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Screen Addiction and Media Multitasking among American and Taiwanese Users

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ABSTRACT

This cross-country survey research investigated the relationship between screen addiction and media multitasking and examined factors that mediate and moderate this relationship. The web survey recruited Internet users owning multiple devices in the United States ($N = 798$) and Taiwan ($N = 834$). Although American users spent longer time on screen devices and engaged more in media multitasking more, Taiwanese respondents had higher screen addiction. Results showed that media multitasking and screen device use were positively related to screen addiction. Country of respondents' residence moderated the relationship between media multitasking and screen addiction. Additionally, screen device usage mediated the positive effects of media multitasking on screen addiction. Finally, leisure boredom moderated screen device usage's mediating effects on the relationship between media multitasking and screen addiction, which differed in two countries. Young people and females tended to have high levels of screen addiction. Implications of screen addiction and media multitasking were discussed.

KEYWORDS

Screen addiction; media multitasking; leisure boredom; screen device usage; cross-country comparison

Introduction

Utilizing media-enabled screen devices has become inseparable from daily life when an increasing number of people worldwide engaged in multiscreen media consumption,¹⁻³ which facilitates media multitasking behaviors. The pervasiveness of mobile devices provides the backbone for connecting cross-platform media activities. The multiple functionalities and various mobile activities have led to the increased dependency of individuals on mobile devices.^{4,5} Previous media addiction studies^{6,7} on mobile addiction or dependency have progressed considerably.^{4,8} According to LaRose, Lin, and Eastin,⁷ media addiction is regarded as a type of behavioral addiction without external chemical substance influence. In the same vein, screen addiction in this study refers to a continuum of unregulated media behaviors using multiple screen devices, extending from compulsive media consumption to extremely problematic and even pathological behaviors. These types of screen device addictions can occur during using various devices, such as personal computers (PCs), laptops, smartphones, and tablets, resulting in maladaptive symptoms (e.g., inability to control craving, withdrawal/escapism, productivity loss, and feeling anxious and lost).⁴ Screen addiction is likely to cause poor psychosocial and physical health⁶ and unsatisfactory academic or work performance due to excessive use.^{5,8,9}

With the advancements in wireless networks and screen technologies, media multitasking has become prevalent,^{3,10-12} and research on this behavior has grown in recent years.¹³⁻¹⁸ Scholars have defined media multitasking as simultaneous media usage via several devices.^{17,19} On the one hand, media multitasking has been regarded as a critical skill for work, study, and leisure in the digital society^{20,21}; on the other hand, increasing

concerns have been raised about heavy multitaskers' decreased cognitive control and socio-emotional regulation,²² which may correlate with screen device addiction. Although prior studies have highlighted the predictors for different types of screen addiction (e.g., Internet, computer, and mobile phone/smartphone) and their implications on the physical, psychological, and socio-emotional health of individuals,^{6,23,24} little research focuses on the link between media multitasking and the emerging concept of screen addiction. Hence, this survey research highlights several key questions when examining Internet users in the United States and Taiwan: How can media multitasking influence the level of screen addiction? What kinds of socio-psychological and behavioral variables may mediate the relationship between media multitasking and screen addiction? How do these effects differ by country of respondents' residence?

This study examines screen addiction (to PC, laptop, smartphone, and tablet) and its relationships with media multitasking, device usage, leisure boredom, and country of residence, while controlling age, gender, and media ownership. As past studies have primarily investigated a specific type of media addiction in a country, this cross-country survey in the United States and Taiwan that focuses on screen addiction will contribute to the existing media addiction and multitasking literature by comparing cultural differences. The findings can provide robust evidences that explain the complex relationships of screen addiction with media multitasking and other variables (e.g., screen device use, leisure boredom, and country). Practically, the findings will shed light on the development of strategies to alleviate harmful consequences of screen addiction and media multitasking.

