Information and Communication Technology: Affects on U.S. College Students

Michael Massimini[1], Michael Peterson[2]

[1, 2]University of Delaware, Delaware, USA

Abstract

Objectives: To identify information and communication technology's (ICT) intrusiveness on college students by determining usage patterns and exploring affects on perceived stress. Methods: Questions related to demographics, ICT behavior and stress were used to measure perceived stress, ICT-related stress, and relationships between these variables among undergraduate college students (N=300). Results: Students preferred non-personal communication, and relationships were identified between ICT, being late for class, losing sleep, and stress. Conclusion: This investigation found ICT as a major intrusion affecting sleep, time management, and perceived stress as well as implications in students' communication

Key words: technology, intrusion, stress, college students.

Introduction

From the cumbersome personal phones and numeric pagers of the early 1990's to the Internet-ready mobile devices common today, advances in technology have afforded people of all ages many forms of communication and information gathering (Agar, 2004). The advent of mobile phone technology, the Internet, and computers has concurrently provided a vast array of information gathering techniques and communication mediums. Left at people's fingertips is a high-tech plethora commonly referred to as information and communication technology (ICT) (Friedman, 2005).

The utilization of ICT can be described as nothing short of astounding. In 2007, worldwide mobile telephone subscriptions reached 3.3 billion, a number equivalent to half the global population (Sydney Morning Herald, 2008). Innovative websites such as Wikipedia, the free content encyclopedia (Wales & Sanger, 2001), and Internet search engines akin to Google (Reuters, 2005) have also flourished in recent years, enabling anyone with an Internet connection to retrieve a wide-array of information with relative ease. Likewise, online social networks (SN) have gained notable popularity (Anderson & DeWolfe, 2003; Rosenbush, 2006) allowing people the ability to communicate impersonally via electronic text (boyd & Ellison, 2007). In 2007, an estimated 150 million user accounts existed on MySpace (Scalet, 2007), and Facebook reported 50 million user accounts (Facebook, 2008). When one considers the technological advances that have taken place throughout the twentieth century, it is apparent that ICT has had a substantial effect on today's society (Biocca, 2000; Bradley, 2000; Greenwood, 1997; Thomee, Eklof, Gustafsson, Nilsson, & Hagberg, 2007).

Among the people affected by ICT are young adults, specifically college-age students. There are a number of studies that indicate college students are one of the highest ICT use demographics (Jasper & Lan, 1992; Lee, 2006; Morgan & Cotten, 2003; Perry, Perry, & Hosack-Curlin, 1998; Thomee et al., 2007). This creates a profound complexity for student health professionals. In light of ICT and its rate of advancement, a case could be made that a contemporary student health focus requires a binary approach; an approach that focuses on the traditional aspects of college student health as well as the complexity that today's advances in ICT present to the college experience. Traditionally, college has been viewed as a transition period in which new experiences and meeting new people mark the transformation from the period of adolescence to early adulthood. Research has suggested this stage of life is a crucial period of development marked by many difficult challenges (Arnett, 2000; Lanthier & Windham, 2004) and numerous studies have attempted to make health a research focus as it pertains to these developmental challenges (Brooks & DuBois, 1995; De Fruyt & Mervielde, 1996; Valde, 1996; Waterman, 1982).

Aside from the traditional developmental challenges involved in college student health, a fairly new adaptation has taken place on college campuses: ICT. Technology is changing the way people live and socially interact, for better or for worse, and in support of the case for contemporary approaches to the study and practice of college student health, ICT has had a profound impact on the college experience and continues to change it as technology becomes more advanced. Unlike college students of yesteryear, students today live in a world of communication and media overload. In light of the work from Arnett (2000) and Lanthier, et al. (2004), it appears logical that emerging adults trying to make an effective transition into college would find ICT appealing; particularly when one considers the 24-hour high-speed Internet access available on most college campuses (Young, 2006) and the ubiquity of cell phone usage in today's society (Glotz & Bertsch, 2005).

Despite how widespread it has become, ICT use is not always healthy and, as research has shown (Anandarajan, Simmersm, & Igbaria, 2000; Anderson, 2001; Beckers & Schmidt, 2003; Biocca, 2000; Cummings, Lee, & Kraut, 2006;

Fusilier, Durlabhji, Cucchi, & Collins, 2005; Hansen, 2002; Scherer, 1997; Thomee et al., 2007), can be quite detrimental to students' health and wellbeing. Often times ICT may become an intrusion on normal everyday life, be a source of perceived stress, and have other ill health effects. Many health professionals have recognized the impact that ICT has made on college students and the importance of incorporating it into research. Much effort has been made to integrate ICT into investigations that focus on the health of college students and subsequently, a large body of research exists concerning implications associated with ICT use and college student health (Anandarajan et al.,2000; Anderson, 2001; Cummings et al., 2006; Fusilier et al., 2005; Scherer, 1997). Some early studies have looked at the physiological and psychological repercussions related to excessive ICT use (Gerr et al., 2002; Thomee et al., 2007) while others have investigated the psychological underpinnings associated with ICT use (Beckers et al., 2003; Thomee et al., 2007). Many of the early findings have given researchers the means for further, more detailed investigation. Recent research has focused on a phenomenon known as "Internet addiction" (Chen, Liu, & Luo, 2007; Hansen, 2002; Huang, Wang, Qian, Zhong, & Tao, 2007). As earlier research has created further explorations, the "Internet addiction" concept has led others to take a more in depth look at ICT use in the college setting and they have discovered complex behavior patterns associated with things such as online shopping (Kim & LaRose, 2004; Seock & Norton, 2006; Watchravesringkan & Shim, 2003) and online gambling (Ladd & Petry, 2002; Petry & Weinstock, 2007).

