Psychological and Health Outcomes of Perceived Information Overload

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Abstract

The rapid growth and transmission of information in the digital age poses new challenges for individuals coping with the onslaught of communications from multiple sources. This research (a) conceptualizes and measures perceived information overload from cyber-based and place-based sources, (b) tests the reliability and validity of a newly developed Perceived Information Overload Scale, and (c) tests hypotheses concerning the psychological and health outcomes of information overload. A repeated-measures panel study design was used to test the proposed hypotheses. Confirmatory factor analyses provided support for the hypothesized two-factor model of perceived information overload, encompassing cyber-based and place-based sources of stimulation. Hierarchical regression analyses indicated that higher levels of perceived cyber-based overload significantly predicted self-reports of greater stress, poorer health, and less time devoted to contemplative activities, controlling for age, gender, ethnicity, and baseline measures of stress and health status. Participants' sensation-seeking levels were found to significantly moderate the relationships between cyber-based, place-based, and composite perceived information overload and stress. Directions for further study are discussed.

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Electronic information and communication technologies have provided individuals and organizations unprecedented opportunities to broaden their social and professional networks, access large amounts of information, and ease the constraints of time and place. At the same time, however, these advanced technologies have imposed certain behavioral and psychological burdens on people. Burgeoning rates of data production, dissemination, and storage have prompted concerns about the effects of information overload on organizational productivity and effectiveness (Farhoomand & Druiy, 2002; Hwang & Lin, 1999; Kohn, Corrigan, & Donaldson, 2000; Speier, Valacich, & Vessey, 1999). Faced with an onslaught of communications from multiple sources (e.g., email, voice mail, online conferencing, telephones, fax, surface mail, and telex), managers in a cross-national survey reported that they were unable to maintain effective coping strategies to deal with the growing volume of information and communications. Two thirds of the managers associated information overload with tension and reduced job satisfaction. Also, 42% believed that it negatively affected their health, and 43% said it impaired their decision-making abilities (Waddington, 1997). Other studies suggest that the perception of information overload and its attendant strains have been exacerbated by rapid advances in digital communication technologies (Edmunds & Morris, 2000; Eppler & Mengis, 2004).

Despite the growing salience of information overload and scientific interest in its effects, the concept of overload remains largely undifferentiated taking on alternative meanings depending on the context (e.g., the piling up of paperwork, receipt of large numbers of email messages, frequent faxes, telephone calls, and continual exposure to multiple information sources). A unified construct or global measure of perceived information overload is yet to be developed and its impacts on stress and health remain to be assessed. This article is an initial effort to conceptualize and measure perceived information overload and understand its effects on stress and health.

The Internet and wireless communication technologies have introduced new forms of environmental experience and sources of overload. At the same time, the digital information explosion has prompted theoretical and methodological concerns about the behavioral, emotional, and health impacts of increasing levels of sensory overload (Information Overload Research Group [IORG], 2008; Jackson et al., 2008; Stokols, Misra, Runnerstrom, & Hipp, 2009;

Stokols & Montero, 2002). It is important to distinguish among different facets of stimulation overload for purposes of evaluating their respective cognitive, health, and societal impacts. In this article, we develop a global construct of perceived information overload, incorporating cyber-based and place-based sources of stimulation. Cyber-based sources of stimulation include information transactions that are mediated by electronic technologies (e.g., computers and cell phones), whereas place-based sources of stimulation refer to stimulants that originate primarily from place-based settings (e.g., work places and home environments) and are not mediated by electronic technologies.

Conceptualization of Perceived Information Overload

Information overload refers to the experience of feeling burdened by large amounts of information received at a rate too high to be processed efficiently or used effectively (Lipowski, 1975; Milgram, 1970; Miller, 1978, Sweller, 1988). Perceived information overload is a form of psychological stress that occurs when the environmental demands perceived by an individual exceeds his or her perceived capacity to cope with them (Evans & Cohen, 1987; Lazarus, 1966; Selye, 1973). Information overload occurs when individuals feel overwhelmed by multiple communication and information inputs from *cyber-based* and *place-based* sources of stimulation.

Cyber-Based Sources of Stimulation

Cyber-based sources of stimulation encompass *information and communication transactions that are mediated by technologies*, such as the Internet, cell phones, smart phones, laptops, computers, personal digital assistants, and iPods. Technologically mediated transactions include sending and receiving emails, digital attachments, instant messages, text messages, messages exchanged on personal web pages, processing spam messages, and other information from sources such as podcasts, news websites, and blogs. Additional technologically mediated demands result from the need to manage, organize, and store information; maintain electronic devices and install software updates; and synchronize one's email across multiple computers and hand-held devices.

Cyber-based information overload arises from the strain experienced when encountering large volumes of electronic messages, keeping track of multiple email accounts, and receiving too many cell phone calls, voice messages, and text messages. Indications of cyber-based information overload include forgetting to respond to important messages because they get lost in the large

volume of communications and feeling compelled to do several things simultaneously (multitask), and to respond to email communications quickly.