Theoretical background and hypotheses

Screen addiction is the key concept being examined as the dependent variable in this study. Although addiction is a term traditionally reserved for bodily or psychological dependence on a physical substance,²⁵ recent research has examined different forms of technological addictions,²⁶ including Internet,^{27,28} computer game,^{29–31} social media,^{32,33} and mobile phone or smartphone addictions.^{8,34} These media addictive behaviors are viewed as a form of the repetitive media habit involving loss of self-control and ineffective self-regulation, thus increasing health risks and social problems.^{35,36} As multiscreen devices provided sophisticated and diverse services, users develop increasing dependency or addiction in their extensive use.^{4,25} Despite its pervasiveness, no scholarly research has provided any definition of the screen addiction. Grounded upon mobile addiction,^{4,25} this study defines screen addiction as a continuum of unregulated media behaviors to use multiple screen devices (e.g., PCs, laptops, smartphones, and tablets) compulsively, which is manifested by maladaptive symptoms (e.g., inability to control craving, withdrawal/escapism, productivity loss, and feeling anxious and lost). Different from goal-oriented media dependency to solve individual problems and satisfy needs,⁹ screen addiction may cause potential physical, emotional, and social harm to individual users.^{8,37,38} In a sensitive occupational context, high levels of concentration on task performance are required to avoid the negative consequences of distraction caused by screen addiction.³⁹ This finding demonstrates an urgent need to uncover the factors affecting screen addiction, especially when a considerable number of people routinely engage in multiscreen activities.

Media multitasking and screen addiction

Media multitasking is defined in this study as the simultaneous use of multiple media activities simultaneously on several devices.¹⁷ Media multitasking has become prevalent in well-connected, multiscreen environments.⁴⁰ People multitask in various media to satisfy their habitual needs in using various devices,^{41,42} including fulfilling ritualistic, automatic, and taken-for-granted motives.^{40,43} However, past research has shown the negative effects of media multitasking on the well-being of users. For example, Ophir, Nass, and Wagner⁴⁴ used the media multitasking index (MMI) to evaluate multitasking levels across media types and platforms (e.g., print media, texting, music, and social media) and found that heavy multitaskers had low performance on cognitive tasks. Loh and Kanai²² discovered the positive correlations among a high MMI score, Internet addiction, and impulsivity. Increased multitasking was also found to be positively associated with a high level of inability to curb the craving of mobile phone usage, thus deteriorating users' task performance.⁴⁵ Additionally, Kononova and Chiang¹⁶ found that individuals' media addiction was positively associated with levels of media multitasking. People who had deficient self-regulation of media usage tended to develop addictive behaviors.⁴⁶ The literature suggests when users habitually engage in media multitasking, it may result in their inability to control screen

device usage and addiction. Thus, we propose the following hypothesis:

H1: Media multitasking is positively associated with the extent of screen addiction.

Cross-country comparison: United States and Taiwan

This study examines the effects of structural level factor (national media market) on the relationship between media multitasking and screen addiction. Countries that differ in their technological environments apart from cultural characteristics are likely to influence individual multitasking behaviors.^{2,14,47,48} Srivastava⁴⁹ highlighted the impacts of mobile technologies and devices on cultural identities. Vaghefi and Lapointe⁵⁰ emphasized the importance of contextual and environmental factors, such as peer pressure and social norms to enable or inhibit addiction to information and communications technology (ICT). Kononova and Chiang¹⁶ found that the effects of media multitasking on screen devices differed in the United States and Taiwan, because media markets in these countries influenced users' media multitasking. If people are situated in communities that culturally disfavor multiscreen multitasking, they are likely to reduce their tendency for screen addiction. However, societies that regard screen dependency as a social norm may encourage high levels of screen addiction.

In the United States and Taiwan, users have considerable similarities in their accessibility to digital technologies. Both countries have high levels of ICT development and screen device usage. According to International Telecommunication Union,⁵¹ both countries have 80% Internet penetration and exceed 100% mobile phone penetration. Their democratic societies have low constraints on the use of screen devices for information searching, sharing and distribution, and opinion expression. As their media markets and political structures are not that different, culture becomes a crucial factor to explain cross-country differences in media multitasking and screen addiction. Hofstede^{52,53} emphasized people's behavioral differences in collectivistic and individualistic societies. People in collectivistic societies, such as Taiwan, are more likely to use screen devices to facilitate social cohesion^{16,54,55} than those in individualistic societies like the United States. Based on aforementioned literature, we propose the following hypothesis:

H2: Country of respondents' residence will moderate the effects of media multitasking on the extent of screen addiction.

