The Media and Technology Usage and Attitudes Scale: An empirical investigation

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ABSTRACT

Current approaches to measuring people's everyday usage of technology-based media and other computer-related activities have proved to be problematic as they use varied outcome measures, fail to measure behavior in a broad range of technology-related domains and do not take into account recently developed types of technology including smartphones. In the present study, a wide variety of items, covering a range of up-to-date technology and media usage behaviors. Sixty-six items concerning technology and media usage, along with 18 additional items assessing attitudes toward technology, were administered to two independent samples of individuals, comprising 942 participants. Factor analyses were used to create 11 usage subscales representing smartphone usage, general social media usage, Internet searching, e-mailing, media sharing, text messaging, video gaming, online friendships, Facebook friendships, phone calling, and watching television in addition to four attitude-based subscales: positive attitudes, negative attitudes, technological anxiety/dependence, and attitudes toward task-switching. All subscales showed strong reliabilities and relationships between the subscales and pre-existing measures of daily media usage and Internet addiction were as predicted. Given the reliability and validity results, the new Media and Technology Usage and Attitudes Scale was suggested as a method of measuring media and technology involvement across a variety of types of research studies either as a single 60-item scale or any subset of the 15 subscales.

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1. Introduction

Until recently, before mobile computer technologies became the norm, measuring media and technology use most often involved monitoring hours and minutes spent doing various computer activities (Kraut et al., 1998; Stanger & Gridina, 1999; Subrahmanyam, Kraut, Greenfield, & Gross, 2000), watching television (Stanger, 1998), playing video games (Phillips, Rolls, Rouse, & Griffiths, 1995) or some combination of those activities (Media Metrix, 1999; Nielsen Media Research, 1999). In the pioneering Home-Net Study, for example, Kraut et al. (1998) reported Internet use in hours per week. Similarly, in a widely quoted study, the Kaiser Family Foundation (Rideout, Foehr, Roberts, & Brodie, 1999) reported a national sample of children ages 2- to 18-year-old children's daily television, movies, computers, music, video games, and radio use in hours and minutes.

Those measurements were only possible because technology interaction—particularly computer use and online activities—was primarily accomplished on stationary devices including desktop and laptop computers or video game consoles. The advent of portable technology—including MP3 players, smartphones and other wireless mobile devices—changed the landscape so that nearly any activity that can be performed on a desktop or laptop machine can also be performed on a small, pocket size device. With a Wi-Fi enabled mobile device, people can access the Internet, e-mail, text, and use applications that can do most traditional computing activities anywhere and at any time of the day or night and research shows that people are doing just that. A recent national study of 7446 18- to 44-year-old smartphone users (IDC, 2013) found that nearly eight in 10 adults and nine in ten young adults reach for their phone within 15 min of waking. Other research (Oulasvirta, Rattenbury, Ma, & Raita, 2012) has demonstrated that adults typically access their smartphones for an average of 34 daily short durations (less than 30 s) while another national study (Mobile Mindset, 2012) showed that 58% of US smartphone users check their phones at least every hour, and 73% feel panicked if they misplace their phone. In a study on Japanese students' cell phone and text message use, Kamibeppu and Sugiura (2005) found that almost half of the respondents experienced a feeling of insecurity when their text messages went unanswered. The students developed insecurity and a perception of being ignored, which the authors concluded could cause great anxiety among children.

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1.1. Methods for assessing technology usage

A survey of recent research indicates that there are four current methods for assessing general technology usage including: (1) time measured in hours or minutes per day or per usage (Becker, Alzahabi, & Hopwood, 2012; Carrier, Cheever, Rosen, Benitez, & Chang, 2009; Junco, 2013; Kimbrough, Guadagno, Muscanell, & Dill, 2012; Padilla-Walker & Coyne, 2011; Pea et al., 2012; Reich, Subrahmanyam, & Espinoza, 2012; Rideout, Foehr, & Roberts, 2010; Rosen, Carrier, & Cheever, 2013; Rosen, Chang, Erwin, Carrier, & Cheever, 2010; Rosen, Whaling, Rab, Carrier, & Cheever, 2013; Turner & Croucher, 2013); (2) frequency measured in the number uses in a particular time period (Burak, 2012; Johnson, 2010; Thompson, 2013); (3) attitudinal Likert-type scales measured on a continuum from strongly agree to strongly disagree (Jenkins-Guarnieri, Wright, & Johnson, 2013a, 2013b; Venkatesh, Thong, & Xu, 2012); and (4) experience sampling, querying use at a particular prompted point in time (Moreno, Jelenchick, Koff, & Eikoff, 2012a; Moreno, Jelenchick, Koff, Eikoff, Diermyer, & Christakis, 2012b; Wang & Tchernev, 2012).

Although it is appealing to measure actual time of usage, this has proven problematic. For example, Junco (2013) compared actual versus self-reported time by first having 45 university students report how many hours and minutes they felt that they accessed Facebook, Twitter, and their e-mail in addition to how much time they searched for information online on a typical day. Following this self-reported time, monitoring software was installed on their computers and their actual use of these websites was evaluated over a one-month period. Although the correlations between self-reports and actual time were significant and reasonably high (e.g., the correlation between self-reported and actual Facebook use was .587 and for e-mail it was .628), the estimates were drastically different. For example, while users self-reported spending an average of 149 min per day accessing Facebook on their computer, the actual average time, according to the monitoring software, was 26 min per day. Similar results were found for all time estimates suggesting that users are not accurate at estimating time they spend on the computer.