Despite this large body of research there are some inconsistencies present. Gordon, Juang and Syed (2007) have acknowledged the extensive research on Internet use and highlighted the discrepancies among the types of Internet use that have been measured. There is also a concern for better-defined research due to the rapid rate of ICT advancement and the increase of ICT as a part of both leisure and working time (Bradley, 2000). A good example of this phenomenon is the recent increase in popularity of SNS, namely Facebook and MySpace. Scalet (2007) reports that after the launch of MySpace in January of 2004, the site reached 1 million users by February of that same year and later reached over 5 million users by the end of that same year. With 80 million users in June of 2006, MySpace grew to 135 million by year's end and over 150 million by the spring of 2007. Likewise, Facebook boasts similar success and provides a timeline of its growth on its website (Facebook, 2008). By the end of 2005 the site had roughly 5 million users. By the end of 2006 it doubled its user base to over 12 million and reports 50 million users as of October, 2007. In light of these figures it can be assumed that the growth of ICT is often unpredictable and difficult to extrapolate making the validity of research short-lived.

Outside of Internet use, other forms of ICT have received far less attention. Thomee, et al. (2007) have pointed to research regarding cell phones, explaining that the main focus has been on the effects of radiofrequency and electromagnetic fields resulting from usage (Lee, Lam, Yee, & Chan, 2003; Willen, Sandstrom, & Mild, 2003) and the safety concerns of cell phone use while driving (Lamble, Kauranen, Laakso, & Summala, 1999; Redelmeier & Tibshirani, 1997). Additionally, the capabilities of cell phones have increased considerably over the years and most studies that have included cell phone use as a form of ICT have not fully explored the extent of their communication capacity. In summary, despite current literature a comprehensive investigation of ICT has yet to be conducted. Finally, although ICT has been found to be a disturbance in students' lives, its degree of intrusiveness has yet to be encompassed by a multitude of ICT forms of use. This study aimed to address the need for more depth in the ICT literature by further exploring ICT use among college students. This investigation was exploratory in nature and, building off existing research, had three main objectives. The first objective was to identify current college student ICT usage patterns. The second objective was to identify the degree of ICT intrusiveness (as identified by being late for class, losing sleep, or experiencing stress as a direct result of ICT use) on the lives of college students. The third objective was to identify relationships between college student ICT usage/intrusiveness and health behaviors and perceived stress. With these objectives it was hopeful that this investigation would shed further light on the topic and provide a unique insight as to how ICT plays a role in college students' lives and health.

Methods

Participants

A convenience sample comprised of undergraduate students (N=300) at a Mid-Atlantic university participated in the study. Participants were enrolled in introductory elective courses open to all students at the university. Participants received a form that contained general information about the survey and study, informed consent information, and a study questionnaire. Participation was voluntary and the study was approved by the institution's Internal Review Board. Out of 340 distributed surveys, 300 were returned fully completed providing a return rate of 88.24%. Five questions were asked to establish the gender, age, class status, ethnicity, and place of residence of the sample (Table 1). Participants' average age was approximately 19 years old (M=19.38; SD=1.26).

Table 1: Demographic Characteristics

Gender	N	%
Male	91	30,3
Famele	209	69,7
Class	**N**	**%**
Freshman	161	53,7
Sophomore	70	23,3
Junior	33	11,0
Senior	36	12,0
Ethnicity	**N**	**%**
White/non-Hispanic	252	84,0
Black/non-Hispanic	19	6,3
Hispanic	9	3,0
Asian	9	3,0
Native-American	0	0,0
Other	11	3,7
Residence	**N**	**%**
Campus housing	209	69,7
Non-campus housing	75	25,0
Fraternity/Sorority house	3	1,0
Home	13	4,3

Measurements

Perceived Stress Scale (PSS10)

The PSS10 is a ten-item version of the original fourteen-item PSS which measures the degree to which situations in one's life are appraised as stressful (Cohen, Kamarck & Mermelstein, 1983). The PSS10 is intended to measure perceived stress levels in the last month by asking about feelings and thoughts, e.g., "in the last month, how often have you felt that you were unable to control the important things in your life?". The questions are based on a 5-point Likert-type scale ranging from never to very often. In comparison to the longer Perceived Stress Scale, (Cohen & Williamson, 1983) the PSS10 provides a valid measure of perceived stress, has a tighter factor structure, and a reliability of $r > 0.78$.