Leisure boredom

Leisure boredom is defined in this study as the experience of inadequate satisfaction from available leisure experiences.⁵⁶ When people have too much time with too few tasks or what they can do is not exciting enough, leisure boredom is likely to occur.²⁵ Typical manifestations of leisure boredom include under-stimulation, under-arousal, and lack of momentum or psychological involvement.^{57,58} Past studies

have shown that people experiencing leisure boredom tended to have a tendency toward substance abuse, such as drugs⁵⁹ and alcohol.^{60,61} Problematic gambling was likely to occur among youths with high leisure boredom.⁶² In terms of screen device use, people with high levels of leisure boredom perceived tablet use as a good stress reduction activity.⁴⁵ Leung⁵⁷ found leisure boredom's considerable influence on Hong Kong adolescents' mobile phone addiction. Leisure boredom also predicted smartphone addiction.^{63,64} Hence, this study proposes the following hypothesis:

H3: Leisure boredom is positively associated with the extent of screen addiction.

Moreover, boredom is associated with risk behaviors, which are characterized by the needs to seek sensation, excitement, and easy distraction.^{61,65} Several studies supported that sensation seeking behavior, which refers to the need for diverse and exciting experiences, can predict media multitasking.^{10,14,66,67} Individual users who felt leisure boredom may seek gratifications by using screen devices for media multitasking. This, in turn, could help individuals fulfill their sensation seeking needs, but will likely increase the risk of screen addiction. In addition, as relaxation was the strongest motivator for predicting media multitasking, leisure boredom moderated the relationship between media multitasking and device use,⁵⁷ wherein the effect of media multitasking on screen addiction tended to be considerably high among people with great leisure boredom. This study further proposes the following research question:

RQ1: How will leisure boredom moderate the effects of media multitasking on screen addiction?

By comparing datasets in the United States and Taiwan datasets, we would like to determine whether the moderating effect of leisure boredom on the relationship between media multitasking and screen addiction varied among countries. Then, we propose the following research question:

RQ2: Will the moderating effect of leisure boredom on the relationship between media multitasking and screen addiction differ by country?

Screen device usage

Spending time online could bring positive outcomes, including productivity increase and improvement in social relationships or civil participation.^{68,69} Using screen devices could provide "brain rewards" through various activities (e.g., texting, emailing, or social media)⁵⁰ that led to informative and pleasurable feelings.⁷⁰ When people interacted with screen devices and obtained gratifications, they were likely to increase the frequency of usage and thus develop reliance on such devices.⁹ The frequency of using mobile Internet and text messages positively predicted Singaporean young adults' smartphone dependency.⁴ Past studies also found that the duration of smartphone use was positively associated with addiction to it.⁷¹ Some users who lacked self-

regulation tended to use media excessively and develop screen addiction.^{7,32} The overuse of screen devices may lead to addictive behaviors^{35,71} and psychosocial and health problems.⁶ Based on aforementioned studies, we present the following hypothesis and research questions:

H4: Screen device usage is positively associated with the extent of screen addiction.

RQ3: Will screen device usage mediate the effects of media multitasking on the extent of screen addiction?

RQ4: How will leisure boredom moderate screen device usage's mediating effects on the relationship between media multitasking and screen addiction and also differ by country?

Control variables: media ownership, age, and gender

This study selects media ownership, gender, and age as control variables which are identified as antecedents of media multitasking in past studies.^{10,14,20,72} Predictors of media multitasking can be grouped into media and audience factors, such as demographic characteristics (e.g., gender and age).¹⁰ First, media ownership is defined in this study as individuals having or being surrounded by media and technologies.^{10,16,20} It was associated with preferences for media multitasking.⁷³ In countries with high media ownership, people tend to engage in media multitasking.^{2,16} Then, past literature has no consensus on *how* media multitasking behaviors vary by gender and age. Duff, Yoon, Wang, and Anghelcev⁶⁶ found that age and gender considerably influence media multitasking, wherein elderly and male respondents tend to have high multitasking levels. Carrier et al.⁷² stated that young generations had a high tendency of media multitasking. Nonetheless, Voorveld and van der Goot⁷⁴ supported that older groups also engaged in media multitasking, but differed in their selections of media devices and functions. According to Cotten, Shank, and Anderson,⁷⁵ more females multitasked with media in different multi-screen activities than males. Furthermore, Srivastava, Nakazawa, and Chen⁷³ found that young respondents tended to multitask more than old respondents. In terms of Internet addiction, gender differences on social communication could explain women's high propensity for using online activities to maintain relationships with family and friends.³⁴ Past studies found gender differences in mobile addiction and Taiwanese female youths tended to have more mobile phone addiction than males.^{34,76} Youths were prone to the risks of addiction behaviors, especially for smartphones activities.^{63,77-79} Moreover, the study has shown that social media addiction was associated with the youth and females.³⁸