1.2. Assessing social media usage

Since the emergence of social media—particularly Facebook—special efforts have been performed to measure its usage. An early attempt saw the creation of the Facebook Intensity Scale (Ellison, Steinfield, & Lampe, 2007), which presented six attitudinal statements (e.g., "Facebook is part of my everyday activity" or "I would be sorry if Facebook shut down") initially as open-ended questions (Ellison et al., 2007) plus an assessment of daily hours and minutes spent on the site and an accounting of the number of Facebook friends on a 10-point numerical scale. Later, the attitudinal questions were modified to be closed-ended requiring Likert scale responses (Steinfield, Ellison, & Lampe, 2008) and several studies have used that scale to assess Facebook activities (Clayton, Osborne, Miller, & Oberle, 2013; Ellison, Steinfield, & Lampe, 2011; Glynn, Huge, & Hoffman, 2012; Jenkins-Guarnieri et al., 2013a, 2013b; Kalpidou, Costin, & Morris, 2011; Kapidzic, 2013; Lampe, Wohn, Vitak, Ellison, & Wash, 2011; Lou, Yan, Nickerson, & McMorris, 2012; Ross et al., 2009; Tazghini & Siedlecki, 2013).

Facebook usage has been measured in other ways including daily time spent on the site (Hunt, Atkin, & Krishnan, 2012; Jelenchick, Eichoff, & Moreno, 2012; Junco, 2012a, 2012b; Karpinski, Kirschner, Ozer, Mellott, & Ochwo, 2013; McAndrew & Jeong, 2012; Moore & McElroy, 2012; Rosen et al., 2013), number of times logging onto Facebook on a typical day (Hunt et al., 2012; Junco, 2012a, 2012b; Kittinger, Correia, & Irons, 2012; Locatelli, Kluwe, & Bryant, 2012; McAndrew & Jeong, 2012; McKinney, Kelly, & Duran, 2012; Moore & McElroy, 2012; Oldmeadow, Quinn, & Kowert, 2012; Rosen et al., 2013; Skues, Williams, & Wise, 2012; Tosun, 2012; Trepte & Reinecke, 2013), and a raw count or assessment of Facebook activities and friends (Clayton et al., 2013; Deters & Mehl, 2013; Kittinger et al., 2012; Moore & McElroy, 2012; Ong , Ang, Ho, Lim, Goh, Lee, & Chua 2011; Pempek, Yermolayeva, & Calvert, 2009).

1.3. Multitasking and technology usage

Numerous research studies have shown a relationship between preference for multitasking or task switching as it is often labeled and the use of various technologies (Media Metrix, 1999; Pea et al., 2012; Rideout et al., 1999; Rideout et al., 2010). For example, Rosen et al. (2013) replicated studies by Gonzalez and Mark (2004), Dabbish, Mark, and Gonzalez (2011) and Judd and Kennedy (2011) in demonstrating that students and office workers switched tasks often and the impetus was most often technological in nature such as an incoming text message or e-mail message or a perceived need to check in with a social network site. A recent study by Moreno et al. (2012a, 2012b) reported that when they sent daily text messages to university students to assess their multitasking activities at random times during the day and evening, more than half the time they were using the Internet they were multitasking. In addition, Carrier et al. (2009) showed that younger people in the Net Generation believe that they can perform more tasks simultaneously, particularly those that are technological, than older members of Generation X or Baby Boomers. Based on these results the proposed measurement tool will include a measure of one's preference for task switching or multitasking.

1.4. The Current Study: developing a comprehensive method for assessment

With such a variety of methods for evaluating media and technology usage and attitudes, it is often difficult to make comparisons across different research studies as each uses its own measurement tools and most often assesses activities and attitudes in a limited domain. In addition, many of the current measurement tools were developed far enough in the past that new technologies have been developed and their usage needs to be assessed. The current study examined a new, comprehensive measurement tool that incorporates prior models for assessing self-reported frequency of media and technology use as well as attitudes toward technology use, rather than relying on inaccurate self-reports of time spent using a variety of technologies.

Nearly all studies measuring time spent using technology ask about computer usage in general or do not differentiate between using the same functions through a variety of devices, including computers and mobile phones. The current measure was created with several precepts: (1) it must measure self-reported frequency of use rather than self-reported time of use; (2) it must include activities performed on computers as well as those on mobile phones and those on dedicated devices such as televisions, music players, and video game players; (3) it must include attitudinal scales to capture beliefs about the use of technology and (4) it must be validated by traditional measures such as self-reported time of use and Internet addiction.

Through a literature search and pilot studies performed by the researchers, a wide variety of constructs were gathered about the use of technology which was, through focus groups, streamlined to include 50 items that spanned usage of all major technologies on a variety of standard devices. Eighteen additional items that measured attitudes toward technology and toward task switching were culled from previous work (Rosen et al., 2013) to form an initial 68-item measurement tool. This tool was evaluated using data

from two separate studies with separate samples to allow an assessment of the validity of the new scales compared to more traditional measures of self-reported time of use, technological anxiety and Internet addiction. Two independent studies using online, anonymous survey methodology—one examining the impact of technology use on magical thinking and the other examining the impact of technology use on sleep—used sets of items for possible inclusion into the Media and Technology Usage and Attitudes Scale. Each of those studies also used identical demographic items as well as items to be used for validity assessment. They will be referred to as the "magical thinking study" and "sleep study" for clarity. Factor analyses were applied to the results from the combined sample to refine a series of subscales based on the data.

2. Methods

2.1. Participants

In both studies participants were required to be at least 18 years of age. Both studies allowed students in an upper division course to participate and/or to solicit participants from the general community. For the magical thinking study 397 participants completed the entire online survey without any incomplete or missing data. For the sleep study 545 participants completed an online survey without any incomplete or missing data. Participants from the two studies were combined to form a sample of 942 participants of which 62% were female, ranging in age from 18 to 73 ($M = 29.96$; $Mdn = 25$; $SD = 12.48$), and including the following ethnic or cultural backgrounds: 9% Asian, 15% Black/African-American, 14% Caucasian, 55% Hispanic and 7% other. The sample included mainly participants with some college (51%), or a college degree (32%), 29% of which were employed part-time and 33% employed full-time. Overall 49% were single, never married and living with family or relatives while 31% were married or living with someone in a romantic relationship; 40% of the sample participants had a mean of 2.68 children while 60% had no children. Participants supplied additional demographic information including residence ZIP code, which was transformed into estimated median income based on U.S. Census figures (U.S. Census Bureau, 2007–2011). Overall median income averaged $41,004 ($SD = 15,007$). These figures match the census figures for the Los Angeles area (U.S. Census Bureau, 2006).

