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COGNITIVE CONTROL AND SOCIAL MEDIA OVERLOAD

Full Paper

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Abstract

The use of social media technologies in the workplace is proliferating at an incredible pace. However, recent research reports that our inability to cope with the slew of digital communications is creating mental health problems, hampering productivity, generating stress, and lowering morale. This paper investigates how three aspects of cognitive control (i.e. fear of missing out, internet cognitive failure, and deficient self-regulation) affect communication and information overload. We test the model by collecting data from 129 students from an US and an Irish university. Partial Least Squares (PLS) techniques were used to test the model. The findings suggest that (1) communication overload is explained by fear of missing out, Internet cognitive failure, and deficient self-regulation, whereas (2) information overload is explained by only Internet cognitive failure and deficient self-regulation.

Keywords

Social media, Fear of missing out, Cognitive control, Cognitive failure, Information overload, Communications overload

Introduction

The extensive adoption and use of social media has exposed people to a massive amount of information and communication demands that may require energy and cognitive processing beyond their capabilities, a phenomenon called *social media overload* (Lee et al. 2016), which can lead to physical and psychological strain.

Adopting the work of Karr-Wisniewski & Lu's (2010) on technology overload, social media overload can be conceptualized using two dimensions: *information overload* and *communication overload*. Information overload occurs when the information that needs to be processed exceeds one's information processing capabilities. On the other hand, communication overload occurs when one is interrupted by too many communication demands that exceed his/her communication capacities.

Our inability to cope with the slew of digital communications is crippling economic growth. Nearly 30% of a worker's day in the US is spent on either interruptions or recovery time from social media interruptions, equating to $650 billion annual loss in productivity (Kent, 2012). Studies from a variety of disciplines have also linked communication and information overload to stress (Tarafdar et al, 2007), low morale (Ayyagari et al. 2011), poor decision-making (Pennington & Tuttle, 2007), mental health problems (Chen & Lee, 2013), and decreased performance (Karr-Wisniewski & Lu, 2010). Consequently, it is important to investigate what factors lead to information and communication overload.

Most prior research investigated the outcomes of information and communication overload. Very few prior research studies investigated the antecedents of information and communication overload in the social media context (Lee et al., 2016). This paper sets to fill this research gap by investigating three aspects of cognitive control that influence information and communication overload. To the best of our knowledge, no studies have investigated how different aspects of cognitive control can influence information and communication overload.

We collected data from 129 students from the United States and Ireland and analysed the data using the partial least squares (PLS) approach. The key findings are: (1) communication overload is explained by fear of missing out, internet cognitive failure, and deficient self-regulation, whereas (2) information overload is explained by only internet cognitive failure and deficient self-regulation.

The remainder of this paper is organized as follows. Section 2 describes the theoretical foundations. In section 3, we present our research model and develop hypotheses. Section 4 is dedicated for data collection and analysis. In section 5, we discuss the theoretical and practical implications from our findings. Finally, section 6 concludes the paper with limitations and directions for future research opportunities.

Theoretical Foundations

Information and Communication Overload

Social media use can have positive outcomes such as increased social capital (Ellison et al. 2007) and psychological wellbeing (Islam & Patil 2015). However, according to Karr-Wisniewski & Lu (2010), technology use, once exceeding the optimum level, can result negative outcomes. Islam & Patil (2015) also show that social network service use has an inverted U shaped relationship with psychological wellbeing. Perhaps the phenomenon of "technology overload" can explain the dilemma that more technology does not always result to higher social capital (Ellison et al. 2007) and productivity (Karr-Wisniewski & Lu 2010). Karr-Wisniewski & Lu (2010) describe three dimensions of technology overload: information overload, communication overload, and system feature overload. Information overload occurs when the information that needs to be processed exceeds one's information processing capabilities. Communication overload is the undesirable condition arising when communication demands from ICT channels, such as social media, exceed users' processing capacities (Cho et al. 2011). Finally, system feature overload occurs when the given technology is too complex for a given task or the addition of new features is outweighed by the impact of technical resources and the complexity of use.