Model summary

Figure 1 illustrates a conditional-effects model proposed in this study. Direct and indirect (mediated by screen device usage) effects of media multitasking on screen addiction are predicted to vary with screen addiction based on the different values of moderator 1 (leisure boredom), and the effects of which depend on the levels of moderator 2

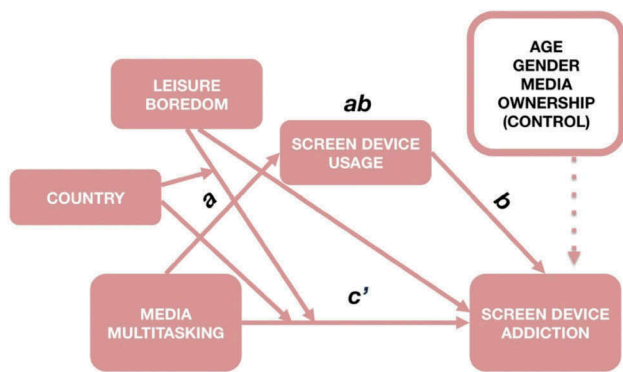


Figure 1. Conditional effects of media multitasking on screen addiction with screen device usage as a mediator and leisure boredom and country as moderators.

(country). The model tests the main and interaction effects of media multitasking, leisure boredom, and country on the mediator (screen device usage; *a*-path); main effects of screen device usage on screen addiction (*b*-path); and main and interaction effects of media multitasking, leisure boredom, and country on screen addiction (*c'*-path). *C'*-path represents the direct effects of independent and moderating variables on the dependent measure, and the product of *a* and *b* (*ab*) represents the indirect (mediating) effects of screen device usage as a moderator. Age, gender, and media ownership (individual device ownership) were included as covariates in the proposed model.

Method

Survey administration and sample

A cross-sectional survey was administered in the United States ($N = 798$) and Taiwan ($N = 834$). Participants from the United States were recruited using an Internet crowdsourcing platform, namely, Amazon Mechanical Turk (MTurk). Studies have shown the usefulness of MTurk in recruiting survey participants for media-related research.⁸⁰ The survey for American participants was administered using Qualtrics. In Taiwan, participants were recruited via the CyberPanel database owned by Taipei-based marketing research InsightXplorer. The survey was administered in Mandarin, the official language of Taiwan. Back translation and post-translation evaluation were performed to ensure instrument validity.

Gender distribution in American sampling was almost equal (49% males to 51% females). The average age was 35 ($SD = 10.13$), ranging from 18 to 73. Approximately 47% of respondents had an associate degree; 24% held a bachelor's degree; 22% of the sample completed high school; and 7% reported other levels of education or refused to answer. The majority of American respondents were White/Caucasian (79%); 7% of them were African American, followed by 6% Asian and 5% Hispanic/Latino. By contrast, all respondents in Taiwan were Taiwanese nationals and Asian. The sample has 50% males and 50% females, with an average age of 35 ($SD = 9.16$).

Measures

Screen addiction

To measure screen addiction, 17 items were adapted from Leung's²⁵ 17-item mobile phone addiction index (MPAI), which was derived from Bianchi and Phillips.⁸¹ Several studies have modified the index to test smartphone dependency.^{4,6} Without any established measure, we adapted MPAI items by replacing "mobile phone" with "your most used screen device" that respondents selected in Q1. This index is suitable to examine complex screen addiction symptoms, including inability to control craving, escapism/withdrawal, feeling anxious and lost, and productivity loss. Sample items include the following: "You feel anxious if you have not checked or switched on your most used device for some time," "You have used your most used device when you were feeling isolated," and "Your productivity has decreased as a direct result of the time you spend on your most used device." Each statement was rated on five-point scales with 1 = not at all, 2 = rarely, 3 = occasionally, 4 = often, and 5 = always. The scale reliability was indicated by Cronbach's alpha, which was remarkably high at .95.