Place-Based Sources of Stimulation

Place-based sources of stimulation refer to *stimulants not mediated by electronic devices* that originate from sources such as social interactions in physical settings (e.g., work places, residences, and community settings), commuting and traffic congestion, noise, environmental pollution, and crowding. In some cases, cyber-based informational demands may intermingle with place-based demands. For example, professional and interpersonal relationships may be maintained through both electronic communications as well as face-to-face interactions. Similarly, news may be received through online broadcasts from news websites as well as traditional television broadcasts. In this research, we distinguish between primarily cyber-based and place-based sources of perceived information overload, and other sources of overload that reflect a combination of both cyber- and place-based stimulants.

Place-based information overload may arise from the strains experienced when dealing with workplace and residential demands that exceed one's capacities to cope and having too little time for relaxation. Some indicators of place-based information overload include becoming less sensitive to the needs of others, feeling hassled by one's commute to work, and feeling fatigued from exposure to noisy work and home environments.

One purpose of this research was to evaluate the hypothesized two-factor structure of the perceived information overload construct. Another goal was to test several hypotheses about the relationships between cyber-based, place-based, and composite information overload (which combines both cyber- and place-based sources of stimulation), on one hand, and self-reports of stress, health, and contemplative activities, on the other hand.

A repeated-measures panel design study was conducted to examine the effects of perceived cyber-based, place-based, and composite information overload on individuals' reported stress levels, health status, and contemplative activity levels. The following hypotheses were evaluated in this study:

Hypothesis 1a (H1a): Higher levels of cyber-based overload at Time 1 will be associated with greater perceived stress at Time 2, controlling for the effects of age, sex, ethnicity, baseline measures of perceived stress, and stressful life events obtained at Time 1.

Hypothesis 1b (H1b): Higher levels of place-based overload at Time 1 will be associated with greater perceived stress at Time 2, controlling

for the effects of age, sex, ethnicity, baseline measures of perceived stress, and stressful life events obtained at Time 1.

Hypothesis 1c (H1c): Higher levels of composite perceived information overload (encompassing both cyber-based and place-based overload) at Time 1 will be associated with greater perceived stress at Time 2, controlling for the effects of age, sex, ethnicity, baseline measures of perceived stress, and stressful life events obtained at Time 1.

Hypothesis 2a (H2a): Higher levels of cyber-based overload at Time 1 will be associated with poorer health status at Time 2, controlling for the effects of age, sex, ethnicity, stressful life events at Time 1, and overall health status measured at Time 1.

Hypothesis 2b (H2b): Higher levels of place-based overload at Time 1 will be associated with poorer health status at Time 2, controlling for the effects of age, sex, ethnicity, stressful life events at Time 1, and overall health status measured at Time 1.

Hypothesis 2c (H2c): Higher levels of composite perceived information overload at Time 1 will be associated with poorer health status at Time 2, controlling for the effects of age, sex, ethnicity, stressful life events at Time 1, and overall health status measured at Time 1.

Hypothesis 3a (H3a): Higher levels of cyber-based overload at Time 1 will be associated with less time devoted to contemplative activities at Time 2, controlling for the effects of age, sex, ethnicity, and contemplative activities measured at Time 1.

Hypothesis 3b(H3b): Higher levels of place-based overload at Time 1 will be associated with less time devoted to contemplative activities at Time 2, controlling for the effects of age, sex, ethnicity, and contemplative activities measured at Time 1.

Hypothesis 3c (H3c): Higher levels of composite perceived information overload at Time 1 will be associated with less time devoted to contemplative activities at Time 2, controlling for the effects of age, sex, ethnicity, and contemplative activities measured at Time 1.

Furthermore, it is important to examine the effects of contextual moderators on the relationship between the intensity of place-based and cyber-based informational demands and their psychological, behavioral, physiological, and health outcomes. For example, certain personal dispositions may add to the strain of place-based and cyber-based information overload. People who are low stimulation seekers, less psychologically hardy, and/or more coronary disease prone personalities (Type A) might be differentially susceptible to higher degrees of stress and strain from information overload as compared

with high-stimulation seekers, more psychologically hardy and resilient, and/
or more easy going personality types (Type B). This study focuses on sensa-
tion seeking as a dispositional moderator of the relationship between per-
ceived overload and stress based on the findings reported by Smith, Johnson,
and Sarason (1978). They investigated the relationship between negative life
change and psychological distress and found that the detrimental effects of
negative life change were restricted to individuals reporting low levels of
sensation seeking. High sensation seekers were more tolerant of the stress
associated with negative life change. Accordingly, our fourth hypothesis (H4a)
predicted that individuals' sensation-seeking tendencies would moderate the
relationship between perceived cyber-based and self-reported stress. Specifically,
individuals with higher sensation-seeking levels were expected to report
lower levels of stress associated with perceived cyber-based and place-based
information overload as compared with those individuals characterized by
lower sensation-seeking levels. Similarly, it was hypothesized (H4b and
H4c) that individuals' sensation-seeking motive would moderate the rela-
tionship between and place-based information overload and composite per-
ceived information overload.