2.2. Materials

2.2.1. Media and Technology Usage and Attitudes Scale (MTUAS)

The proposed media and technology usage portion of the MTUAS, used in both studies, included 50 items. These items were developed by generating a set of possible technology uses including activities performed specifically on a mobile phone (searching for information, browsing the web, using apps, listening to music, taking photos, recording video, reading e-mail, getting directions or using a GPS, checking text messages, sending and receiving text messages, using a mobile phone during class or work time, checking voice calls, making and receiving voice calls, checking phone in the middle of the night, getting news, use while driving), activities performed specifically on a computer (downloading media files, watching video clips, watching television shows or movies, sharing media files), activities performed specifically using a television set (watching TV shows or movies, watching video clips), device-free (non-mobile phone) technological activities (searching the Internet for information, images, videos, or news; sending and receiving e-mail; checking personal, work or school e-mail; sending or receiving files via e-mail; playing games with other people in the same room, playing games alone, playing

games with other people online; listening to music; video chat; texting or instant messaging; shopping), and social networking activities, which were only answered by those indicating that they had a Facebook page (checking Facebook and other social networks, checking from a smartphone, checking from work or school, posting status updates, posting photos, browsing profiles, reading posts, commenting on posts, clicking like). A 10-item frequency response scale was used for these items including: never, once a month, several times a month, once a week, several times a week, once a day, several times a day, once an hour, several times an hour and all the time. Five additional questions queried Facebook users on the number of friends on Facebook, the number of Facebook friends known in person, the number of people met online but never met in person, the number of people regularly interacting with online but never met in person and the number of close friends online never met in person. Each of these was answered on a 9-point numerical scale including 0, 1–5, 51–100 101–175, 176–250, 251–375, 376–500, 501–750 and 751 or more.

Eighteen items were included to assess attitudes toward technology with responses on a five-point Likert scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). These items included attitudes toward the importance of finding any information online, the importance of being able to access the Internet any time, the importance of keeping up with technology, getting anxious without availability of a cell phone, getting anxious without availability of the Internet, feeling dependent on technology, believing that technology will provide solutions to our problems, believing that with technology anything is possible, believing that more gets accomplished due to technology, believing that technology is easy to use, enjoying using technology as soon as it hits the market, believing that technology makes people waste time, believing that technology makes life more complicated and believing that technology makes people more isolated. Finally, this scale included four items taken from the Multitasking Preference Inventory (Poposki & Oswald, 2010) such as "I prefer to work on several projects in a day rather than completing one project and then switching to another." Items were selected from the original 14-question inventory ($\alpha = .88$) by using those with the top four loadings in a factor analysis (Poposki & Oswald, 2010).

2.2.2. Validity scales

Additional validity items were collected in the sleep study that allowed for the assessment of the validity of the MTUAS. These included the following:

- *Daily media usage hours*: Participants were asked nine questions concerning the amount of time they spent "on a typical day" using 10 forms of media and technology (going online, using a computer for other than being online, e-mailing, instant messaging/chatting, phone calling, social networking, texting, video gaming, listening to music, and watching television) and one additional question on reading books or magazines for pleasure on a daily use scale including: not at all, 1–30 min, 31 min to 1 h, 1–2 h, 3 h, 4–5 h, 6–8 h, more than 8 h. Responses were transformed into hours of use by converting each response into hours including not at all (0), 1–31 min (.25), 31 min to 1 h (.75), 1–2 h (1.5), 4–5 h (4.5), 6–8 h (7), more than 8 h (9).
- *Technology-related anxiety*: A set of six items were included that asked, "If you can't check in with the following technologies as often as you'd like, how anxious do you feel?" The list of technologies included: text messages, cell phone calls, Facebook and other social networks, personal e-mail, work e-mail and voice mail and each were assessed on a four-point scale (not anxious at all, a little anxious, moderately anxious, and highly anxious).

- *Internet Addiction Test*: Young's (1998) short 8-item Internet Addiction Test (IAT) was used. This measure includes eight yes/no items taken from the DSM diagnostic criteria for addiction disorders with a higher score indicating more Internet addiction. Inadvertently, Item 2 ("Do you feel the need to use the Internet with increasing amounts of time in order to achieve satisfaction?") and Item 3 ("Have you repeatedly made unsuccessful efforts to control, cut back, or stop Internet use?") were displayed together with only the option to say "yes" or "no" for both. A "yes" on that item was scored as indicating two diagnostic criteria met and a "yes" on any other item was scored as indicating one diagnostic criterion met. IAT scores were treated as a bivariate variable with a score of "5" or more indicating an Internet addiction disorder as noted by Young (1998).

3. Results

3.1. Factor structure of the Media and Technology Usage and Attitudes Scale (MTUAS)

The 50 media usage items were subjected to a varimax-rotated factor analysis using the assumption that the factors would and should be intercorrelated as they all represent uses of similar technologies. Using a factor loading cutoff of .55 and an eigenvalue of 1.0, the analysis yielded 11 usable factors, which included 44 of the items. These are displayed in Tables 1 and 2 and in the Appendix. These 11 factors, which accounted for 68% of the variance, were easily identifiable as representing 11 daily media uses including smartphone usage (9 items accounting for 11.94% of the variance), general social media usage (9 items; 11.61%), Internet searching (4 items; 7.15%), e-mailing (4 items; 6.94%), media sharing (4 items; 5.81%), text messaging (3 items; 5.56%), video gaming (3 items; 4.69%), online friendships (2 items; 4.23%), Facebook

friendships, (2 items; 3.69%), phone calling (2 items; 3.35%), and watching television (2 items; 3.07%). Each factor was computed using the mean score as all items were scaled on the same frequency scale. Overall, 669 participants (71%) indicated that they had a Facebook page. Those who did not participate in social networking were removed from three scales: general social media usage, online friendships and/or Facebook friendships.