Media multitasking

MMI was calculated on the basis of previous studies.^{14,16,43} Participants reported the total number of hours weekly spent on using screen devices (i.e., desktop computer, laptop, tablet, and mobile phone). They reported how often they used each device simultaneously with other media. The responses were measured on an ordinal scale with four categories, namely, "never," "rarely," "sometimes," and "often." Each category was assigned a numerical value: often = 1, sometimes = .67, rarely = .33, and never = 0. Then MMI was calculated as a ratio of time spent on screen device use for multitasking to the total time spent with all devices.⁴² Specifically, multitasking frequency values were summed for each medium to quantify the extent of media use while performing other tasks. Then, we summed the number of four screen devices' cumulative frequency value per medium multiplied by time spent on the medium. The sum divided by the total hours of using all media generated the MMI value.

Leisure boredom

The boredom subscale of the Leisure Experience Battery⁸² was used to ask participants to what extent they feel bored during their free time. Sample items included: "During my free time I almost always have something to do," and "For me, free time just drags on and on." Items were measured on a 5-point scale ranging from "strongly disagree" (1) to "strongly agree" (5). The factor analysis result indicated the existence of a single factor with a high internal consistency reliability of .81.

Screen device usage

Participants reported the number of hours weekly spent on using the following devices: desktop computer, laptop, tablet, and mobile phone. Then, the hours reported for each device were summed to obtain the total measure of screen device use. We did not include TV and other screen devices (e.g., game consoles) due to the short time spent using such devices.

Media ownership

Media ownership was a control variable. Participants indicated the number of screen devices (e.g., PC, laptop, tablet, and mobile phone) in each household. They also reported their usage of wireless Internet, mobile Internet, and active social media accounts. If the answer was yes or no, then it was assigned the value of “1” or “0,” respectively. Dummy variables representing the ownership of multiple devices and services were summed into one media ownership index ($M = 12.50$; $SD = 3.00$). Participants owned an average of three screen devices.

Country of residence

Participants were recruited in two countries, namely, the United States and Taiwan.

Demographic information

Age and gender were included as control variables in the model as prior research showed that both demographic variables significantly predicted media multitasking.^{20,72}

Results

IBM SPSS Version 23 was used to perform statistical analyses. To test the proposed moderation-mediation model, we installed an open-source macro within the SPSS program, called PROCESS⁸³, which is a flexible statistical tool to test up to 72 conditional effect models.

Cross-sample differences

Five *t*-tests were run to test the country differences in media ownership, screen addiction, leisure boredom, screen device usage, and media multitasking. In Table 1, all results identified significant differences. American participants were found to own more screen devices ($t(1630) = 2.65, p < .01$, Cohen’s $d = .13$), spend more time using screen devices (PCs, laptops, tablets, and mobile phones) ($t(1565) = 8.31, p < .001$, Cohen’s $d = .42$), and engage more in media multitasking ($t(1616) = 7.58, p < .001$, Cohen’s $d = .41$) than Taiwanese counterparts. Yet, Taiwanese participants scored higher than Americans on screen addiction ($t(1630) = -6.77, p < .001$, Cohen’s $d = .34$) and leisure boredom ($t(1628) = -24.92, p < .001$, Cohen’s $d = 1.24$).

Table 1. Cross-country differences (t-tests).

	Country	N	Mean	SD	Cohen’s d
MO	United States	798	3.46**	1.31	.13
	Taiwan	834	3.32**	.81	
SA	United States	798	2.40***	.95	.34
	Taiwan	834	2.69***	.76	
LB	United States	796	2.10***	.81	1.24
	Taiwan	834	2.92***	.47	
SDU	United States	757	54.49***	28.57	.42
	Taiwan	810	42.42***	28.83	
MMT	United States	785	3.83***	1.75	.41
	Taiwan	834	3.21***	1.50	

*** $p \leq .001$. ** $p \leq .01$.

MO = media ownership; SA = screen addiction; LB = leisure boredom; SDU = screen device usage; MMT = media multitasking.

Table 2. Multicollinearity diagnostics.

Variable	Model 1		Model 2		Model 3	
	Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
Age	1.000	1.000	1.000	1.000	.962	1.040
Gender	.998	1.002	.997	1.003	.987	1.013
Media ownership	.998	1.002	.994	1.006	.941	1.063
Country			.995	1.005	.665	1.504
Media multitasking					.838	1.193
Leisure boredom					.683	1.465
Screen device usage					.897	1.115

Regression

Hierarchical multiple regression was used to examine variance in screen addiction explained by each set of variables. Table 2 showed the results of multicollinearity diagnostics, illustrating no correlation among variables that could serve as independent predictors of the dependent variable. VIF values ranged from 1.00 to 1.50 and the lowest tolerance value was .67.