Method

Participants

A total of 484 undergraduate students (84% female and 16% male) from a
large public university in the United States participated in this study. Parti-
cipants were recruited from the university's social science research participa-
tion pool, comprised of undergraduate students who earn course credit for
participating in "no more than minimal risk" research. The mean age of the
sample was 19.98 years (SD = 2.34). Eighty-two percent of the participants
were Asian, and 16% were of other ethnicities, including White, Middle Eastern,
and African American.

Procedures

Participants who elected to sign up for the study were provided with a link
to an online questionnaire that assessed their perceived information overload
levels, perceived stress, health status, contemplative activities, and sensation-
seeking levels. Before participants could access the survey, they were provided
with an International Review Board–approved consent form that informed them
about the purposes of the study and requested their voluntary participation in

completing an online questionnaire. Six weeks later, the same participants were sent another link requesting them to complete a second online survey assessing their stress levels, contemplative activity levels, and overall health status. Each survey took about 20 to 25 min to complete. All participants received course credit for their participation in the study. There was no attrition of participants between Time Points 1 and 2.

Measures

At Time 1, participants were asked to complete Cohen, Kamarck, and Mermelstein's (1983) 14-item Perceived Stress Scale (α =. 83); three 5-point Likert-type scales adapted from Stokols, Shumaker, and Martinez (1983) assessing overall health (α =. 71; for example, "In general, how has your health been lately?" [1 = *very good* to 5 = *poor*]); and Zuckerman's (1979) 22-item Sensation-Seeking Scale (α = .73). In addition, participants completed a modified version of the Holmes-Rahe Life Stress Inventory (Holmes & Rahe, 1967) in which they were asked to report the occurrence of certain life events in the past year (e.g., death of a spouse or family member, separation or divorce, detention in jail, personal injury, or illness).

The Perceived Information Overload Scale (α = .86) consisted of two subscales (for the complete scale please refer to the online appendix at http://eab .sagepub.com). First, respondents completed nine items regarding their subjective experiences of overload from cyber-based sources in the last month (α = .85) on the 5-point Likert-type scales (where 0 = *never* and 4 = *very often*). For example, participants were asked how often they felt overwhelmed with the email messages, cell phone calls, and email attachments they receive; how often they had forgotten to respond to important messages; how often they felt pressured to respond to email messages quickly; and how often they spent too much time maintaining information and communication devices. Participants also were asked to report how often they felt that they had too many messages (e.g., wall postings, event notifications, personal messages, status updates, and applications) on their Facebook or MySpace pages to deal with. As well, participants were asked how often they felt that they received more instant messages than they could handle (where 0 = *never* and 4 = *very often*).

Respondents also completed another seven items (where 0 = *never* and 4 = *very often*) asking them about their experiences of overload from place-based sources in the last month (α = .74; for example, how often they felt hassled by their commute to work; that the demands of their work place exceeded their capacity to deal with them; were bothered by noisy work or home environments; or by work activities that left them too little time for recreational

activities). Respondents' scores on the nine cyber-based items were summed to yield a total perceived cyber-based information overload score, and the seven place-based items were summed to yield a total perceived place-based information overload score. Respondents' scores on the 16-items were summed to yield an overall composite index of perceived information overload stemming from both place-based and cyber-based sources.

At Time 2, six weeks later, participants were asked to complete the 16-item Perceived Information Overload Scale ($\alpha = .86$), the Perceived Stress Scale ($\alpha = .85$), the Overall Health Scale ($\alpha = .71$) as well as an Overall Health Situation Scale ($\alpha = .71$) incorporating a subset of Marx, Garrity, and Bower's (1975) health situation items. Participants were asked, for example, on how many occasions in the past 3 months they were ill or injured with different health problems ($0 = none$ to $15 = 15\ or\ more$). In addition, they completed a symptoms checklist (seven items; $\alpha = .77$) that included a composite of Langner's (1962) Langner-22 Psychiatric Symptoms Scale and modified version of Psychiatric Epidemiology Research Interview Demoralization Index (Dohrenwend, 1978) used by Dooley and Catalano (1981). These items assessed the frequency (over the preceding 3 months) of several physical and emotional conditions ($1 = I\ did\ not\ have\ this\ condition$, $2 = I\ had\ this\ condition\ sometimes$, and $3 = I\ had\ this\ condition\ often$), such as headaches, acid or sour stomach, feeling blue or depressed, and trouble getting sleep or staying asleep. Cronbach's alpha values (Cronbach, 1951) for all the scales used in this study at Time Points 1 and 2 were above the required .70 value. The alphas of the cyber-based and place-based overload subscales at Time 2 were .88 and .79, respectively.

Data Analyses

After creating the summated scale for perceived information overload encompassing the scales for cyber-based and place-based sources of overload, we conducted an item analysis to assess item-to-total and inter-item correlations among the Perceived Information Overload Scale items. These tests also were conducted for the cyber-based overload and place-based overload scale items. None of the item-to-total correlations were less than .5 and none of the interitem correlations were less than .3, the thresholds for deletion (Hair, Black, Babin, Anderson, & Tatham, 2006). The hypothesized factor structure of the perceived information overload construct was tested through confirmatory factor analyses.[1] Finally, a series of hierarchical regression analyses (incorporating key covariates at Steps 1 and 2) were conducted to test the hypothesized relationships among predictor, moderator, and dependent measures.