Among these dimensions, we suggest information overload and communication overload are more typical in social media context. Empirical evidence from a variety of fields link communication and information overload to poor decision-making (Pennington & Tuttle, 2007), stress (Tarafdar et al., 2007), low morale (Ayyagari et al., 2011), mental health problems (Chen & Lee, 2013) and decreased performance (Karr-Wisniewski & Lu, 2010).

We believe system feature overload may have little importance in the social media use context. Established social media service providers like Facebook have been widely adopted among a variety of users due to the ease of use of these services. The social media operators continuously aim at improving the user experience by developing more user-friendly interfaces (Islam et al. in press). Thus, the users are unlikely to suffer from system feature overload in the social media context. Based on the above, we adopt information overload and communication overload in order to conceptualize social media overload in this paper.

Cognitive Control

Cognitive control is a construct from contemporary cognitive neuroscience referring to the process by which goals or plans influence behaviour. Cognitive control allows your mind to override your impulses and helps you make decisions based on your goals, rather than your habits or reactions.

For example, you are working to meet a tight deadline and you hear the ping of your smartphone alerting a new email. Your impulse is to check the new message but it is your cognitive control which suppresses the internal signal as it is contrary to the goal of meeting the pending deadline.

Scholars have examined numerous aspects of cognitive control, such as attention, working memory, and goal management. Relating to the IS discipline, theories of cognitive control have most recently been used to explain the varying effects of media multitasking. In a series of task experiments, Ophir, et al. (2009) find that chronic media multitaskers have greater difficulty filtering out irrelevant stimuli

from their environment. In contrast, action video game players have been found to have better selective attention (ignore some elements at the expense of others) and sustained attention (maintaining attention over longer periods) (Green & Bavelier, 2012).

Ample research exists suggesting the immediate gratifications provided by communication technologies are a significant threat to our cognitive control processes (see Hofmann book chapter for a deeper discussion). Yet, very few studies have applied theories of cognitive control to explain information and communication overload. As detailed in our research model in figure 1, we theorize on the relationship between information and communication overload, and three aspects of cognitive control associated with using modern ICT systems such as social media – the fear of missing out, Internet cognitive failure, and deficient self-regulation.

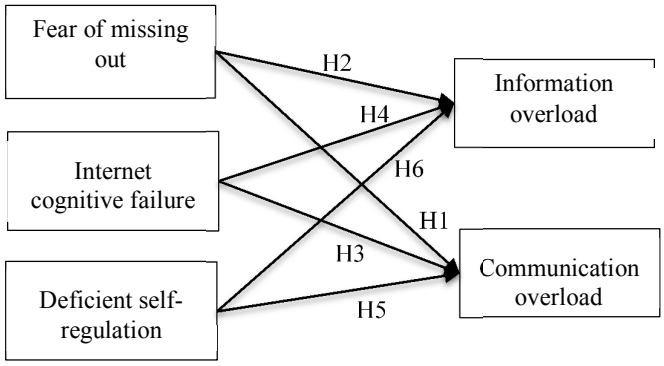

Figure 1. The Research Model

Fear of Missing Out

The fear of missing out (FoMO) is "…a pervasive apprehension that others might be having rewarding experiences from which one is absent" (Przybylski, et al. 2013). FoMO is a particular problem in today's technology saturated environment. Our digital devices continually provide us with evidence our colleagues are making more money, have a better job, better car, or a more interesting social life.

Scholars have recently begun to explore FoMO and its correlates. Stress has been shown to be influenced by FoMO (Jones 2014). Przybylski et al. (2013) found that FoMO was the mechanism linking adults' need satisfaction with social media engagement. Whilst supporting the link between FoMO and stress, Beyens, et al. (2016) also report FoMO was associated with increased Facebook use. In a vicious cycle, the possibility to be constantly connected with others may further fuel FoMO, driving people towards greater use of social media (Beyens et al. 2016). Directly related to our current study, Internet multitasking and communication load have been found to be positively correlated with FoMO (Reinencke 2017).

FoMO is not a pleasant feeling. In an effort to avoid feeling left out, we hypothesize that people unable to suppress the need to constantly check communication updates and search for information, are more likely suffer communication and information overload.