Model 1 included covariates only (age, gender, and media ownership) and accounted for 1.4% of screen addiction variance ($R^2 = .014, F(3, 1542) = 7.22, p < .001$). Age and gender were important predictors of screen addiction, wherein old and male participants were less likely to develop an addiction to screen devices. Media ownership did not predict screen addiction. Adding the variable of country in Model 2 accounted for 5% of variance for the dependent variable ($R^2 = .05, F(4, 1541) = 18.17, p < .001$). Taiwanese participants were more likely to be addicted to screen devices than their American counterparts. Model 3 added another 15% to the variance explained in screen addiction ($R^2 = .20, F(7, 1538) = 54.00, p < .001$), with a set of predictors, including country, media multitasking, leisure boredom, and screen device usage. That is, the more hours participants spent on using screen devices, the more they multitasked with media, and the more bored they felt at leisure; then, the more likely they would get addicted to screen devices.

Conditional effects model

The model was tested with the PROCESS software (model 12).⁸³ It accounted for 22% of variance in screen addiction ($R = .47, R^2 = .22, F(11, 1534) = 38.65, p < .001$). As model 12 tested a total of 21 main and interaction effects on the dependent variable, we adjusted the *p*-value threshold to .002, using the Bonferonni correction method ($0.05/21 = 0.002$, where 21 was the number of tests performed to examine multiple main and interaction effect hypotheses). Thus, only *p*-values $\leq .002$ were considered significant.

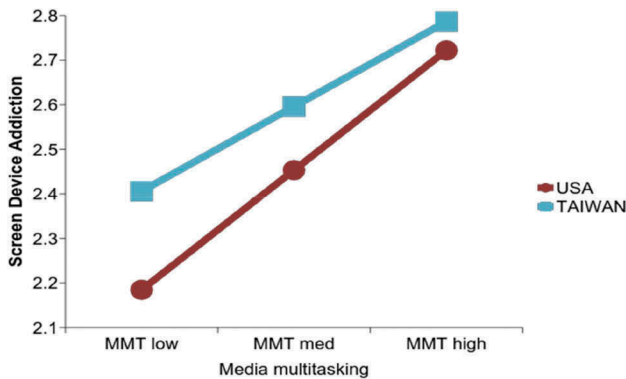
The direct effect of media multitasking on screen addiction (*c*-path) was significant ($B = .11, SE = .02, t = 6.89, p < .001, CI_{LL-UL} = .08$ to $.15$), thereby supporting H1. That is, media multitasking is positively associated with the extent of screen addiction.

Next, the results showed a two-way interaction effect (media multitasking \times country interaction), supporting H2. This case posited that country of respondents’ residence would moderate the effects of media multitasking on the extent of screen addiction. Media multitasking \times country interaction effect on screen addiction was significant ($B = -.06, SE = .02, t = -3.84, p < .001, CI_{LL-UL} = -.09$ to $-.03$). At lower levels of media multitasking,

Table 3. Hierarchical multiple regression (screen addiction = dependent variable).

Variable	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β
Age	-.01	.002	-.10**	-.01	.002	-.10**	-.002	.002	-.02
Gender	.05	.02	.06*	.06	.02	.07*	.05	.02	.06
Media ownership	.02	.02	.02	.03	.02	.10	.02	.02	.02
Country				.15	.02	.18**	.07	.02	.09**
Media multitasking							.14	.01	.27**
Leisure boredom							.32	.03	.28**
Screen device usage							.02	.001	.08**
<i>R</i> ²		.014**			.05**			.20**	
<i>F</i> for change in <i>R</i> ²		7.22**			50.31**			97.25**	

** $p < .001$ and * $p < .017$ (Model 1), * $p < .013$ (Model 2), * $p < .007$ (Model 3); *p*-values are adjusted for multiple hypothesis testing using Bonferonni correction.

**Figure 2.** Interaction effect of media multitasking and country on screen addiction.

Taiwanese respondents indicated greater screen addiction than American respondents. These differences between Taiwanese and Americans, however, became smaller at higher levels of media multitasking (Figure 2).

The main effect of leisure boredom on screen addiction was not significant at the *p*-value threshold of .002 ($B = .42$, $SE = .04$, $t = 11.67$, $p < .01$, $CI_{LL-UL} = .35-.49$), although it could be marginally significant at the critical *p*-value of .01. Thus, H3 was not supported.