Results

Confirmatory Factor Analyses

Confirmatory factor analysis was conducted using the maximum likelihood method with Amos 6.0 (Arbuckle, 2005). Strongest support was found for the hypothesized two-factor correlated model of perceived information over-load with two dimensions—cyber-based (F1) and place-based (F2) sources of overload. Several goodness-of-fit statistics were applied to this two-factor correlated model (Figure 1). Figure 1 also shows the unstandardized factor loadings for each variable and covariance between the two factors in the model. The standardized factor loadings for the two-factor model were found to be large, and the critical ratio of the regression weights was statistically significant at $p < .001$ for all items, suggesting convergent validity. The covariance between F1 (cyber-based information overload) and F2 (place-based information overload) was .28 and the correlation was .47, small to moderate values that suggest adequate discriminant validity.

The cyber-based overload (Time 1) and Perceived Stress Scales (Time 1) were found to be significantly correlated ($r = .32$, $p < .01$). The .32 intercorrelation between these scales suggests that the constructs they represent are not sufficiently overlapping to preclude their use in the analyses reported below as separate and distinct variables. Similarly, the place-based overload (Time 1) and Perceived Stress Scales (Time 1) were significantly correlated ($r = .45$, $p < .01$) but did not overlap sufficiently to preclude their use as separate constructs. Similarly, the Composite Perceived Information Overload Scale (Time 1) and the Perceived Stress Scale (Time 1) were significantly correlated ($r = .44$, $p < .01$). However, the Composite Perceived Information Overload Scale and Perceived Stress Scale were sufficiently non-overlapping to suggest that each measured a different construct and that the Composite Perceived Information Overload Scale contributed incremental validity in these analyses. On the whole, these analyses indicate that the cyber-based and place-based overload scales measure different constructs than perceived stress.

Hierarchical Regression Analyses[2]

The first set of hypotheses (H1a, H1b, and H1c) examined the effects of cyber-based, placed-based, and composite information overload at Time 1 on perceived stress levels at Time 2, controlling for the effects of age, sex, ethnicity, baseline measures of perceived stress, and stressful life events obtained at Time 1. Age, gender (coded as 1 = *male*; 0 = *female*), and ethnicity (coded as 0 = *Asian*; 1 = *all other ethnicities*) were entered as covariates at Step 1.
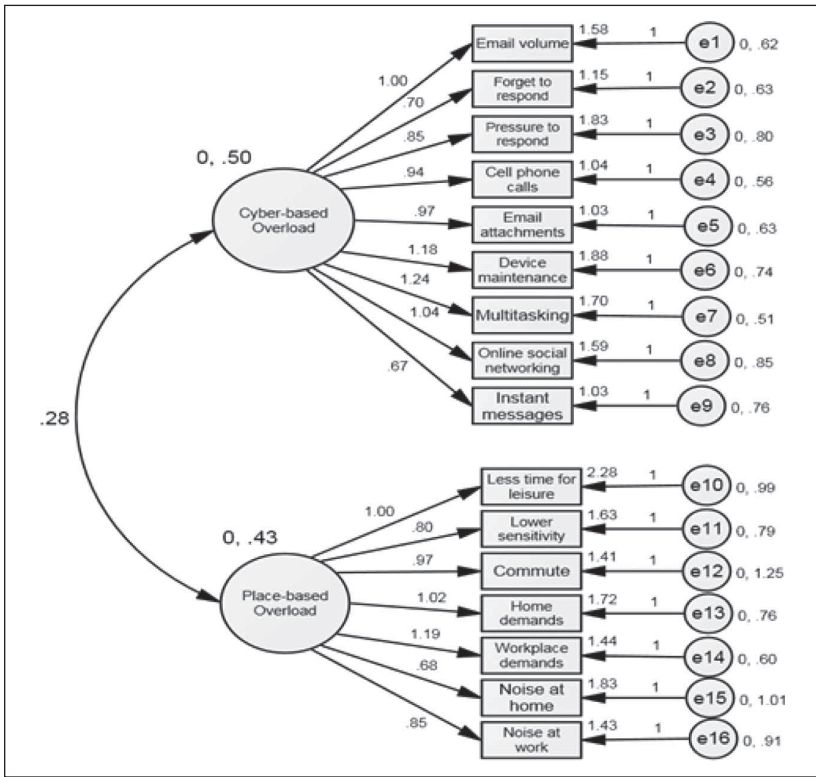
Figure 1. Two-factor, correlated model of perceived information overload, including cyber-based information overload at Time 1 and place-based information overload at Time 1

Note: The ratio of the minimum discrepancy and degrees of freedom (χ^2 / df) was 3.98, $p < .001$ (where $\chi^2 = 409.78$ and $df = 103$). Marsh and Hocevar (1985) recommend values between 2 and 5 as criteria of reasonable fit between the hypothesized model and the sample data. The Incremental Fit Index (Bollen, 1989) was .87, the Normed Fit Index (Bentler & Bonnet, 1980) was .83, the Comparative Fit Index (Bentler, 1990) was .87, and the Tucker–Lewis Index (Bentler & Bonnet, 1980) was .82, all indicating a good to excellent fit between the hypothesized model and sample data (with all values being reasonably close to 1). The root mean square error approximation of the model was .08, indicating a reasonable error of approximation (Brown & Cudeck, 1993). The model was found to be parsimonious as well with a Parsimony Normed Fit Index of .63 (James, Mulaik, & Brett, 1982).