The 18 attitudinal items, when subjected to an orthogonal factor analysis with a varimax rotation, resulted in four factors accounting for 66.13% of the variance. Two items failed to meet the .55 threshold and were not included in any factor. With this criterion, the first factor included six items related to positive attitudes toward technology including the importance of finding information online on demand, the importance of access the Internet on demand, the importance of keeping up with technology trends, the assertion that with technology anything is possible, getting more accomplished with technology, and the belief that technology will provide solutions to many of our problems. Items were reversed scored so that higher scores indicated more positive attitudes toward technology. The second factor included three items reflecting anxiety related to being without a phone or the Internet and technological dependence, while the third factor included the four task switching items after reverse scoring one item ("I like to finish one task completely before focusing on anything else") and then calculating the mean score with higher scores indicating a stronger preference to task switch. Finally the fourth factor included three items reflecting negative attitudes toward technology including technology wasting time, technology making people more isolated, and technology being too complicated. Items for two subscales were reversed scored so that higher scores indicated more technology anxiety and dependence and more negative attitudes toward technology, respectively. Each factor was computed using the mean score as all items were measured on the same scale.

Table 1
Factor loadings for first five daily media usage factors (minimum factor loading .55).

Media usage items	Media usage factors				
	1 Smartphoneusage	2 General social media usage	3 Internet searching	4 E-mailing	5 Media sharing
Search for information with a mobile phone	.80				
Browse the web on a mobile phone	.79				
Use apps (for any purpose) on a mobile phone	.74				
Listen to music on a mobile phone	.72				
Check the news on a mobile phone	.69				
Take pictures using a mobile phone	.66				
Record video on a mobile phone	.63				
Read e-mail on a mobile phone	.63				
Get directions or use GPS on a mobile phone	.62				
Read social media postings		.85			
Comment on social media postings, status updates, photos, etc.		.82			
Click "Like" to a social media posting, photo, etc.		.81			
Check Facebook page or other social networks		.80			
Browse social media profiles and photos		.76			
Check Facebook at work or school		.72			
Post social media status updates		.66			
Check Facebook page from smartphone		.65			
Post social media photos		.60			
Search the Internet for informationon any device			.81		
Search the Internet for images or photos on any device			.73		
Search the Internet for news on any Device			.72		
Search the Internet for videos on any device			.72		
Send, receive and read e-mails(not including spam or junk mail)				.87	
Check your personal e-mail				.86	
Check your work or school e-mail				.81	
Send or receive files via e-mail				.81	
Download media files from other people on a computer					.78
Watch video clips on a computer					.76
Watch TV shows, movies, etc. on a computer					.62
Share your own media files on a computer					.61

Table 2
Factor loadings for second five daily media usage factors (minimum factor loading .55).

Media usage factors	Media usage items					
	6 Text messaging	7 Video gaming	8 Online friendships	9 Social media friendships	10 Phone calling	11 Television viewing
Check for text messages on a mobilephone	.72					
Send and receive text messages on a mobile phone	.69					
Use Your Mobile phone during class or work time	.59					
Play games on a computer, video game console or smartphone WITH OTHER PEOPLE IN THE SAME ROOM		.82				
Play games on a computer, video game console or smartphone BY YOURSELF		.79				
Play games on a computer, video game console or smartphone WITH OTHER PEOPLE ONLINE		.78				
Number of people you regularly interact with online that you have never met in person			.80			
People have you met online that you have never met in person			.74			
Facebook friends you know in person				.89		
Friends you have on Facebook				.86		
Check for voice calls on a mobile phone					.69	
Make and receive mobile phone calls					.56	
Watch TV shows, movies, etc. on a TV set						.83
Watch video clips on a TV set						.72

Table 3 displays the means, standard deviations, skewness scores and Cronbach's alpha coefficient of all 15 subscales. All subscales had acceptable to excellent reliabilities. Only two subscales had suspect skewness scores: video gaming (1.13) and online friendships (2.45). In each case the positive skewness was due to a larger percentage of nonusers or infrequent users and a few participants who played video games very often or who reported a large number of online friendships. Both variables were examined as the skewed raw averages and also after splitting the averages into approximate thirds; all analyses of these two scales were performed with the raw scores as well as the tertile splits. Note that based on the mean scores across all participants the most commonly used technologies were text messaging, phone calling, e-mailing and Internet searching, respectively.

3.2. Demographic differences

Comparisons were made between each demographic—gender, age, ethnic background, education, employment, living situation and median income—and the 15 subscales of the Media and Technology Usage and Attitude Scale.

3.2.1. Gender

Across all these demographics only four significant two-tailed differences were apparent with males ($M = 3.63$; $SD = 2.63$) playing video games more often than females ($M = 3.06$; $SD = 2.35$; $t(940) = 3.44$, $p < .001$); males ($M = 2.06$; $SD = 1.25$) having significantly more online friends than females ($M = 1.79$, $SD = 1.11$; $t(940) = 2.91$, $p = .004$); males ($M = 4.14$; $SD = 2.38$) doing significantly more media sharing than females ($M = 3.52$, $SD = 2.19$; $t(543) = 2.55$, $p = .011$); and females ($M = 3.25$; $SD = 1.09$) having significantly less technological anxiety and dependency than males ($M = 3.00$, $SD = 1.08$; $t(940) = 2.55$, $p = .011$). Using the third split variables indicated that a higher percentage of males were in the top third of video game playing frequency [χ^2 (2, $N = 942$) = 15.51, $p < .001$] as well as in the top third of online friendships [χ^2 (2, $N = 669$) = 8.04, $p < .018$].

3.2.2. Age

Table 4 displays the correlations between the subscales and age. As is apparent, older people showed significantly lower daily use of all media/technology items with the exception of online friendships and general Facebook usage. When treated as a tertile split,

there was no significant age difference among the top, middle and bottom thirds of online friendships [$F(2, 666) = .64$, $p > .05$] but there was a significant age difference between tertiles of video gaming [$F(2, 939) = 30.93$, $p < .001$] with lower third (mean age = 34.28) significantly older than those in the middle third ($M = 27.96$) and the top third ($M = 27.54$). In addition, older people showed less positive attitudes toward technology and were less anxious about not checking in with technology but age was not correlated with preference for task switching or negative attitudes toward technology.

