines in depression for those with the lowest levels of perceived social support (see Figure 2). This finding is consistent with both the displacement hypothesis and with the social compensation hypothesis. First, people with high levels of

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social support show marked increases in their depression scores if they use the Internet to meet people, suggesting that they are neglecting relationships in their lives to seek out new ones (that is, displacement). 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 are the only group to show improvements in their depression scores. Because just 20% of the sample reported using the Internet to meet people, less than 3% of the sample with very low social support experienced improved depression scores consequent to this use of the Internet.

Insert Figure 2 about here

We conducted similar analyses using our two other measures of social resources. Table 5 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. These effects were the same when we modeled regression to the mean (Singer 1998), and no such effects were found for other uses of the Internet.

Insert Table 5 about here

Discussion

The Internet offers connections to others and convenient, sometimes unique information and entertainment or escape. We argued that the social effects of using this technology depend on people's their ways of using the Internet and, to some extent, on their existing social resources. Our longitudinal analyses of respondents' changes in depression support this general argument. Respondents' overall use of the Internet predicted only small changes in their well-being. Non-social uses of the Internet for entertainment/escape and acquiring information had no discernable 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 social purposes 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. Doing so predicted increases in depression among those with higher levels of social support but not among those with low support. Only about 2.5% of the sample used the Internet to meet people and also had very low levels of social resources, and some of these people experienced reduced depression. The pattern was much stronger for the those with higher support, who reported markedly higher depression when they used the Internet to meet people (Figure 3).

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

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communicate with friends and family online to experience reduced depression and we found support for this hypothesis. The displacement hypothesis led us to expect that Internet users who use the Internet to meet people would be distracted from maintaining their everyday close relationships with friends and family or perhaps would substitute Internet socializing for more valuable offline activities with friends and family. The results show that on average, and especially for those with high levels of social resources, use of the Internet to meet people increased depression.

The social compensation hypothesis (McKenna & Bargh 1998) led us to expect that people who used the Internet to meet people online who also had poor offline social resources would benefit from this use. Our results did not show much support for 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 strong evidence of declines in their levels of depression when they used the Internet to meet people.

The displacement and social compensation results merit further investigation. One might ask what “meeting new people” online and “talking in online groups” really meant in our sample. Were these respondents (who tended to be young, extraverted, less wealthy, and with smaller social networks of friends and relatives) looking for romance outside their committed relationships? Were they looking for people with whom to share stigmatized common interests, as McKenna and Bargh have argued? Our questions might have tapped socially undesirable forms of meeting strangers online. We suspect our respondents did not define “meeting new people” as ordinary chatting online, or social networking. To sort among the

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alternative explanations for our data will require more examination of the processes that ensue when people use the Internet for different purposes.

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 2003a). 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 to 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

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change in an outcome. As a result, it is primarily variables that change with time that remain as threats to inferring causation.

Conclusion

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 is an important step in the research in this area, and could help explain the widely disparate results in previous research.

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 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 baserates.

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

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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.

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Table 1. Means/percentages and correlations among variables used in this study (N = 1045).

No	Variable	Mean	sd	1	2	3	4	5	6	7	8	9	10	11	12	1
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	
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	

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 7-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 8 5-point scale items from the Big Five extraversion scale

Internet use

Table 2. Predicting different uses of the Internet from respondent demographics and social resources.