Perceived stress levels at Time 1 and a dummy coded stressful life events score (coded as 1 = *300 points or more*; 0 = *below 300 points*) were entered at Step 2. These covariates were entered to control for individual differences

Table 1. Regression of Perceived Stress at Time 2 on Cyber-Based Overload at Time 1 and Covariates (*N* = 484)

	Model 1		Model 2		Model 3	
	β	Std. β	β	Std. β	β	Std. β
Age	−0.279	−.093	−.203	−.067	−.201	−.067
Gender	−3.153**	−.165	−.950	−.050	−.874	−.046
Ethnicity	−2.045*	−.110	−.597	−.032	−.674	−.036
Stressful life events			.213	.012	−.029	−.002
Perceived stress (Time 1)			.656**	.663	.629**	.636
Cyber-based overload (Time 1)					.097*	.088
R^2	0.049**		.471**		.478*	
R^2 change			.422		.007	

*$p \leq .05$. **$p \leq .01$ (two-tailed).

on the dimensions of stressful life events and perceived stress at Time 1. Perceived cyber-based overload at Time 1, perceived place-based information overload at Time 1, or composite perceived information overload at Time 1 was entered at Step 3, depending on the specific hypothesis being tested. These Time 1 measures of perceived overload served as the principal predictor variables in the analyses. The reported effects of perceived information overload at Time 1 on the dependent variable and perceived stress levels at Time 2 were found to be significant after controlling for the Time 1 covariate measures.

Hierarchical regressions showed that higher levels of cyber-based information overload at Time 1 predicted higher levels of perceived stress at Time 2, $\beta = .10$, $t(406) = 2.28$, $p < .05$. Table 1 presents the unstandardized regression coefficients for each model. However, higher levels of place-based information overload at Time 1 were not found to significantly predict perceived stress levels at Time 2. Similarly, composite information overload from both cyber-based and place-based sources was not found to significantly predict self-reported stress levels at Time 2.

The second set of hypotheses (H2a, H2b, and H2c) tested the effects of cyber-based, place-based, and composite information overload measured at Time 1 on health status at Time 2, controlling for the effects of age, sex,

Table 2. Regression of Overall Health Status at Time 2 on Cyber-Based Overload at Time 1 and Covariates (*N* = 484)

	Model 1		Model 2		Model 3	
	β	Std. β	β	Std. β	β	Std. β
Age	6.935 (e⁻⁵)	.000	.007	.007	.004	.005
Sex	0.647*	.106	.053	.009	.019	.003
Ethnicity	0.731**	.128	.502*	.088	.523**	.092
Stressful life events			−.189	−.035	−.097	−.018
Overall health status (Time 1)			.593**	.613	.580**	.600
Cyber-based overload (Time 1)					−.031*	−.092
R^2	0.049**		.471**		.478**	
R^2 change			.422		.007	

*$p \leq .05$. **$p \leq .01$ (two-tailed).

ethnicity, stressful life events at Time 1 and overall health status measured at Time 1. Age, gender, and ethnicity were entered as covariates at Step 1. Participants' overall health and stressful life events scores at Time 1 were entered at Step 2. Finally, perceived cyber-based overload at Time 1, perceived place-based information overload at Time 1, or composite perceived information overload at Time 1 was entered at Step 3, depending on the particular hypothesis being tested. The reported findings are significant above and beyond the effects of the covariates on the dependent variable, overall health status at Time 2.

Higher levels of cyber-based overload at Time 1 predicted poorer overall health status at Time 2, β = −.03, *t*(445) = −2.43, *p* < .05. Similarly, participants experiencing higher levels of cyber-based overload at Time 1 reported more severe health problems measured by the frequency of health problems, injuries, and visits to the doctor or hospital, β = .20, *t*(440) = 3.64, *p* < .01. Higher levels of cyber-based information overload at Time 1 also predicted more severe health-related symptoms, such as feeling blue, feeling like crying, sleep problems, headaches, loss of appetite, and stomach problems, β = .09, *t*(431) = 4.41, *p* < .01. See Tables 2, Table 3, and Table 4 for summaries of these analyses.

Whereas hierarchical regressions indicated that place-based information overload at Time 1 did not significantly predict overall health status at Time 2, it was found that higher levels of place-based information overload predicted

Table 3. Regression of Frequency of Health Problems at Time 2 on Cyber-Based Overload at Time 1 and Covariates ($N = 484$)

	Model 1		Model 2		Model 3	
	β	Std. β	β	Std. β	β	Std. β
Age	0.074	.023	0.098	.031	0.113	.035
Sex	−1.728	−.082	−0.785	−.037	−0.547	−.026
Ethnicity	2.369*	.120	2.524**	.128	2.379**	.120
Stressful life events			2.883**	.154	2.314**	.123
Overall health status (Time 1)			−0.751**	−.224	−0.671**	−.200
Cyber-based overload (Time 1)					0.198**	.168
R^2	0.022*		0.102**		0.128**	
R^2 change			0.08		0.026	

*$p \le .05$. **$p \le .01$ (two-tailed).