RQ1 asked if leisure boredom would moderate the effects of media multitasking on screen addiction. The interaction of media multitasking and leisure boredom on screen addiction was not significant at the critical *p*-value of .002 ($B = .05$, $SE = .02$, $t = 2.53$, $p = .05$, $CI_{LL-UL} = .011$ to $.094$).

RQ2 asked if the moderating effect of leisure boredom on the relationship between media multitasking and screen addiction differed by country. The three-way interaction effect was not significant ($B = .03$, $SE = .02$, $t = 1.36$, $p = .173$, $CI_{LL-UL} = -.01$ to $.07$). The main effect of media multitasking on screen device usage (a-path) was significant ($B = 5.11$, $SE = .59$, $t = 8.69$, $p < .001$, $CI_{LL-UL} = 3.95-6.26$). The more participants multitasked with media, the longer time they would spend on using screen devices. The effect of screen device usage on device addiction (b-path) was also significant ($B = .003$, $SE = .001$, $t = 3.87$, $p < .001$, $CI_{LL-UL} = .001$ to $.004$). Hence, H4 was supported. That is, the more time participants spent on screen device use, the higher the level of screen addiction they reported. Additionally, the results answered RQ3 that screen device usage could mediate the positive effects of media multitasking on the extent of screen addiction.

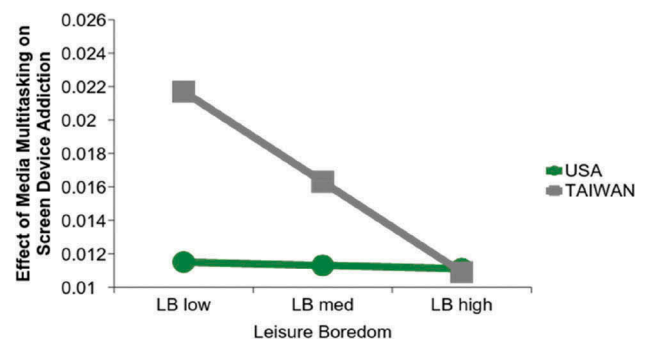
RQ4 asked how leisure boredom moderated screen device usage's mediating effects on the relationship between media multitasking and screen addiction and differed by country of residence. The mediating effect of screen device usage was significant on all levels of country and leisure boredom. In America, the effect of media multitasking on screen addiction mediated by screen device usage stayed somewhat the same, and only slightly increased when the moderator leisure boredom rose. In Taiwan, the effect of media multitasking on screen addiction gradually decreased with the increase in leisure boredom. The differences in the effects between Taiwan and the United States were salient among respondents who perceived low levels of leisure boredom, but the effects became similar among those with high leisure boredom (see Table 3; Table 4; Figure 3).

Discussion and conclusion

The cross-country survey research found that Internet users' media multitasking and screen device use were positively associated with the extent of screen addiction in the United States and Taiwan. People who highly multitasked with media and heavily

Table 4. Effect of media multitasking on screen addiction mediated by screen device usage.

Country	Leisure boredom	Effect	<i>SE</i>	LLCI	HLCI
United States	Low	.0115	.0037	.0053	.0201
	Medium	.0113	.0038	.0050	.0200
	High	.0111	.0045	.0041	.0223
Taiwan	Low	.0217	.0076	.0094	.0399
	Medium	.0163	.0045	.0075	.0280
	High	.0109	.0039	.0047	.0201

**Figure 3.** Effect of media multitasking on screen addiction mediated by screen device usage on different levels of country and leisure boredom.

used screen devices tended to have high levels of screen addiction. The results also showed that the more participants multitasked with media, the longer time they spent on using screen devices. In addition, the results supported that screen device use mediated the positive effect of media multitasking on screen addiction. The finding elucidated a mechanism by which screen device usage could influence screen addiction among heavy media multitaskers. In both countries, when users exhibited excessive usage of screen devices, the probability of screen addiction among heavy media multitaskers increased.

As the results showed that country of residence moderated the effect of media multitasking on the extent of screen addiction, thereby supporting that the contextual and cultural differences in individualistic (United States) and collectivistic (Taiwan) societies could shape the effect of media multitasking on users' extent of screen addiction to PCs, laptops, mobile phones, and tablets. Interestingly, this study found that Taiwanese users tended to have higher degrees of screen addiction, even if they spent less time on screens and engaged less in media multitasking than their American counterparts.