ICT Use & Student Behavior

The survey contained questions that were designed to elicit the participants' preferences and attitudes towards various forms of communication with both friends and family. Other survey questions asked the participants to indicate what degree they agreed or disagreed with statements regarding communication via ICT, e.g., "I use (ICT) to avoid talking to someone directly (phone call or face-to-face)".

The questionnaire also contained a six-question series that assessed direct technology use. These items were measured by asking the students to recall their usage from the previous 24 hours. The students were asked to indicate the frequency (total amount of separate times used) and the time of day of their usage. SN use was treated slightly differently than the other forms of ICT use. For the purpose of this study, the use of a SN ("social networking", defined as Facebook and MySpace in the survey) was assessed by examining 3 social-network-specific behaviors: 1.) "sending messages to friends"; 2.) "browsing around"; and 3.) "writing on friends' walls". Sending messages to friends requires a user to create a message with text and/or images which will then be sent to another designated user. These messages can only be seen by the sender and recipient and function like e-mail messages. Browsing around involves the view of other users' pictures and profile content, using the network's search engine to find other users, and editing one's own profile. Writing on friends' walls is similar to sending messages but it does not function like e-mail; it is accomplished by a user posting text and/or images directly on another member's profile for public view.

In addition to the detailed SN questions, two series of questions were designed to quantify ICT intrusiveness. These questions asked students to report how often within the past week ICT use has resulted in being late for class or losing sleep. The remaining questions asked participants about ICT-related behaviors that may indicate ICT use as an intrusion or stressor, e.g., experiencing stress when a cell phone is forgotten (left behind). Time of day was assessed by asking the participants to indicate when, throughout the past 24 hours, they had used various forms of ICT. This was accomplished by grouping a 24 hour day into 6 time categories (e.g. 6 a.m.-9:59 a.m.; 10 a.m.-1:59 p.m.; 2 p.m.-5:59 p.m.; 6 p.m.-9:59 p.m.; 10 p.m.-1:59 a.m.; 2 a.m.-5:59 a.m.) and asking the participants to specify the time categories that corresponded with their ICT use.

Data Analysis

Data was analyzed using SPSS Statistical Software (v. 15.0.1). Given the purpose of the study and its exploratory nature, descriptive statistics were a main component of the analysis. Prior to analysis, outliers were defined and descriptive statistics and frequency scores were used to describe the sample's demographics, ICT behavior, the degree of intrusiveness associated with ICT, the amount of stress ICT causes, and perceived stress. No significant differences in any of the observed variables were found among gender, ethnicity, class status or residence, subsequently the sample was treated as a homogeneous whole. Composite scores were created for the responses to the questions regarding the frequency of ICT use. Likewise, composite scores were also created for the responses regarding duration of SN use. A correlational design was then used to examine the associations between the independent variables; composite scores of both frequency of ICT use and duration of SN use, and the dependent variables; ICT intrusiveness, ICT related stress, perceived stress (PSS10 scores), and behaviors. PSS10 mean scores were compared to normative data (Cohen & Williamson, 1983).

Results

ICT Use & Student Behavior

ICT use was assessed with a variety of questions that were specifically designed to measure the type, frequency and duration of use. On average, participants had approximately 2 e-mail accounts (M=2.09; SD=.76) and reported using one Instant Messaging (IM) service (M=1.24, SD=.68). When asked to identify Internet-related cell phone use (other than phone calls and text messages), 20% of the participants reported using their cell phone to instant message people, 11% used their cell phone to check their e-mail, and 11% reported using their cell phone for viewing websites.

The participants reported that they were most likely to use text messaging to communicate with friends (62.9%) and phone calls to communicate with family (90.3%) See Table 2. The results also indicated that almost half of the sample (47.3%) agreed with the statement "I use text messaging, e-mail, instant messaging, Facebook or MySpace to avoid talking to someone directly (phone call or face-to-face)". Additionally, the results suggested the sample was more likely to reach out to a friend (92.7%) rather than a family member (77.3%) when "really stressed". Two questions asked about iPod ownership and usage indicated that 90.3% of the sample owned an iPod. Of the people who owned an iPod, 20.3% of them indicated that they use their iPod to avoid talking to people while walking around campus.

Table 2: Percentage of students most likely to use various ICT modes to communicate with friends & family

	Communicate with friends	Communicate with family
Phone call	22,7%	90,3%
Text messaging	62,9%	2,8%
Instant Messaging	4,3%	0,7%
Facebook/MySpace	3,2%	0,3%
Face-to-face contact	6,9%	5,9%

Participants were asked to indicate how many separate times they used various forms of ICT (Table 3) and how many minutes they spent performing behaviors specific to SN use (Table 4). The results indicated that, on average, students sent over 20 (M = 23.65, SD = 28.32) text messages per day. Additionally, they used a SN approximately five times per day, spending a little less than an hour per day on behaviors specific to SNs (sending messages, browsing around and creating wall posts). The sample also reported an average of less than seven hours of sleep (M = 6.69, SD = 1.12) a night during the week and an average of slightly more than eight hours of sleep (M = 8.06, SD = 1.75) a night during the weekend. Lastly, the normative data for the PSS10 provided by Cohen and Williamson, categorized by age and profession, maintains the 18-29 years old demographic at a mean score of 14.2 (SD = 6.2) and the student demographic at 15.3 (SD = 6.6). The mean score for the sample of this study was higher (M = 17.98, SD = 5.59). A higher PSS10 score indicates more perceived stress.