H1: The fear of missing out is positively associated with communication overload.

H2: The fear of missing out is positively associated with information overload.

Internet Cognitive Failure

A cognitive failure can be defined as a mistake in the performance of an action that the person is normally capable of completing (e.g., Wallace et al. 2002). The term Internet cognitive failure (ICF) is used when the concept is applied to completing online tasks (Hong et al, 2017). A person displaying ICF will lack focus, be absent minded while online, and prone to errors. Stemming from cognitive control theory, cognitive failures are the result of a lack of focus and attention, triggered internally (e.g. mind wandering) or by an external distraction.

In conjunction with other moderating variables, ICF has been used to explain the variability of performance in e-learning tasks. Learners who had high ICF are less likely to continue using an e-learning course (Hong et al. 2017). Likewise, for students learning a language online, ICF is negatively correlated with the ability to self-regulate when learning vocabulary (Hong et al., 2015).

Whelan & Teigland's (2013) research into information overload suggests the problem is better explained by the failure to filter irrelevant information than by any sudden surge of digital information. Extrapolating from these studies, we hypothesize that people displaying high ICF are more likely to suffer communication and information overload, as they lack a clear goal when online and more open to being distracted by irrelevant content.

H3: Internet cognitive failure is positively associated with communication overload.

H4: Internet cognitive failure is positively associated with information overload.

Deficient Self-Regulation

A subcomponent of cognitive control, deficient self-regulation (DSR) is defined as a state in which conscious self-control is diminished. Individuals suffering from DSR lack the ability to judge their own behavior against appropriate standards, and to moderate their media consumption. DSR has been proposed as an explanatory mechanism for Internet addiction (LaRose et al., 2003), problematic online pornography use (Sirianni & Vishwanath, 2016), compulsive social networking use (LaRose et al. 2010). In a study of students' use of instant messaging, Lee and Perry (2010) noted that DSR was clearly evident across sample participants. It has been suggested that using the Internet for mood regulation is a contributory factor to DSR (LaRose, et al. 2011; Lee and Perry, 2010).

Those exhibiting DSR have a hard time keeping their Internet use under control. DSR is directly related to Internet usage and also contributes to usage indirectly, through habit strength (LaRose et al. 2011). Thus we hypothesize users are more likely to be overloaded from communications and information if they exhibit high DSR.

H5: Deficient self-regulation is positively associated with communication overload.

H6: Deficient self-regulation is positively associated with information overload.

Study Design

Data Collection

To evaluate our research model, we developed a measurement instrument and then conducted a survey. The measures for information overload, communication overload, fear of missing out, deficient self-regulation, and internet cognitive failure were adopted from prior literature and were measured on a seven-point Likert scale with response choices ranging from "Strongly disagree (1)" to "Strongly agree (7)". The sources of the measures are presented in Table 1.

Data were collected from 129 undergraduate business students from an US and an Irish university. A total of 131 usable responses were received. Approximately 52% of the respondents were male.

Data Analysis

The analysis utilized the partial least squares (PLS) approach with SmartPLS software (Ringle et al. 2005). A rule of thumb for required sample size in PLS is that the sample should be at least ten times that of the most complicated multiple regressions in the model (Barclay et al. 1995; Hair et al. 2011), and the sample size here fulfils this criterion well.

We followed Gefen & Straub's (2005) procedure to test convergent and discriminant validity. Convergent validity indicates the extent to which items on a scale, which are theoretically related, are also related in reality. We evaluated the convergent validity by examining item loadings, composite reliabilities, and average variance extracted (AVE) values. With regard to item loadings, Fornell & Larcker (1981) have recommended values of at least 0.7 to be acceptable. Based on this criterion, several items were removed. The composite reliabilities being above 0.8 and AVE values exceeding 0.5 further support satisfactory convergent validity (Fornell and Larcker 1981). The loadings, CRs and AVEs are shown in Table 1.