Table 4. Regression of Severity of Health-Related Emotional and Physical Symptoms at Time 2 on Cyber-Based Overload at Time 1 and Covariates ($N = 484$)

	Model 1		Model 2		Model 3	
	β	Std. β	β	Std. β	β	Std. β
Age	−0.045	−.035	−0.041	−.033	−0.035	−.028
Sex	−2.008**	−.245	−1.388**	−.170	−1.293**	−.158
Ethnicity	−.214	−.027	−0.096	−.012	−0.162	−.021
Stressful life events			1.114**	.153	0.854**	.117
Overall health status (Time 1)			−0.534**	−.409	−0.497**	−.381
Cyber-based overload (Time 1)					0.086**	.186
R^2	0.062**		0.261**		0.293**	
R^2 change			0.199		0.032	

*$p \le .05$. **$p \le .01$ (two-tailed).

more severe health symptoms at Time 2, $\beta = .08$, $t(424) = 3.11$, $p < .01$. Higher levels of place-based information overload also predicted marginally significantly more health problems at Time 2, $\beta = .14$, $t(431) = 1.87$, $p < .07$.

Table 5. Regression of Contemplative Activity Levels at Time 2 on Cyber-Based Overload at Time 1 and Covariates (N = 484)

	Model 1		Model 2		Model 3	
	β	Std. β	β	Std. β	β	Std. β
Age	−.015	−.041	−.015	−.041	−.017	−.046
Sex	.051	.021	.023	.009	.000	.000
Ethnicity	.064	.028	.040	.018	.049	.022
Contemplation level (Time 1)			.324**	.352	.307**	.333
Cyber-based overload (Time 1)					−.015**	−.112
R^2	.003		.126**		.138*	
R^2 change			.123		.012	

*$p \leq .05$. **$p \leq .01$ (two-tailed).

Furthermore, higher composite perceived information overload at Time 1 was found to significantly predict more severe health symptoms, $\beta = .06$, $t(412) = 4.62$, $p < .01$, and a higher frequency of health problems, $\beta = .13$, $t(419) = 3.47$, $p < .01$, at Time 2.

The third set of hypotheses examined the relationships between cyber-based, place-based, and composite perceived information overload at Time 1 and time available for contemplation at Time 2. Hierarchical regression analyses showed that individuals reporting higher levels of cyber-based information overload at Time 1 reported significantly less time devoted to contemplative activities at Time 2, above and beyond the effects of age, sex, ethnicity, and the time they had available for contemplation at Time 1, $\beta = -.02$, $t(445) = -2.45$, $p < .05$ (see Table 5). Similarly, higher levels of place-based information overload at Time 1 marginally significantly predicted less time devoted to contemplative activities at Time 2, $\beta = -.02$, $t(437) = -1.82$, $p < .07$. Also, individuals experiencing higher levels of composite information overload from cyber-based as well as place-based sources at Time 1 reported significantly less time devoted to contemplative activities at Time 2, after controlling for age, sex, ethnicity, and initial contemplation levels, $\beta = -.01$, $t(425) = -2.54$, $p < .05$.

The fourth set of hypotheses examined the moderating effect of sensation-seeking levels on the relationship between cyber-based, place-based, and

Table 6. Regression of Perceived Stress at Time 2 on Cyber-Based Overload at Time 1, Interaction Term, and Covariates (*N* = 484)

	Model 1		Model 2		Model 3	
	β	Std. β	β	Std. β	β	Std. β
Age	−0.280	−.090	−0.241	−.078	−0.258	−.083
Sex	−3.404**	−.177	−2.786**	−.145	−2.958**	−.154
Ethnicity	−1.910*	−.103	−1.983*	−.107	−1.821*	−.098
Sensation seeking level			−0.064	−.035	0.597**	.331
Cyber-based overload (Time 1)			0.322**	.293	0.761**	.692
Sensation seeking level × Cyber-based overload					−0.049**	−.617
R^2	0.051**		0.134**		0.168**	
R^2 change			0.083		0.034	

*$p \leq .05.$ **$p \leq .01$ (two-tailed).

composite information overload at Time 1 and perceived stress levels at Time 2. For these hypotheses, age, gender, and ethnicity were entered as covariates at Step 1. All the results reported are significant above and beyond the effects of age, sex, and ethnicity on the dependent variable, perceived stress at Time 2. Participants' sensation-seeking levels significantly moderated the relationship between cyber-based information overload at Time 1 and perceived stress at Time 2, β = −.05, *t*(418) = −4.15, *p* < .01. Participants reporting high sensation-seeking levels were significantly more likely to report lower levels of perceived stress at Time 2 associated with cyber-based information overload at Time 1, as compared with those reporting lower sensation-seeking levels (see Table 6).