Table 3: Frequency of ICT use

Form of ICT Use	# of times in past 24 hours	
	N	Mean
Talking on a cell phone	268	5,44
Text messaging with a cell phone	268	23,49
Using an Instant Messenger service	268	3,62
Using a social network	268	5,24
Checking/sending e-mails	268	5,50

Table 4: Frequency & Duration of Specific Social Networking Behaviors

Social Network Behavior	Frequency		Duration (in minutes)	
	N	Mean	N	Mean
Sent messages to friends	296	1,44	294	7,87
Browsed around (view pictures, profiles, etc.)	295	4,77	295	37,56
Written on friends' walls	296	2,42	296	7,20

Frequency & Duration: table represents the average amount of separate times and the average amount of minutes spent performing each of the above social network behaviors in the past 24 hours, as reported by the sample

ICT Intrusiveness

Through several series of questions, the degree to which ICT was intrusive upon the lives of college students was measured. For example, when asked what they would do if they left home and realized they had forgotten their cell phone, more than half of the participants (63%) indicated they would "go back and get it" as opposed to leaving it behind. Another question asked how many times in the past week the participants have been late for a class due to various forms of ICT use. Participants reported being late for class for a variety of reasons, however checking/sending e-mails and using SNs were the reasons most reported as causing class lateness (Table 5).

Table 5: Percentage of participants who reported being late for class due to ICT use

Reason for being late	Number of times participant has been late in past week		
	None	1-2 times	3 or more
Using cell phone	87,7%	9,7%	2,7%
Playing video games	92,7%	6,7%	0,7%
Checking/sending email	73,7%	24,7%	1,7%
Using an IM service	86,7%	12,0%	1,3%
Facebook/MySpace	74,0%	20,3%	5,7%
Browsing the Internet	80,0%	17,3%	2,7%
Misplaced/forgot cell phone	85,0%	14,0%	1,0%

A similar question asked how many times in the past week the participants had lost sleep due to ICT use. Almost half of the sample reported losing sleep at east once due to talking on their cell phone and using an IM service (Table 6). Perhaps the most notable findings involved the use of SNs and the act of browsing websites on the Internet. Over half of the students surveyed (62%) reported losing sleep at least once in the past week due to using SNs and 21.3% reported losing sleep at least three times. Over half (54.7%) of the students surveyed reported losing sleep at least once due to browsing websites on the Internet and 17% reported losing sleep at least three times.

Table 6: Percentage of participants who reported losing sleep due to ICT use

Reason for lost sleep	Number of times participant has lost sleep in past week		
	None	1-2 times	3 or more
Using cell phone	50,3%	34,0%	15,7%
Playing video games	84,7%	10,7%	4,6%
Checking/sending email	61,3%	30,0%	8,7%
Using an IM service	53,0%	31,3%	15,7%
Facebook/MySpace	38,0%	40,7%	21,3%
Browsing the Internet	45,3%	37,7%	17,0%

Two questions involved the concept of "Cyber Bullying" [1](Slonje & Smith, 2008), another behavior treated as an ICT intrusion. Almost a quarter of the sample (20.4%) reported being a victim of cyber bullying and conversely, 13.7% admitted to being guilty of cyber bullying at some point in the past. One question on the survey asked the students if they had ever thrown their cell phone because of a stressful or angry phone conversation. More than one out of three participants (37%) reported they had thrown their cell phones in anger.

There were two questions that were specifically designed to measure how the participants felt when they were without their cell phones. The first question asked the participants to indicate how much stress they experienced if they left their cell phone behind and had to go through an entire day without it, based on a Likert-type scale of 1-7 (1 = "no stress"; 4 = "moderate stress"; & 7 = "a lot of stress"). The sample reported an average score of M = 4.11 (SD = 1.61) for stress caused by forgetting cell phone. Furthermore, only 34.3 % of the participants reported experiencing stress levels of ≤ 3. The second question asked the participants to indicate how they felt when they did not have their cell phones on them, based on a similar Likert-type scale of 1-7 (1 = a feeling of being "free"; 4 = the feeling of being "inconvenienced"; & 7 = a feeling of being "completely helpless"). The sample reported an average score of M = 4.13 (SD = 1.35) with less than one quarter of the sample (24%) reporting scores of ≤ 3.

Time of Day

Aside from frequency, duration and mode, a fourth component was also measured; time of day. This was designed to answer the important question of "when?" and was used in lieu of directly asking the participants to report the exact times of their ICT use. Results of this analysis showed that participants text messaged at more times throughout the day than they did any other form of ICT behavior (Table 7).