Construct	Item	CR	AVE	Loading	P value
Information Overload (Karr-Wisniewski & Lu 2010)	In_Over1: I am often distracted by the excessive amount of information in social media	0.90	0.76	0.87	<0.001
	In_Over2: I find that I am overwhelmed by the amount of information that I			0.91	<0.001

	process on a daily basis from social media				
	In_Over3: Usually, my problem is with too much information to make sense of, instead of not having enough information to make decisions			0.83	<0.001
Internet cognitive failure (Hong et al 2016)	*Cog_fail1: I often misinterpret the meaning of the message so that I must read the message again.	0.85	0.58	-	<0.001
	Cog_fail2: I often have difficulty finding the information I need on the webpage.			0.76	<0.001
	Cog_fail3: If there are too many messages on the screen, I always experience inability to see the information, even though it is actually there.			0.82	<0.001
	Cog_fail4: I often miss the location of what I post on the internet.			0.73	<0.001
	Cog_fail5: I often forget what message I posted.			0.73	<0.001
Fear of missing out (Beyens 2016)	*Fomo1: I fear others have more rewarding experiences than me.	0.88	0.60	-	<0.001
	Fomo2: I get worried when I find out my friends are having fun without me.			0.80	<0.001
	*Fomo3: I get anxious when I don't know what my friends are up to.			-	<0.001
	Fomo4: It is important that I understand my friends "in jokes".			0.81	<0.001
	Fomo5: Sometimes, I wonder if I spend too much time keeping up with what is going on.			0.78	<0.001
	Fomo6: It bothers me when I miss an opportunity to meet up with friends.			0.76	<0.001
	*Fomo7: When I have a good time it is important for me to share the details online (e.g. updating status).			-	<0.001
	*Fomo8: When I miss out on a planned get-together it bothers me.			-	<0.001
	Fomo9: When I go on vacation, I continue to keep tabs on what my friends are doing.			0.72	<0.001
Communication Overload (Karr-Wisniewski & Lu 2010)	Com_Over1: I feel that in a less connected environment, my attention would be less divided allowing me to be more productive	0.87	0.62	0.75	<0.001
	Com_Over2: I often find myself overwhelmed because technology has allowed too many other people to have access to my time			0.86	<0.001
	Com_Over3: I waste a lot of my time responding to messages that are not directly related to what I need to get done			0.79	<0.001
	Com_Over4: The availability of electronic communication has created more of an interruption than it has improved communications.			0.74	<0.001
Deficient self-regulation (Larose & Eastin 2004)	Def_Self_reg1: I have a hard time keeping my Internet use under control.	0.90	0.55	0.77	<0.001
	Def_Self_reg2: I have to keep using the Internet more and more to get my thrill.			0.75	<0.001
	Def_Self_reg3: I get tense, moody, or irritable if I can't get on the Web when I			0.70	<0.001

	want.				
	Def_Self_reg4: I have tried unsuccessfully to cut down on the amount of time I spend online.			0.75	<0.001
	Def_Self_reg5: I sometimes try to conceal how much time I spend online from my family or friends.			0.76	<0.001
	Def_Self_reg6: I would go out of my way to satisfy my Internet urges.			0.73	<0.001
	Def_Self_reg7: I feel my Internet use is out of control.			0.73	<0.001

*Note: Average Variance Extracted (AVE), Composite Reliability (CR), * Items were removed due to loadings less than 0.70*

Table 1. Item means, standard deviations (S.D.), loadings and significance levels

Discriminant validity refers to whether the items measure the construct in question or other (related) constructs (Gefen and Straub 2005). We evaluated the discriminant validity by comparing the square roots of AVE values to the inter-construct correlations (Fornell and Larcker 1981). Table 2 shows the correlation matrix with the square root of AVE values presented diagonally. As can be seen from the table, the square roots of the AVE values for the variables are consistently greater than the off-diagonal correlation values, suggesting satisfactory discriminant validity between the variables.

	Communication Overload	**Deficient Self-Regulation**	**Fear of Missing Out**	**Information Overload**	**Internet Cognitive Failure**
Communications Overload	**0.79**				
Deficient Self-Regulation	0.44	**0.74**			
Fear of Missing Out	0.47	0.56	**0.77**		
Information Overload	0.59	0.40	0.37	**0.87**	
Internet Cognitive Failure	0.47	0.45	0.50	0.42	**0.76**

Table 2. Correlations between latent variables (square root of AVEs in the main diagonal)

We further verified discriminant validity by examining item cross-loadings, presented in Table 3.