3.2.3. Ethnic background

Oneway ANOVAs were used to assess ethnic background differences on the subscales. Only three subscales demonstrated significant differences with both the omnibus F-test and a posthoc Scheffe Test: online friendships [$F(3, 614) = 5.92$, $p < .001$; Black ($M = 2.33$) significantly higher than Asian ($M = 1.64$) and Hispanic ($M = 1.83$)]; voice calls [$F(3, 868) = 3.19$, $p = .023$; Black ($M = 6.89$) significantly higher than Asian ($M = 6.10$)]; and negative attitudes toward technology [$F(3, 491) = 3.44$, $p = .017$; Caucasian ($M = 3.60$) significantly higher than Black ($M = 3.11$)].

3.2.4. Education

Education level was correlated with several subscales including: smartphone usage ($r = .14$, $p < .001$), Internet searching ($r = .20$, $p < .001$), e-mailing ($r = .25$, $p < .001$), media sharing ($r = .08$, $p = .011$), text messaging ($r = .19$, $p < .001$), voice calls ($r = .13$, $p < .001$), positive attitudes ($r = .21$, $p < .001$), and technological anxiety ($r = .19$, $p < .001$). In all cases, more educated participants showed higher scores.

3.2.5. Employment

Part-time employees showed significantly higher scores than either full-time employees or unemployed (mostly students) on the following subscales: smartphone usage, general Facebook use, Internet searching, media sharing, e-mailing, texting, Facebook friends, voice calling and anxiety.

3.2.6. Living situation

Single/unmarried participants showed significantly higher scores than either married participants or separated/divorced/widowed participants on the following subscales" smartphone usage,

Internet searching, e-mailing, media sharing, text messaging, video game playing, Facebook friendships and anxiety.

3.2.7. Median income

Using a one-tailed test, median income was significantly correlated with only general social media use ($r = .07$, $p = .039$) indicating that those who had a higher median income used social media more often.

3.3. Facebook users vs. nonusers

Table 5 displays the comparisons between Facebook users and nonusers on the 12 relevant subscales completed by all participants and, thus, did not include the Facebook usage, online friendships and Facebook friends subscales. As is evident, Facebook users showed significantly more use of nearly all technologies except for television viewing. When examining the tertile split in video gaming, Facebook users were more likely to be in the top and middle third while nonusers were more likely to be in the bottom third [χ^2 (2, $N = 942$) = 58.27, $p < .001$]. In addition, Facebook users showed significantly more positive attitudes and less negative attitudes toward technology but also significantly higher anxiety about not checking in often enough with technology. There was no difference in multitasking preferences between Facebook users and nonusers. A discriminant function analyses was performed using the eight relevant media usage factors (not including the three that relate to social media use, Facebook friendships or online friendships) as potential discriminators between Facebook users and nonusers. Results indicated a significant discriminant function [χ^2 (8, $N = 942$) = 132.59, $p < .001$] with the three highest canonical discriminant function coefficients (beta weights) attributed to: text messaging (.632), Internet searching (.338) and e-mailing (.308). No other coefficient exceeded .175. When the attitudes subscales were included (which were only collected in the sleep study) the discriminant function analysis showed similar results with the reduced sample [χ^2 (12, $N = 545$) = 150.64, $p < .001$] with the top beta weights belonging to text messaging

(.530) followed by Internet searching (.245), and media sharing (.211). All other beta weights were below .180.

3.4. Multitasking and technology usage

Research has demonstrated a positive relationship between technology use and multitasking. Correlations were computed between the preference for task switching subscale and the 11 usage scales of which eight were significant in the predicted direction. Those participants who preferred to task switch showed more usage of smartphones ($r = .10$, $p < .05$), more general Facebook usage ($r = .14$, $p < .01$), more Internet searching ($r = .14$, $p < .001$), more e-mail use ($r = .14$, $p < .001$), more media sharing ($r = .11$, $p < .05$), more text messaging ($r = .10$, $p < .05$), more video gaming ($r = .10$, $p < .05$) and more phone calling ($r = .09$, $p < .05$). Those who preferred to task switch more often also showed more anxiety about not checking in often enough with technology ($r = .21$, $p < .001$) and less positive attitudes ($r = .19$, $p < .001$).

3.5. Validity assessment

3.5.1. Daily media usage hours

Several measures were collected in the sleep study that allowed an examination of the validity of the 15 subscales. A set of questions queried the hours per day that the participant typically used a variety of media and technologies. The top two correlations between these measures of media and technology usage and the new subscales are presented in Table 6. As can be seen, nearly all the top two correlations are the ones that would have been predicted. For example, those who self-reported watching television for more daily hours had a higher frequency of watching television in the MTUAS. This result was also evident for other activities including texting, video game playing, e-mailing, social networking, phone calling and media sharing. One noteworthy result is that those who used smartphones more often spent more hours texting and social networking, which are the two most common smartphone activities.

3.5.2. Technology-related anxiety

Table 7 displays the correlations between each of the subscales and anxiety about not checking in often enough with six different communication technologies. As is evident, with the exception of television viewing, the subscales were all correlated with at lest two areas of anxiety and most correlated with four or five of the six anxiety items. The fact, for example, that those who used smartphones more showed more anxiety about missing out on text

Table 3
Mean, standard deviation, and skewness of subscales.