Sensation-seeking levels also moderated the association between place-based information overload at Time 1 and perceived stress at Time 2, β = −.03, *t*(409) = −2.00, *p* < .05. Individuals reporting higher levels of sensation seeking were significantly more likely to report lower stress at Time 2 associated with place-based information overload at Time 1 as compared with those reporting lower sensation-seeking levels. Similarly, higher sensation-seeking levels significantly moderated the relationship between composite perceived

information overload at Time 1 and stress at Time 2, $\beta = -.03$, $t(400) = -3.30$, $p < .01$. Individuals reporting higher sensation-seeking levels were significantly more likely to report lower perceived stress associated with composite perceived information overload as compared with the low sensation seekers.

Discussion

We conceptualized perceived information overload in terms of cyber-based and place-based sources of stimulation and developed scales to measure the impacts of both sources of information overload. These constructs and scales were used to assess the effects of perceived information overload on individuals' stress, health, and contemplative activity levels. An important goal of the study was to determine whether perceived cyber-based, place-based, and composite information overload measured at an initial time point are predictive of higher stress levels and poorer health status reported several weeks later. It also aimed to establish the incremental predictive validity of the cyber-based and place-based overload constructs. As a conservative and stringent test of the predictive validity of cyber-based, place-based, and composite information overload, baseline measures of individual stress levels and health status were used as covariates in the hierarchical regression analyses to examine the effects of cyber-based and place-based overload on stress and health above and beyond the effects of other life stressors.

This research also evaluated the hypothesized two-factor structure of perceived information overload. The results of the confirmatory factor analyses provided evidence for the convergent and discriminant validity of the proposed theoretical constructs. In addition, the study assessed the test–retest reliabilities of the cyber-based, place-based, and composite information overload scales. Statistical analyses indicated that the scales are reliable measures of the cyber-based, place-based, and composite perceived information overload constructs.

In examining the effects of cyber-based overload at Time 1 on individuals' reported stress levels and health status at Time 2, it was found that higher levels of cyber-based overload predicted higher levels of perceived stress, controlling for other stressful life events, baseline measures of perceived stress, age, gender, and ethnicity. Similarly, individuals experiencing higher levels of cyber-based overload report poorer health status in terms of the frequency and severity of health problems and their subjective feelings about their overall health, controlling for stressful life events and baseline measures of health status. These findings offer initial evidence for the distinct impacts of perceived cyber-based overload on stress and health and the incremental predictive

power of the cyber-based overload construct above and beyond the Time 1 covariates.

Neither place-based nor composite information overload was found to significantly predict higher levels of stress while controlling for stressful life events at Time 1. This finding does not necessarily preclude the influence of place-based and composite information overload on individual stress levels. Indeed, a hypothesis for future research is that cyber-based overload mediates the effect of place-based overload on stress. In many contexts, people encounter cyber-based sources of information overload through their activities in physical place-based environments, such as workplaces and homes. Place-based overload at Time 1, however, significantly predicted poorer health measured by the severity of symptoms reported at Time 2, such as stomach problems, difficulty in sleeping, and feeling like crying, controlling for baseline measures of stressful life events and overall health status and age, sex, and ethnicity. Similarly, higher composite information overload from both cyber-based and place-based sources predicted higher frequency and severity of a number of health problems and injuries after controlling for the same variables.

The analyses also revealed a significant moderating effect of sensation-seeking levels on the relationship between cyber-based overload and perceived stress. Individuals reporting higher sensation-seeking levels reported lower levels of stress associated with cyber-based overload compared with those reporting lower sensation-seeking levels. Similarly, high sensation seekers were better able to buffer stress associated with place-based and composite information overload compared with low sensation seekers. These findings are consistent with those of Smith et al. (1978) on the moderating role of sensation seeking in the relationship between negative life change and psychological distress.

Another important finding was that individuals experiencing higher levels of cyber-based overload devoted significantly less time to contemplative activities as compared with those reporting lower levels of cyber-based overload, controlling for baseline measures of contemplative activities, age, sex, and ethnicity. This finding highlights the potentially negative after effects of cyber-based sources of overload on individuals' mental capacity for concentration and self-reflection (cf. Cohen, 1980). Similarly, higher levels of composite information overload predicted lower levels of contemplation controlling for age, sex, and ethnicity and contemplative activities at Time 1. This relationship was not significant for place-based overload, however. It is possible that cyber-based overload mediates the effect of place-based overload on contemplative activity levels. This hypothesis remains to be investigated in future research on the topic.

Overall, the findings from this study suggest that the heightened levels of information overload resulting from people's increasing use of digital communication technologies may pose certain opportunity costs stemming from their adverse impacts on individuals' attentional capacities and well-being. Recent studies of knowledge workers indicate that their workplace and organizational routines have become increasingly fragmented, in that they frequently switch between multiple tasks and encounter many interruptions arising from their use on the Internet and wireless communication technologies (Mark, Gonzalez, & Harris, 2005; Mark, Gudith, & Klocke, 2008). Although a number of authors have commented on the potentially disruptive effects of digital communications on individuals' mental habits and their capacities for concentration and contemplation (e.g., Bowman, 2008; Carr, 2008), there have been few systematic studies of these effects. The present research contributes to the growing debate on these topics by using a repeated-measures panel study design and baseline covariate measures to evaluate the behavioral and health effects of perceived cyber and place-based information overload.