Table 7: Time of Day:Question Design & Responses

Instructions: For the following question, please check the box * that corresponds with the time of day you have used each						
In the past 24 hours, what times of the day have you:						
	6 am-9:59 am	10am-1:59 pm	2 pm-5:59 pm	6 pm-9:59 pm	10 pm-1:59 am	2 am-5:59 am
Talked on cell phone	13,7%	47,3%	64,0%	73,3%	50,7%	7,0%
Text messaged with cell phone	25,7%	73,7%	77,0%	79,3%	71,7%	19,7%
Checked and/or written emails	36,7%	54,3%	57,3%	68,0%	52,3%	7,3%
Instant messaged people	5,0%	20,7%	34,3%	51,7%	49,3%	8,0%
Been on Facebook or MySpace	17,3%	39,3%	53,3%	67,7%	68,0%	11,0%
Played a video game	1,3%	7,0%	9,7%	14,0%	14,0%	3,7%

NOTE: the percentages in the table above are in place of the check boxes used in the original survey question. They present responses from the sample, i.e., 13,7% the sample reported talking on their cell phone between 6 a.m. and 9:59 p.m.

Correlations

There were a number of statistically significant correlations between overall ICT use and being late for class and losing sleep due to talking on a cell phone (Table 8). To summarize, the more frequently (in a 24 hour period) students talked on their cell phones, text messaged, used an IM service, used e-mail, used a SN and the more time throughout the course of a day they spent using a SN, the more likely they were to be late for class because they lost or misplaced their cell phones and the more likely they were to lose sleep because of talking on their cell phones.

Table 8: Correlations between ICT intrusions and ICT use

	Frequency of ICT use (all forms)		Duration of social network use	
	r	p <	r	r
Late for class due to losing/misplacing a cell phone **Lost sleep due to talking on a cell phone**	,20 ,24	0,1 0.1	,22 ,23	0,1 0,1

Without A Cell Phone

One of the more interesting aspects of the correlational analyses was that of the relationships found between the participants' feelings towards not having their cell phones on them and other variables measured. Of all of the correlations, the strongest was between these two statements; stress caused by forgetting cell phone and cell phone helplessness ($r = .74$, $p < .01$), indicating that students who experience more stress when they forget their cell phones are more likely to feel helpless when they do not have their cell phones on them. Relationships between feeling helpless without a cell phone and SN behaviors were also analyzed. Significant correlations were found between feeling helpless without a cell phone and the frequency and duration of SN behaviors (message and wall posting frequency, $r = .24$; browsing frequency, $r = .14$; duration of message and wall posting, $r = .17$ and $r = 0.20$ respectively; and duration of browsing, $r = 0.12$). In other words, increased helplessness without a cell phone was associated with longer and more frequent SN use.

There were also notable correlations between stress caused by forgetting one's cell phone and losing sleep due to ICT use. Results of the analyses suggest that experiencing high amounts of stress as a result of forgetting one's cell phone is significantly correlated with losing sleep due to various ICT usages (cell phone use, $r = .39$; IM Service use, $r = 0.28$; Facebook/MySpace use, $r = .23$; and Email use, $r = .17$). Specifically, students who reported losing more sleep due to cell phone use and SN use also reported experiencing more stress when they forget their cell phones. Furthermore, the average amount of sleep achieved on a weeknight was negatively associated with stress caused by forgetting a cell phone ($r = -.21$, $p < .01$), which indicated that students who reported achieving less sleep on an average weeknight were more likely to experience stress when they forgot their cell phones. In addition, there were a number of significant correlations found losing sleep due to various ICT usages and an increased feeling of helplessness without a cell phone (cell phone, $r = .33$; IM Service, $r = .25$; Facebook/MySpace, $r = .17$). Most notably, loosing sleep due to cell phone use had the strongest correlation with feeling helpless without a cell phone. Finally, there was a negative association between the participants' reported average amount of sleep achieved on a weeknight and cell phone helplessness ($r = -.12$, $p < .05$). That is to say, students who reported feeling more helpless when they do not have their cell phones on their person were more likely to lose sleep due to the use of various forms of ICT and more likely to achieve less sleep on an average weeknight.