Subscale	Mean	SD	Skewness	Alpha
Usage subscales				
Smartphone usage[a]	5.00	2.61	.01	.93
General Facebook usage[a]	4.82	2.21	.08	.97
Internet searching[a]	5.64	2.73	.01	.91
E-mailing[a]	5.89	2.37	−.23	.91
Media sharing[a]	3.76	2.29	.97	.84
Text messaging[a]	7.21	2.41	−.85	.84
Video gaming[a]	3.28	2.33	1.13	.83
Online friendships[b]	1.89	1.17	2.45	.83
Facebook friendships[b]	4.92	1.94	.24	.96
Phone calling[a]	6.47	2.06	−.28	.71
Television viewing[a]	5.33	2.42	.42	.61
Attitudes subscales				
Positive[c]	3.66	.84	−.70	.87
Anxiety and dependence[d]	3.15	1.09	−.23	.83
Negative[e]	3.35	.92	−.23	.80
Multitasking preference[f]	3.25	.92	−.05	.85

[a] Scale ranges from 1 to 10 with higher numbers indicating more daily usage.
[b] Scale ranges from 1 to 10 with higher numbers indicating more friendships.
[c] Scale ranges from 1 to 5 with higher scores indicating more positive attitudes toward technology.
[d] Scale ranges from 1 to 5 with higher scores indicating more technological anxiety and dependence.
[e] Scale ranges from 1 to 5 with higher scores indicating more negative attitudes toward technology.
[f] Scores range from 1 to 5 with lower scores indicating increased preference for task switching.

Table 4
Correlations between all subscales and participant age.

Subscale	r	p-value
Usage subscales		
Smartphone usage	−.37	<.001
General Facebook usage	−.07	.083
Internet searching	−.32	<.001
E-mailing	−.25	<.001
Media sharing	−.27	<.001
Text messaging	−.45	<.001
Video gaming	−.21	<.001
Online friendships	−.04	.355
Facebook friendships	−.19	<.001
Phone calling	−.12	<.001
Television viewing	−.10	<.005
Attitudes subscales		
Positive	.21	<.001
Anxiety and dependence	−.29	<.001
Negative	−.03	.482
Multitasking preference	.03	.465

messages and social networks shows validity for this subscale as those are the two main activities that are performed with smartphones. Similarly, the Facebook usage scale was most highly correlated with anxiety about not checking in often enough with social networks and similar results were seen for each subscale with the most anxiety reported by people who used that communication function the most.

3.5.3. Internet Addiction Test

The Internet Addiction Test yielded a bivariate variable where those participants with five or more signs of Internet addiction ($n = 64$; 22%) could be compared to those with fewer than five signs ($n = 230$; 78%). From the MTUAS, an independent t-test indicated that those who were more likely to be addicted to the Internet were those who: used Internet searching more often [$t(292) = -1.96$, $p < .05$]; shared media more often [$t(292) = -3.41$, $p < .001$]; and played video games more often [$t(292) = -2.21$, $p < .05$] all three activities that have been linked to Internet addictive behaviors. The only other variable showing a significant difference between those addicted and those not addicted was anxiety about being without technology and dependence on technology [$t(292) = -3.83$, $p < .001$]. This latter result shows strong validity as these anxieties and dependencies are reflective of items in the IAT.

4. Discussion

Attempts to measure media and technology usage have been widespread and no single measurement tool has been adopted by more than a handful of studies. This makes it difficult to compare results across studies. The current study was designed to develop a tool that could fill that gap and be used across research paradigms in different fields. The initial tool included two parts: a pool of items assessing frequency of usage of various technologies and media and a smaller pool of items assessing attitudes toward technology and toward task switching. The latter items—assessing one's attitude toward either completing one task before

moving to another or working on one task and then switching to another before its completion—have been shown in previous research to relate to technology usage (Rosen et al., 2013). The resultant 60-item measurement tool—the Media and Technology Usage and Attitudes Scale—includes 15 subscales, 11 measuring usage and four assessing attitudes. The subscales can be used together or separately as they are internally reliable and externally valid.

The 11 usage subscales of the new measure provide a solid mixture combining the use of older technologies such as television with newer technologies such as smartphones as well as separating device-based assessments (e.g., smartphone usage subscale, television viewing subscale) from device-free assessments (e.g., Internet searching subscale, e-mailing subscale). They are also phrased in such a manner as to make them available for new items as new technologies emerge.

Three of the 11 usage subscales also involve social networking with two subscales relating directly to Facebook usage and one to generic online friendships. This is of extreme importance given the nearly ubiquitous use of Facebook as the current social network (Smith 2012). When Facebook users and nonusers were compared they showed strong differences on individual subscales of the MTUAS, painting a picture of social media users as consumers of other media and technology—with the exception of television—and possessing both positive attitudes, but also anxieties about missing out on technology as well as feeling dependent on technology. Although two subscales directly relate to Facebook, the individual items can be modified to fit any social networking site or application that may arise in the future.

The MTUAS also offers the inclusion of four attitude-based subscales including both positive and negative attitudes toward technology in general rather than toward any specific technologies as well as attitudes that reflect anxiety and dependence on technology and preferences for task switching over task completion. The addition of these four subscales makes the MTUAS a robust measurement tool as it includes both frequency of usage and attitudes toward that usage where the attitudes expressed are independent of the specific form of technology being used. Again, the MTUAS can be used with or without the attitudinal items.

The 15 subscales of the MTUAS showed strong reliability and validity. In every case when assessing the validity of individual subscales there was a stronger correlation with the predicted subscale and daily media usage, anxiety about not checking in often enough and Internet addiction. This supports the power and stability of the MTUAS. In addition to the direct validity and reliability

Table 5
Comparison between Facebook users ($n = 669$) and nonusers ($n = 273$) on all relevant subscales.

Subscale	Users mean (SD)	Nonusers mean (SD)	t-score
Usage subscales[a]			
Smartphone usage	5.42 (2.44)	3.95 (2.72)	8.10[***]
Internet searching	6.13 (2.50)	4.46 (2.92)	8.82[***]
E-mailing	6.29 (2.07)	4.90 (2.75)	8.49[***]
Media sharing	4.02 (2.25)	3.11 (2.25)	5.68[***]
Text messaging	7.71 (2.00)	6.00 (2.86)	10.38[***]
Video gaming	3.51 (2.49)	2.70 (2.35)	4.61[***]
Phone calling	6.65 (1.88)	6.05 (2.41)	4.07[***]
Television viewing	5.35 (2.40)	5.27 (2.48)	0.48
Attitudes subscales			
Positive[b]	3.85 (.70)	3.26 (.95)	8.15[***]
Anxiety and Dependence[c]	3.39 (.97)	2.67 (1.16)	7.63[***]
Negative[d]	3.23 (.90)	3.58 (.92)	-4.26[***]
Multitasking Preference[e]	3.22 (.91)	3.31 (.93)	-1.11

[***] $p < .001$.
[a] Scale ranges from 1 to 10 with higher numbers indicating more daily usage.
[b] Scale ranges from 1 to 5 with higher scores indicating more positive attitudes toward technology.
[c] Scale ranges from 1 to 5 with higher scores indicating more technological anxiety and dependence.
[d] Scale ranges from 1 to 5 with higher scores indicating more negative attitudes toward technology.
[e] Scores range from 1 to 5 with lower scores indicating increased preference for task switching.