Examining the interaction effect of media multitasking and country on screen addiction, heavy media multitaskers in both countries relied more on using multiple screen devices for media activities, and thus increased their addiction symptoms such as inability to control craving and productivity loss. To be noted, although Taiwanese participants consistently showed greater screen addiction than Americans, at the lower level of media multitasking, the gap between Taiwanese and Americans was larger at the low level than at the high level of media multitasking. The results can be explained when the power of high multitasking exceeded the moderating effect of country on screen addiction, wherein the differences in two countries became less salient.

Additionally, leisure boredom has been identified as a positive factor affecting specific types of device addictions (e.g., mobile phone,²⁴ smartphone phone,⁶³ and tablet). This study is one of the first works to examine the relationship of leisure boredom with screen addiction. The cross-country comparison showed that Taiwanese participants had a higher level of leisure boredom than Americans. Even if the results showed that leisure boredom had no association with screen addiction and no moderating power over the effect of media multitasking on screen addiction, it significantly moderated the mediating effects of screen device usage on the relationship between media multitasking and screen addiction, and differed by country of residence. The results showed that salient differences existed in screen device usage's mediation effects between Taiwanese and American participants. In comparison with the flat slope in American data analysis, the interesting results in Taiwan revealed that the mediation effect of screen device usage on the relationship between media multitasking and screen addiction gradually decreased when participants' leisure boredom increased. That is, when Taiwanese users felt higher levels of leisure boredom, their time spent on screen devices became less crucial (but still significant) in shaping the relationship between media multitasking and screen addiction. As Taiwanese Internet users perceived higher leisure boredom than Americans, this case could

explain why they had less screen devices, less time spent, and less media multitasking, but still had higher screen addiction. These results highlighted the vitality of reducing leisure boredom for preventing screen addiction.

To clarify, users became addicted to screen activities, not devices;⁴ entertaining and exciting screen activities (e.g., gaming and social media) were likely to cause high levels of screen addiction. People who perceived high leisure boredom tended to seek sensational stimulations⁵⁶ and engage in addictive screen-related activities.^{45,63,64} In this study, screen device users with high leisure boredom were likely to seek highly sensational media activities, resulting in negative outcomes, such as overuse and addiction. In Taiwan, screen addiction is a prevalent but alarming phenomenon. Many Taiwanese users who feel bored at leisure easily immerse themselves in screen activities and multitasking to pass the time. Users with high leisure boredom tendency are likely to underestimate their time spent and dependence on using various screen devices, unfortunately resulting in harmful addiction symptoms. These findings imply the high risk of screen addiction in collectivistic Asian culture.

With respect to theoretical contributions, this study is pioneering to examine the factors for predicting, mediating, or moderating the prevailing screen addiction phenomenon in culturally different countries. It expands past addiction research on a single medium or device to the latest multi-screen addiction, and eradicates the complex relationships among key antecedents (e.g., media multitasking, screen device use, leisure boredom, and country of residence) and screen addiction. As the results support that both media multitasking and screen device use positively predict the extent of screen addiction, this innovative study further identifies the substantial effects of cultural differences and leisure boredom on screen addiction. These crucial findings contribute to the literature in media addiction and media multitasking research.

In practice, the findings can shed light on media literacy education to promote the importance of controlling time spent on using screen devices in order to curb screen addiction. Health professionals, educators, and parents should pay extra attention to screen device users with high leisure boredom, and increase their awareness of unhealthy screen media use, because they are prone to high risks of screen addiction. In digitally savvy Asian societies, multiscreen media consumption is a social norm, wherein users unaware of screen addiction may perceive that their increasing engagement in screen activities and media multitasking as a positive way to spend time, rather than imposing self-regulated screen behaviors for healthy outcomes.

Past media addiction studies primarily used the survey approach for generalization purposes. To uncover the complicated psychological conditions of screen addiction, future research is advised to involve psychologists or clinicians to codesign in situ experiments and test the casual relationships between key predictors (e.g., media multitasking and screen device use) and levels of screen addiction or dimensions of addiction symptoms. Next, because screen addiction is a complex and pervasive phenomenon, future research should exert an effort to develop specific measurements

through a rigorous mixed-method research process, in order to advance new media addiction research. Next, it will be critical to further investigate how different media multitasking activities and purposes (social, work, and entertaining) influence screen addiction mediated by time spent on device usage. Future research can also examine how other socio-psychological factors (e.g., self-regulation) influence screen addiction among different social groups.

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