	Communication Overload	**Deficient Self-Regulation**	**Fear of Missing Out**	**Information Overload**	**Internet Cognitive Failure**
Cog_fail2	0.39	0.34	0.35	0.43	**0.76**
Cog_fail3	0.39	0.42	0.37	0.32	**0.82**
Cog_fail4	0.33	0.27	0.37	0.27	**0.73**
Cog_fail5	0.31	0.32	0.45	0.24	**0.73**
Com_Over1	**0.75**	0.32	0.28	0.51	0.42
Com_Over2	**0.86**	0.36	0.44	0.50	0.36
Com_Over3	**0.79**	0.38	0.45	0.49	0.37
Com_Over4	**0.74**	0.30	0.26	0.32	0.34
Def_Self_reg1	0.43	**0.77**	0.42	0.35	0.30
Def_Self_reg2	0.34	**0.75**	0.44	0.31	0.37
Def_Self_reg3	0.26	**0.70**	0.35	0.31	0.24
Def_Self_reg4	0.33	**0.75**	0.40	0.21	0.38
Def_Self_reg5	0.38	**0.76**	0.47	0.38	0.36
Def_Self_reg6	0.15	**0.73**	0.35	0.18	0.34
Def_Self_reg7	0.21	**0.73**	0.43	0.17	0.34
Fomo2	0.39	0.39	**0.80**	0.42	0.32
Fomo4	0.36	0.47	**0.81**	0.27	0.46
Fomo5	0.46	0.43	**0.78**	0.26	0.44
Fomo6	0.24	0.42	**0.76**	0.25	0.39
Fomo9	0.29	0.47	**0.72**	0.19	0.34
In_Over1	0.52	0.35	0.38	**0.87**	0.36
In_Over2	0.57	0.42	0.30	**0.91**	0.43

In_Over3	0.42	0.25	0.30	**0.83**	0.31

Table 3. Item loadings and cross-loadings

All items load higher on their assigned latent construct than on any other construct (Fornell and Larcker 1981). This indicates that discriminant validity at the item level is met for all the constructs (Gefen and Straub 2005).

Having verified the convergent and discriminant validity of the measurement, we addressed the potential concern of common method bias (CMB) (Podsakoff & Organ 1986). To evaluate the risk that CMB remained, we conducted several tests. First, we conducted Harman's (1976) one-factor test. A principal component analysis indicated four factors and no single construct accounted for a majority of the total variance. Second, we conducted a test described by Liang et al. (2007). We included a common method factor by reusing all the indicators from the principal constructs in the PLS model. We then calculated each indicator's variances substantively explained by the principal construct and by the method factor. The results demonstrate that the average substantively explained variance of the indicators is 0.51, and the average method based variance is 0.01. The ratio of substantive variance to method variance is about 51:1. Given the small magnitude of method variance, we conclude that the CMB is unlikely to be a serious concern for this study. Overall, we concluded that CMB is unlikely to distort the interpretations.

Results

The test of the structural model includes estimates of the path coefficients, which indicate the strengths of the relationships between the dependent and independent variables, and the R^2 values, which represent the amount of variance explained in the dependent variables. Figure 2 shows the results of the structural model test.

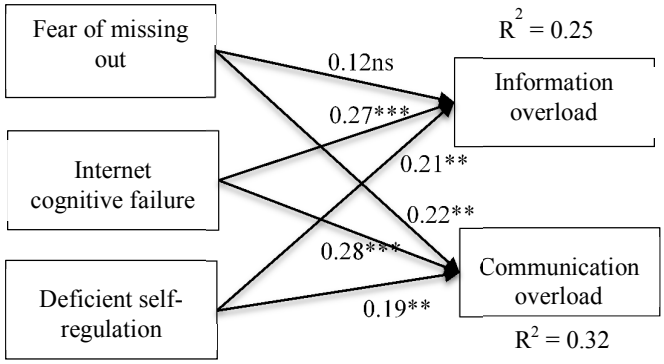

Figure 2. PLS results

Fear of missing out had significant influence on communication overload, supporting H1. In contrast to H2, fear of missing out did not have a significant influence on information overload. As hypothesised in H3 and H4, Internet cognitive failure had significant influence on both communication overload and information overload. Finally, H5 and H6 were supported as deficient self-regulation had significant effect on both communication overload and information overload. Taken together, the model explained 32% variances of communication overload, and 25% variances of information overload.