Table 6
Top two correlations between MTUAS subscales and daily hours using media and technology (all correlations are significant at $p < .001$ unless otherwise noted).

Subscale	Top	Second
Usage subscales		
Smartphone usage	Texting (.46)	Social network (.45)
General Facebook usage	Social network (.51)	Online (.37)
Internet searching	Online (.48)	Social Network (.45)
E-mailing	E-mail (.48)	Computer (.40)
Media sharing	Games (.36)	Online (.36)
Text messaging	Texting (.61)	Social network (.43)
Video gaming	Video games (.57)	Online (.41)
Online friendships	Video games (.31)	Social network (.19)
Facebook friendships	Texting (.31)	Social network (.19)
Phone calling	Phone calling (.27)	E-mail (.22)
Television viewing	TV (.41)	IM/Chat (.20)
Attitudes subscales		
Positive	Online (.29)	Social network (.27)
Anxiety and dependence	Social network (.35)	Online (.30)
Negative	IM/Chat (-.16)	E-mail (-.16)
Multitasking preference	Online (-.16)	E-mail (-.12[a])

[a] $p = .004$.

Table 7
Correlations between MTUAS subscales and anxiety about not being able to check in with various technologies.

Subscale	Anxiety about not checking in often enough with specific media/technology					
	Text messages	Phone calls	Social networks	Personal E-mail	Work/school E-mail	Voice mail
Media usage subscale[a]						
Smartphone usage	.44***	.19***	.33***	.17***	.17***	.09*
General Facebook usage	.35***	.23***	.44***	.19***	.08	.04
Internet searching	.32***	.16***	.30***	.30***	.24***	.04
E-mailing	.24***	.17***	.15***	.36***	.38***	.12**
Media sharing	.27***	.14**	.28***	.21***	.18***	.07
Text messaging	.51***	.27***	.29***	.18***	.23***	.07
Video gaming	.24***	.10*	.27***	.16***	.09*	.06
Online friendships	.08	.05	.22***	.14**	.08	.10
Facebook friendships	.31***	.08	.17**	.03	−.04	.01
Phone calling	.20***	.30***	.12**	.20***	.14**	.26***
Television viewing	.06	.05	.09*	.04	.00	.03
Attitude subscale						
Positive[b]	.36***	.29***	.28***	.28***	.21***	.13**
Anxiety and dependence[c]	.57***	.46***	.46***	.36***	.28***	.16***
Negative[d]	−.17***	−.17***	−.21***	−.17***	−.08*	−.09*
Multitasking preference[e]	−.16***	−.12**	−.13**	−.17***	−.16***	−.07

* $p < .05$.
** $p < .01$.
*** $p < .001$.
[a] Scale ranges from 1 to 10 with higher numbers indicating more daily usage.
[b] Scale ranges from 1 to 5 with higher scores indicating more positive attitudes toward technology.
[c] Scale ranges from 1 to 5 with higher scores indicating more technological anxiety and dependence.
[d] Scale ranges from 1 to 5 with higher scores indicating more negative attitudes toward technology.
[e] Scores range from 1 to 5 with lower scores indicating increased preference for task switching.

assessment, the 15 MTUAS subscales were also examined as a function of the sample demographics. As expected, the subscale differences were exactly those that one would expect from past research. For example, males were more active in video gaming and media sharing, older people used less technology than younger people, and more highly educated people used more technology than less highly educated people.

One interesting side note is the lack of correlations between median income, as measured by residence ZIP code, and 14 of the 15 subscales with only social media showing a small significant correlation. This result suggests that the once prevalent "digital divide" may no longer be as strong (Zickuhr & Smith, 2012).

4.1. Limitations

This study was done with participants comprised a self-selected sample of convenience from urban Southern California and, as such, was comprised of a unique mixture of cultural backgrounds that may not generalize to other settings. However, the fact that there were very few differences in ethnic backgrounds on the 15 subscales supports the use across any sample. In addition, the residence-based median income assessment showed that the sample was firmly middle class with a range of incomes spanning the typical census figures. The current study also has several other obvious limitations including: (1) combining samples from two different but similar research projects, (2) using online survey methodology to collect data and (3) being collected through university classroom participation and friends and family of those same students. Additional studies with different samples, collected from different parts of the country or the world, should be done to further validate the MTUAS. Further, although validity was assessed with concurrently collected measures of time spent using various technologies, technology-related anxiety, and Internet addiction, future research should consider validating the measurement tool with actual usage measured similar to that done by Junco (2013). In addition to Junco's software monitoring system,

research should also assess mobile device usage, which is more difficult to assess as many users simply check in briefly with their social media, electronic communication, and information apps, taking in the necessary information in a matter of seconds. Any smartphone monitoring system must account for both frequency and time of access to provide validity information for the new measurement tool.

Acknowledgements

Appendix A

Media. and Technology Usage and Attitudes Scale (60 items)

Usage. subscales

This scale includes 44 items which comprise 11 subscales: Smartphone Usage (9 items), General Social Media Usage (9 items), Internet Searching (4 items), E-Mailing (4 items), Media Sharing (4 items), Text Messaging (4 items), Video Gaming (3 items), Online Friendships (2 items), Online Friendships (2 items), Facebook Friendships (2 items), Phone Calling (2 items) and TV Viewing (2 items)

10-point frequency scale for items 1–40 (with scoring in parentheses):

Never (1)
Once a month (2)
Several times a month (3)
Once a week (4)
Several times a week (5)

Once a day (6)
Several times a day (7)
Once an hour (8)
Several times an hour (9)
All the time (10)

Please indicate how often you do each of the following e-mail activities on any device (mobile phone, laptop, desktop, etc.)