Variable	Internet: Information				Internet: Entertainment/escape				Internet: Family & friends				Internet: Meet people			
	Beta	SE	t	p	Beta	SE	t	p	Beta	SE	t	p	Beta	SE	t	p
Intercept	0.77	0.1	7.99	***	0.22	0.11	2.03	*	0.68	0.11	6.01	***	0.68	0.07	9.14	***
Male	0.37	0.05	7.6	***	0.11	0.05	1.99	*	-0.38	0.06	-6.81	***	0.07	0.04	1.88	
Age	-0.01	0	-4.89	***	-0.01	0	-8.14	***	0	0	1.46		0	0	-3.03	
White	-0.12	0.08	-1.59		0.02	0.09	0.28		0.17	0.09	1.91	*	-0.08	0.06	-1.27	
Married	0.06	0.05	1.03		-0.03	0.06	-0.55		-0.28	0.06	-4.55	***	-0.08	0.04	-1.83	
Income	0.07	0.01	6.05	***	-0.04	0.01	-2.83	**	0.09	0.01	6.86	***	-0.03	0.01	-3.21	
Perceived social support	0.03	0.04	0.7		-0.24	0.04	-6.06	***	0.2	0.04	4.64	***	-0.05	0.03	-1.57	
Social network size	0	0	-2.48	**	0	0	1.17		0.01	0	4.5	***	0	0	-2.51	
Extraversion	-0.03	0.03	-1.04		0	0.04	0.09		0.08	0.04	2.17	*	0.05	0.03	1.97	
Internet: Information					0.38	0.02	15.2	***	0.49	0.03	19.14	***	-0.02	0.02	-1.17	
Internet: Entertainment/escape	0.32	0.02	15.2	***					0.29	0.02	11.67	***	0.18	0.02	10.5	***
Internet: Family & friends	0.36	0.02	19.14	***	0.25	0.02	11.67	***					0.13	0.02	8.18	***
Internet: Meet people	-0.04	0.03	-1.17		0.35	0.03	10.5	***	0.29	0.04	8.18	***				

Internet use

Table 3. Regression models showing demographics and components of Internet use at time 1 regressed on depression at time 1.

Variable	Beta	SE	t	p
Intercept	1.9	0.08	24.9	***
Male	-0.04	0.02	-2.18	*
Age	0	0	-2.6	**
White	0.05	0.03	1.94	**
Married	-0.06	0.04	-1.31	
Income	-0.02	0.02	-3.82	***
Internet: Information	-0.01	0.02	-0.42	
Internet: Entertainment/escape	0.09	0.06	6.14	***
Internet: Friends & family	0.06	0.01	-3.8	***
Internet: Meet people	-0.06	0.05	1.36	

Internet use

Table 4. 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 resource X Internet: Friends & family									0.01	0.02	0.48	
Social resource X Internet: Information									-0.04	0.03	-1.54	
Social resource X Internet: Meet people									0.17	0.08	2.16	*
Social resource X Internet: Entertainment/escape									-0.02	0.02	-0.76	