Discussion and Implications

Information and communication overload, the two dimensions of social media overload, are felt by millions of social media users. This overload can affect productivity of workers that cannot handle the immense amount of content presented through social media. This study aimed to investigate how three aspects of cognitive control affect communication and information overload. The results are discussed below.

Previous studies demonstrate deleterious behaviors such as Internet addiction (LaRose et al., 2003), problematic online pornography use (Sirianni & Vishwanath, 2016), and compulsive social networking use (LaRose et al. 2010) are associated with a lack of cognitive control. Our study builds on this important work by articulating the link between cognitive control and social media overload. Specifically, we find that the fear of missing out, Internet cognitive failure, and deficient self-regulation are each significantly positively associated with communication overload. The fear of missing out could cause users to actively use multiple communication channels. Through the multi-use, a user feeling this fear could be placated through the belief that if something was happening, the more channels participated in would lead to a greater chance of learning about it. However, there are limits to what a user can effectively process, so if the number and depth of these channels exceeds this limits, communication overload will be felt. Internet cognitive failure could cause the upper limit of a user's processing ability to effectively decrease. By not being able to focus and having a higher likelihood of errors, the effective processing ability for multiple communication channels will shrink, making the boundary for being overloaded much lower. Deficient self-regulation can cause a user to not know when to stop using social media. Without the inner regulatory mechanisms in place, users can continue to add new communication channels to what they are currently using and become overloaded before understanding the warning signs and realizing that they need to stop their usage.

Internet cognitive failure and deficient self-regulation are significantly positively associated with information overload. Internet cognitive failure could lead to information overload as users are less able to focus attention on their primary task. When faced with the information from the primary task along with information from multiple distractions or secondary tasks, this can overload the user such that they are unable to properly process the information related to their current task. Deficient self-regulation can lead to information overload since users are unable to properly regulate their information consumption. It is likely that a user can cross the boundary of being overwhelmed before they realize that it is coming, and only after feeling overwhelmed, know that they need to control their usage.

Interestingly, fear of missing out is not significantly associated with information overload. This may be because users with the fear of missing out are looking for information on specific events or activities. Once the user finds the bit of information about this, the search is completed and no new information will need to be processed. Likewise, it makes sense that a fear of missing out is associated with communication overload rather than searches for and assimilation of information. When a person is apprehensive about being out of the social loop, they will turn to email, instant messaging, and other communication platforms to find ease their fear of missing out.

Overall, this study provides evidence linking lack of cognitive control to both communication and information overload. Unlike the common rhetoric that the best way to prevent overload is to just not use the technology as much (or at all), our results show that there are more nuances than that. Users with deficient self-regulation, for example, have difficulties in controlling their usage and may not be able to just "use it less". Practitioners should focus on determining the underlying causes of overload and address those instead of preaching "use it less".

Conclusions

As with any other empirical research, the present study is subject to a number of limitations. At the same time, however, the limitations could serve as avenues for further research. First, the study has been conducted amongst student users. This evidently limits generalization of the findings directly to other user groups. Thus, we suggest future research validate our findings by collecting data from other user groups, especially organizational employees.

Our measures of communication and information overload are self-reported. It is possible that users may not even be aware they overloaded. An interesting area of future research could use neuroscience tools and techniques to directly measure the neurophysiological markers associated with cognitive overload, such as changes in heart rate variability, pupil dilation, and electrodermal activity.

Another area of future research could be investigating the effects of innovative social media features on information overload, communication overload, and social media fatigue. For example, it would be worth investigating to what extent optional filters to content and communication requests help mitigate communication overload and social media fatigue.

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