1. (E-mailing subscale) Send, receive and read e-mails (not including spam or junk mail).
2. (E-mailing subscale) Check your personal e-mail.
3. (E-mailing subscale) Check your work or school e-mail.
4. (E-mailing subscale) Send or receive files via e-mail.

Please indicate how often you do each of the following activities on your mobile phone.

5. (Text messaging subscale) Send and receive text messages on a mobile phone.
6. (Phone calling subscale) Make and receive mobile phone calls.
7. (Text messaging subscale) Check for text messages on a mobile phone.
8. (Phone calling subscale) Check for voice calls on a mobile phone.
9. (Smartphone usage subscale) Read e-mail on a mobile phone.
10. (Smartphone usage subscale) Get directions or use GPS on a mobile phone.
11. (Smartphone usage subscale) Browse the web on a mobile phone.
12. (Smartphone usage subscale) Listen to music on a mobile phone.
13. (Smartphone usage subscale) Take pictures using a mobile phone.
14. (Smartphone usage subscale) Check the news on a mobile phone.
15. (Smartphone usage subscale) Record video on a mobile phone.
16. (Smartphone usage subscale) Use apps (for any purpose) on a mobile phone.
17. (Smartphone usage subscale) Search for information with a mobile phone.
18. (Text messaging subscale) Use your mobile phone during class or work time.

How often do you do each of the following activities?

19. (TV viewing subscale) Watch TV shows, movies, etc. on a TV set.
20. (TV viewing subscale) Watch video clips on a TV set.
21. (Media sharing subscale) Watch TV shows, movies, etc. on a computer.
22. (Media sharing subscale) Watch video clips on a computer.
23. (Media sharing subscale) Download media files from other people on a computer.
24. (Media sharing subscale) Share your own media files on a computer.
25. (Internet searching subscale) Search the Internet for news on any device.
26. (Internet searching subscale) Search the Internet for information on any device.

27. (Internet Searching Subscale) Search the Internet for videos on any device.
28. (Internet searching subscale) Search the Internet for images or photos on any device.
29. (Video gaming subscale) Play games on a computer, video game console or smartphone BY YOURSELF.
30. (Video Gaming Subscale) Play games on a computer, video game console or smartphone WITH OTHER PEOPLE IN THE SAME ROOM.
31. (Video gaming subscale) Play games on a computer, video game console or smartphone WITH OTHER PEOPLE ONLINE.

Do you have a Facebook account? If the answer is "yes," continue with item 32; if "no", skip to the *Attitudes subscales* below. NOTE: The word "social media" may be substituted for Facebook in the question stem above and in items 32–34.

How often do you do each of the following activities on social networking sites such as Facebook?

32. (General social media usage subscale) Check your Facebook page or other social networks.
33. (General social media usage subscale) Check your Facebook page from your smartphone.
34. (General social media usage subscale) Check Facebook at work or school.
35. (General social media usage subscale) Post status updates.
36. (General social media usage subscale) Post photos.
37. (General social media usage subscale) Browse profiles and photos.
38. (General social media usage subscale) Read postings.
39. (General social media usage subscale) Comment on postings, status updates, photos, etc.
40. (General social media usage subscale) Click "Like" to a posting, photo, etc.

Please answer the following questions about your Facebook and other online friends. NOTE: In items 41 and 42 the words "social media" (or any specific social media site) may be substituted for Facebook.

9-point scale for items 37–40 (with scoring in parentheses:

0 (1)
1–50 (2)
51–100 (3)
101–175 (4)
176–250 (5)
251–375 (6)
376–500 (7)
501–750 (8)
751 or more (9)

41. Facebook friendships subscale) How many friends do you have on Facebook?
42. (Facebook friendships subscale) How many of your Facebook friends do you know in person?
43. (Online friendships subscale) How many people have you met online that you have never met in person?
44. (Online friendships subscale) How many people do you regularly interact with online that you have never met in person?

Attitudes. subscales

These subscales includes 16 items, which comprise four subscales: Positive Attitudes Toward Technology (6 items), Anxiety

About Being Without Technology or Dependence on Technology (3 items), Negative Attitudes Toward Technology (3 items) and Preference for Task Switching (4 items)

5-point Likert scale for all items (with scoring in parentheses):

Strongly agree (5)
Agree (4)
Neither agree nor disagree (3)
Disagree (2)
Strongly disagree (1)

1. (Positive attitudes) I feel it is important to be able to find any information whenever I want online.
2. (Positive attitudes) I feel it is important to be able to access the Internet any time I want.
3. (Positive attitudes) I think it is important to keep up with the latest trends in technology.
4. (Anxiety/dependence) I get anxious when I don't have my cell phone.
5. (Anxiety/dependence) I get anxious when I don't have the Internet available to me.
6. (Anxiety/dependence) I am dependent on my technology.
7. (Positive attitudes) Technology will provide solutions to many of our problems.
8. (Positive attitudes) With technology anything is possible.
9. (Positive attitudes) I feel that I get more accomplished because of technology.
10. (Negative attitudes) New technology makes people waste too much time.
11. (Negative attitudes) New technology makes life more complicated.
12. (Negative attitudes) New technology makes people more isolated.
13. (Preference for task switching) I prefer to work on several projects in a day, rather than completing one project and then switching to another.
14. (Preference for task switching) When doing a number of assignments, I like to switch back and forth between them rather than do one at a time.
15. *(Preference for task switching) I like to finish one task completely before focusing on anything else.
16. (Preference for task switching) When I have a task to complete, I like to break it up by switching to other tasks intermittently.

*Scoring for item 15 is reversed with strongly agree = 1 and strongly disagree = 5.

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