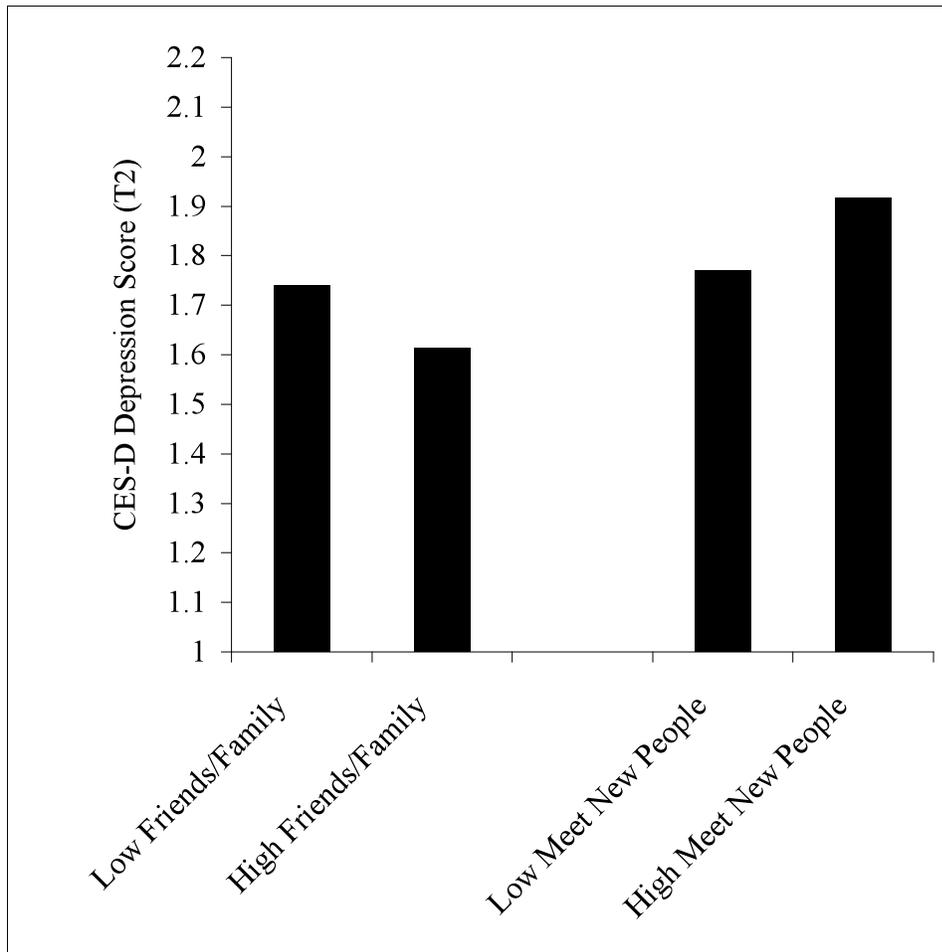
Internet use

Table 5. Linear models predicting depression (time 2) from social network size or extraversion, components of Internet use and their interactions.

Independent Variables	Adding social network size Interactions (model 1)			Adding extraversion interactions (model 2)		
	Beta	t	p	Beta	t	p
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 resource: 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	
Resource X Internet: Friends & family	0.00	-0.53		0.00	0.18	
Resource X Internet: Information	0.00	1.74	t	0.00	-0.21	
Resource X Internet: Meet people	0.01	2.98	**	0.22	3.33	***
Resource X Internet: Entertainment/escape	0.00	-2.25	*	-0.03	-1.42	

Internet use

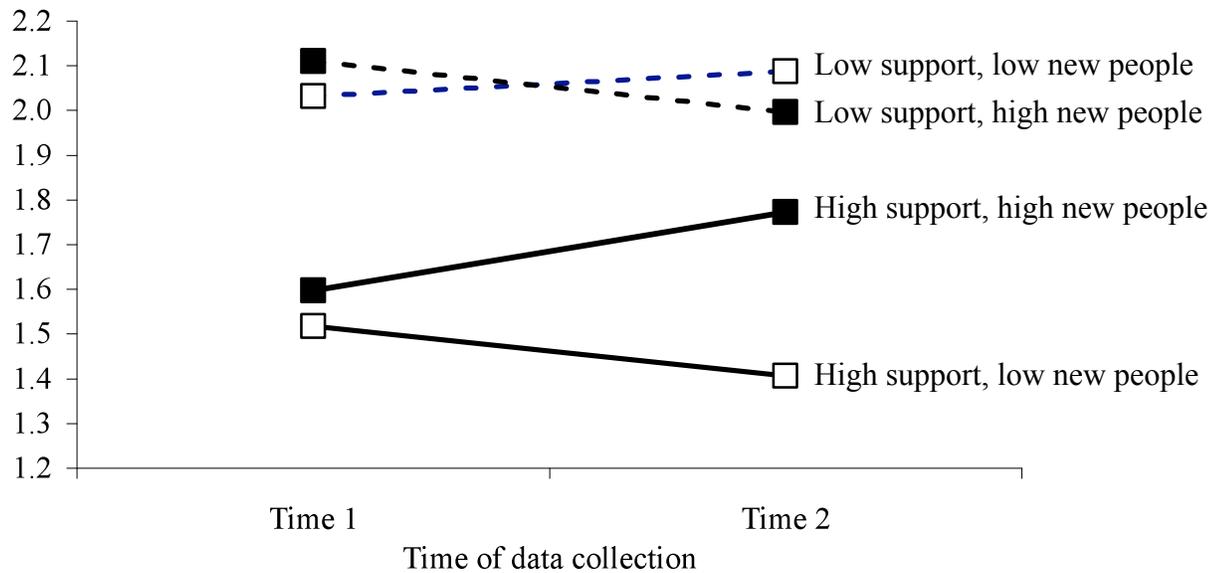
Figure 1. Depression at Time 2 predicted by use of the Internet to communicate with friends and family or to meet new people.



Note. Low Internet use scores reflect the 10th percentile of use at T1. High Internet use scores reflect the 90th percentile of use at T1.

Internet use

Figure 2. Changes in depression predicted by level of perceived social support and use of the Internet to meet people.



Note. The graph represents the expected changes in C-DES depression scores, based on the model described in Table 4. They represent changes for people with high levels of perceived social support (90th percentile) and low perceived social support (10th percentile at T1 for those who used the Internet for meeting new people heavily (90th percentile) or do not use the Internet to meet new people.