Several limitations of this research must be noted. First, the sample of participants was limited to college students. Although a college student sample was highly appropriate for purposes of studying the potential effects of perceived information overload (because this demographic group tends to be tech savvy and quite familiar with the Internet and mobile communication devices), the extent to which the reported findings are replicable and can be generalized to other populations and settings remains to be investigated. Furthermore, a large proportion of the participants in our sample were Asian, reflecting the large percentage of Asian students attending the university where this study was conducted. It is plausible that culture and ethnicity may influence patterns of Internet use. For example, "Internet addiction" appears to be a growing public health concern in South Korea and China (Block, 2008). Although we controlled for the potentially confounding effect of ethnicity in the regression analyses and all of the reported findings were significant above and beyond the effect of ethnicity on stress and health status, future studies are needed to assess the generalizability of the findings to other populations as well as the interaction effects of ethnicity and perceived information overload on physical and emotional well-being.

Second, although the results offer initial evidence for the incremental validity of the newly developed cyber-based, place-based, and composite Perceived Information Overload Scales, more rigorous tests of incremental validity need to be conducted in future research on information overload. For example, one stringent test of the incremental validity of the cyber-based, place-based, and composite information overload in predicting health status, above and beyond

the effects of closely related constructs (such as perceived stress), would be to use hierarchical regression analyses to determine the incremental contribution of the perceived overload scales in predicting criteria other than self-reported stress, such as error proneness or task performance (Hunsley & Meyer, 2003).

Third, although this study provides preliminary evidence for the predictive, convergent, and discriminant validity of the perceived overload constructs and survey scales, it incorporated only self-report data to assess the various predictor and outcome variables. Future studies using both objective and subjective measures of the predictor and outcome variables would help substantiate and extend the findings from this research and provide a more thorough test of construct validity. Fourth, although the theoretical constructs, survey measures, and the observed relationships among them reported in this study are conceptually plausible and we have controlled for potentially confounding variables, the findings do not provide direct evidence of causality.

Limitations notwithstanding, this research contributes new constructs and reliable tools for measuring perceived information overload in terms of two distinct sources: Cyber-based and Place-based stimulation. The reported findings offer initial evidence for the impacts of cyber-based information overload on self-reported stress, health, and contemplative activity as distinct and separate from place-based information overload. Important directions for future research include the design and implementation of longitudinal studies incorporating observational and physiological measures as well as survey and interview protocols to calibrate the joint impacts of cyber-based and place-based overload on physical and emotional well-being.

It is important to gain a more complete understanding of the psychological and health consequences associated with people's increasing use of digital communication technologies. Some corporations and organizations have become attentive to the issue of information overload in the workplace and have begun developing intervention programs to assist their employees in their efforts to manage an increasing barrage of electronic communications and to improve efficiency. For example, Intel Corporation recently implemented two pilot projects to minimize workplace interruptions and distractions. One such effort focuses on the restriction of emails on certain days and encouraging face-to-face or telephone conversations among coworkers who are colocated. The other effort called "quiet time," encourages employees to take time off from electronic communication during designated periods on certain days by setting their emails and instant messengers to "offline" and forwarding the phone calls to voice mail (Huff, 2008). Corporations, consultants, and researchers also have established a nonprofit organization called

the IORG to conduct research, build awareness, and define best practices to counter information overload (IORG, 2008).

To the extent that the findings from this study are replicated in future research and shown to generalize across different populations and settings, it will be important to devise new strategies for coping with multiple sources of information overload. Ultimately, it may become necessary for individuals and organizations to scale back or better modulate their use of digital information and communication technologies to achieve a more sustainable balance with their surroundings.

Declaration of Conflicting Interests

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Notes

1. In a preliminary study (Misra, 2010), the responses to an initially constructed 13-item Perceived Information Overload Scale were subjected to a principal components analysis followed by a Varimax (orthogonal) rotation with Kaiser normalization. Only the first two components displayed Eigenvalues greater than 1, and the results of a Scree test also suggested that only the first two components were meaningful. Therefore, only the first two components were retained for rotation. Combined, Components 1 and 2 accounted for 49.21% of the total variance in this study. In interpreting the rotated factor pattern, an item was said to load on a given component if the factor loading was .40 or greater for that component and was less than .40 for the other (Kim & Mueller, 1978). Using these criteria, seven items were found to load on the first component, which were designated as the cyber-based overload component. Six items loaded on the second component and designated as the place-based overload component. The results of this study provided the basis for our hypothesized two-factor structure of the Perceived Information Overload Scale, which we tested through confirmatory factor analyses in the present study.

2. In this study, we were especially interested in the psychological and health effects of cyber-based overload, as cyber sources of perceived information overload have received relatively little attention in prior research. Although we tested the effects of place-based and composite perceived information overload on health and stress in the hierarchical regression analyses (results of which are provided in the text), in the interest of space, we have paid greater attention to the effects of cyber-based

overload on stress and health and provided detailed results of the hierarchical regression analyses in Tables 1 to 6.

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