Attitudes, Sleep Behavior, and Perceived Stress

Correlational analyses further yielded interesting relationships between study variables. A series of questions were included to capture the participants' attitudes towards social support and forms of communication. One of these questions asked the participants to indicate the degree in which they agreed or disagreed with the statement: "I use text messaging, e-mail, instant messaging, Facebook or MySpace to avoid talking to someone directly". The question utilized a 4-point Likert scale with a 1 indicating that the participant "strongly agreed" with the statement and 4 indicating the participant "strongly disagreed" with the statement. This question was referred to as "degree of avoidance". The analysis revealed an association between degree of avoidance and both; stress caused by forgetting cell phone ($r = -.17$, $p < .01$) and cell phone helplessness ($r = -.12$, $p < .05$). That is, the more the participants agreed to avoiding direct communication with people via a form of ICT, the more stress they experienced when they left their cell phone behind and the more helpless they felt without it. Conversely, the less stress the participants experienced when they left their cell phones behind and the more "free" they felt when they were without their cell phones, the less likely they were to use ICT to avoid talking to people directly. Another question asked the participants to indicate how many times they have been ill in the past 6 months. Results indicated that students who reported a higher incidence of illness also reported experiencing higher levels of stress from forgetting their cell phones ($r = .22$, $p < .01$) and greater feelings of helplessness without a cell phone cell phone ($r = .19$, $p < .01$). PSS10 scores ($r = .16$, $p < .01$), as well as sleep lost due to the following; cell phone use ($r = .15$, $p < .05$), checking/sending e-mails ($r = .13$, $p = .05$), and using a SN ($r = .15$, $p < .01$) were related to illness experience. Illness was also negatively associated with the average amount of sleep achieved on a weekend night ($r = -.15$, $p < .05$) yet there was not a significant relationship between illness and the average amount of sleep achieved on a weeknight.

High PSS10 scores (more perceived stress) were correlated with losing sleep due to cell phone use ($r = .19$, $p < .01$) as well as losing sleep due to e-mail use ($r = .27$, $p < .01$). Losing sleep due to the use of an IM service was also correlated with higher PSS10 scores ($r = .23$, $p < .01$). Losing sleep due to SN use was correlated higher PSS10 scores as well ($r = .20$, $p < .01$). Finally, losing sleep as a result of browsing the Internet was correlated with higher PSS10 scores ($r = .17$, $p < .01$). In summary, the analyses of the participants' attitudes, sleep behaviors, and perceived stress scores revealed relationships with multiple indications. The more students agreed with the use of ICT to avoid talking to people directly, the more likely they were to experience higher illness rates, higher stress due to forgetting their cell phones, more helplessness when they don't have their cell phones on them, higher perceived stress, and more sleep lost due to ICT use. Similarly, the more perceived stress the participants reported (indicated by higher PSS10 scores), the more likely they were to lose sleep due to ICT use.

Discussion

The findings of this study suggest there are specific ICT usage patterns demonstrated within this college student population, various degrees of intrusion caused by ICT use among college students, and a number of important relationships between ICT and health behaviors among college students that have not been merited in prior research. The results indicate that these college students use a multitude of ICT forms for communication purposes. Students typically have and use more than one e-mail account and at least one form of an IM service. Students also rely on their cell phones for communicating and the results indicated that text messaging is preferred over direct contact (face-to-face contact or a phone call) by many. In fact, 62.9% of the sample reported a preference for text messaging when communicating with friends. This is interesting because 92.7% of the sample reported that they are likely to reach out to a friend when they are really stressed. In addition, when compared to how the sample felt about reaching out to a family member when really stressed, 22.3% of the sample reported that they are not likely to reach out to a family member (only 7.3 % reported that they are unlikely to reach out to a friend). This may indicate that students prefer to utilize impersonal, non-verbal forms of communication to utilize social support. Students also appear to have common usage patterns with online SNs. The results indicated that the mean usage time for SNs was slightly below 60 minutes per day. This further supports the suggestion of students' partiality for non-verbal and impersonal communication (Huang, 2006; Huang et al., 2007). Furthermore, it could be hypothesized that a preference for non-verbal, impersonal communication may be detrimental; despite the opulence of features and conveniences ICT offers, communication via ICT is inherently deficient and fails to provide its users with the dialogue of personal interaction.

The results of the analyses not only support the suggestion of students' partiality for impersonal, non-verbal communication, they also suggest other issues that warrant further investigation. Mahatanankoon and O'Sullivan (2008) utilized two expectancy-based constructs (self-efficacy and locus of control) to predict anxiety and attitude valence toward cell phone use and text messages. They found that an enhanced sense of control can prompt further use of text messages via cell phones. With this research in mind it could be proposed that students have a high amount of control over their communication via ICT. SNs, e-mail and cell phones all allow the user to control what messages are conveyed and offer the user the opportunity to not communicate in return. Using ICT for communication in lieu of personal, intimate contact with others may yield deleterious results as one may lose the communication skills and valuable experiences gained through personal and intimate interactions. These concepts were not a focus of this study, but considering the fact that almost half of the sample (47.3%) agreed with the statement "I use text messaging, e-mail, instant messaging, Facebook or MySpace to avoid talking to someone directly (phone call or face-to-face)" and 20.3% of the sample reported using their iPod to avoid talking to people while walking around campus, it is plausible the idea of ICT use having a negative affect on students' communications skills demands investigation. The results of this investigation suggest that a feeling of helplessness can come about when one is without his or her cell phone. The findings of Mahatanankoon and O'Sullivan (2008) imply that anxiety may be an underlying issue with cell phone use, relating to the reported feelings of helplessness in the current study.

Despite these findings, the study also found that 85.7% of the sample agreed that confiding in people face-to-face is more helpful than a phone call, text message, instant message, or SN. Be it a contradiction, this is a very important result to consider. Assuming that human interaction and personal social support (face-to-face contact or directly speaking to someone) is more beneficial in buffering stress than impersonal communication (text messages, social network messages, etc.), it is possible that students are aware of the increased benefit of personal socialization yet still favor impersonal communication.

One possible explanation for this is that ICT has spurred changes in the way people communicate over time. With all of the forms of ICT that exist today, coupled with their high availability, it is possible that young adults are attracted to impersonal communication because of the control it offers. Whether or not students seek and find control through ICT communication (and why they do so) is a discussion for another time. However, what can be hypothesized from these results is that using ICT, even when used as a means of buffering stress, can be an intrusion which causes an increase in perceived stress. Furthermore, forgetting to maintain certain forms of ICT can cause one to experience additional stress (e.g., experiencing stress when forgetting one's cell phone and feeling helpless without it).

In addition to the use of text messaging and SNs as preferred means of communication, the results indicated that ICT can be a significant intrusion on college students' lives. According to the results, talking on a cell phone, using e-mail, using IM services, using SNs, browsing the Internet, and misplacing cell phones accounts for a considerable amount of class tardiness and sleep loss. Students reported that the use of cell phones, e-mail, and SNs were all major contributors of class lateness. The results regarding reasons for lost sleep were somewhat staggering. Almost half of the sample reported losing sleep at east once in the past week due to cell phone and IM use. Over half of the students surveyed (62%) reported losing sleep at least once in the past week due to using Facebook or MySpace and 21.3% reported losing sleep at least 3 times. Over two thirds of the sample (71.7%) reported text messaging between the hours of 10 p.m. and 1:59 a.m. while 19.7% reported text messaging between 2 a.m. and 5:59 a.m. It also appears that SN use happens during that same time with 68% of the sample reporting use between 10 p.m. and 1:59 a.m. and 11% reporting use between 2 a.m. and 5:59 a.m. With this data in mind, consider the recommended hours of sleep per night for college-aged people (18-22 year olds) which is roughly 8 to 10 hours; approximately 33% of the day (National Center on Sleep Disorders Research, 2003). Several studies have supported the belief that sleep habits and quality are related to cognitive and academic performance (Harrison & Home, 1999; Pilcher & Walters, 1997; Pilcher & Ott, 1998; Taub & Berger, 1973). Some well-known research has found that sleep deprived students incorrectly rated their performance as better than that of individuals who were not sleep deprived. These individuals may not see the connection between their reduced performance and their sleep deprivation (Buboltz, Loveland, Jenkins, Brown, Soper, & Hodges, 2006). Compared with the 6.68 hours of sleep the sample reported averaging during the week, it becomes more evident that ICT use can not only be an intrusion, it can also be a health detriment.

Aside from the stress induced by being late for class and losing sleep, the results of the study suggest that ICT use can directly cause stress or can be inherently stressful. More than a third of the sample (37%) reported throwing their cell phones after an angry phone conversation and 20.4% reported to being a victim of cyber bullying at some point in the past. Also important to note is the differences in mean PSS10 scores between the sample of this study and the standards provided by Cohen and Williamson (1983). Although the differences in scores cannot be directly related to ICT use, the participants' PSS10 scores were directly related to frequency of SN use, being late for class because of SN use, and losing sleep due to: cell phone use, e-mail use, IM use, SN use, and browsing the Internet. Furthermore, the less sleep students averaged during the week, the more stress and helplessness they felt without their cell phones. Also, the more occurrences of illness they experienced, the higher their perceived stress scores were.

At this point, a pattern of ICT use, intrusiveness, perceived stress, and social support is clear. The results of the study point toward some specific reasons for ICT use. Students obviously use ICT to communicate with friends and, as this study has shown, is the preferred method of communication. ICT use can then be intrusive, causing either significant class lateness or loss of sleep. These intrusions then cause an increase in perceived stress. Aside from becoming an intrusion and consequently resulting in perceived stress, ICT use can itself be a source of this stress. Naturally, when facing adversity students will turn to social support systems to buffer this stress. Because ICT is the preferred method of communication, students will most likely seek out the benefit of social support via ICT, which will then cause more stress, either by itself or by becoming yet another intrusion. This pattern of ICT use and perceived stress can be a viscous cycle and is illustrated in Figure 1. The more perceived stress that occurs, the higher the utilization of social support via ICT. Because ICT can itself increase perceived stress, the reciprocity of using ICT for the benefits of social support may not be equal and therefore may not allow students to adequately deal with their perceived stress. This proposed cycle presents a challenge for student health professionals and a call for further research in the area of students reliance on ICT as a form of communication.
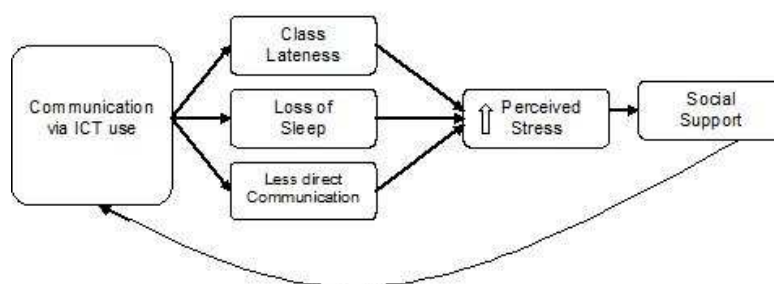

Figure 1: Proposed student ICT-use cycle

Limitations

The use of self-reported questionnaires poses acceptable limitations that require consideration when interpreting the results of this study. The study also utilized a convenience sample that was comprised of mostly female underclassmen, which limits its application of the findings to other populations. In addition to these limitations, the issue of time also comes to mind. The survey used in this study utilized a question that asked students to self-report the times of day of their ICT use by categorizing one 24-hour day into 6 time categories. Although the results provided an invaluable "point in time" insight into when different forms of ICT are used among the college student population, these responses could

not be summed into composite scores and duration of use for cell phone calls, text messages, IM's, e-mail, and video games could not be produced.

Conclusions & future research

The results of this investigation support the notion that ICT use among college students may be a vicious, unhealthy cycle of behavior. Young adults entering into college are faced with new challenges as well as the freedom to approach these challenges with relative carte blanche. Often times, students turn to ICT as a means to cope with a variety of stressors for a variety of reasons. ICT can be very convenient and it can provide the opportunity to keep in contact with a large network of people, however it can also become the preferred form of communication for some. This preference for non-personal communication may contribute to a deficiency in personal communication skills. In addition, high use of ICT can become a major intrusion upon everyday life. These intrusions can drastically increase one's perceived stress, causing some to seek solace in social support. Likewise, if ICT is affecting students' communication preferences and abilities, they may willingly choose to seek out social support through ICT mediums, which in turn can cause more perceived stress and consequently affect health. Future research should account for all forms of ICT, both new and old, to gain a better perspective of the depth of its use. In addition, research should also focus on the duration of all forms of ICT use and the exact times at which they most commonly occur. Once the true depth of use is identified, the task of recognizing the specific disturbances associated with ICT use will become more straightforward. Likewise, it will be easier to identify relationships between ICT use and things such as social support, control, communication and perceived stress. Once these associations are identified, the underlying issues proposed by Kandell (1998); Huang (2006); Gordon, Juang and Syed (2007); Bradley (2000); and Thomee, et al. (2007) can be addressed and implications can be provided for further research and student health professionals alike. Finally, researchers and professionals should be cognizant of the rate of change and advancement of ICT. The importance of this observation is made of good use in a common idiom of technology; "out with the old and in with the new," as changes in ICT will have a profound effect on the ways in which people communicate, cope, socialize, and ultimately live.

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(1) Cyber bullying was defined in the questionnaire as willful communication in the form of electronic text intended to inflict harm and cause emotional distress including; threats, sexual or derogatory remarks, or the act of continually sending e-mails, IM's or text messages to someone who has requested the sender to stop. It can also include the publishing of personal information on websites and other public Internet forums to defame or ridicule someone .

Correspondence to:
Michael Peterson
University of Delaware
023 Carpenter Sports Building
Newark, Delaware, USA
Email: pmpeter et udel.edu

About author(s)

Mike received a B.S. degree in Health and Exercise Science and an M.S.degree in Health Promotion from the University of Delaware, Newark, DE. He is currently a Research Associate for Public Health Management Corporation in Philadelphia, Pennsylvania where he is part of the statewide evaluation team for Pennsylvania's Tobacco Prevention and Control Program. Mike is also involved in the evaluation of Pennsylvania's Clean Indoor Air Act and recently helped conduct a study of compliance with new clean indoor air legislation in Pennsylvania.

Dr. Michael Peterson is a professor at the University of Delaware with graduate degrees in Health Promotion and Behavioral Medicine from the University of Kentucky. Dr. Peterson has extensive experience in behavioral assessment and change. He is the founding director of the graduate Health Promotion program at the University of Delaware which prepares professionals to conduct behavior change interventions at the individual, organizational, and community level. He is also an expert in health and media, social marketing and has developed and implemented numerous research studies related to behavior change via social marketing interventions. He has consulted with a wide variety of private, non-profit, and government agencies in the area of social marketing behavioral change and assessment. Dr. Peterson has been director of the State of Delaware's physical activity social marketing campaign "Get Up And Do Something" and the Lt. Governor's Challenge for the past 9 years. In addition, he has worked on numerous other state and local social marketing campaigns (HIV prevention, immunization, breastfeeding, healthy eating, school attendance, smoking, etc.) targeting a variety of public health audience segments.

Dr. Peterson has been primary investigator of many grant projects that promote health in communities throughout the Mid-Atlantic region, and has created highly acclaimed cutting-edge tools for assessing health-related behavioral, psychosocial, and ecological measures. He is a Senior Scholar at the Thomas Jefferson University College of Medicine, and a health expert with Lluminari Inc (a health and media firm), and on the Social Marketing and Health Communications advisory board for the Nemours Health and Prevention Services organization.