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ORIGINAL ARTICLE

Subjective well-being and internet overuse: A meta-analysis of mainland Chinese students

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Abstract
This meta-analysis tested whether (a) internet overuse was linked to subjective well-being, life satisfaction, positive emotion, or negative emotion and (b) whether participants' geographical region, age, or gender moderated these links. Meta-analysis of 70 primary studies with 68,964 participants showed that students with internet overuse had more negative emotions, less subjective well-being, less life satisfaction, and less positive emotions. Geographic region, age, and gender moderated these links. The link between negative emotions and internet overuse was stronger in studies of participants in Central China and Western China than those of participants in Eastern China. In addition, internet overuse's links to subjective well-being and positive emotions were stronger in studies of younger students than in studies of university students. Lastly, internet overuse's negative links with subjective well-being, life satisfaction, and positive emotion were stronger in samples with more females than with more males.

Keywords Internet addiction · Life satisfaction · Negative emotion · Positive emotion · Subjective well-being · Meta-analysis

Introduction

The rapid development of internet technology has increased the convenience of many tasks for many people, but it has also enticed many people to have an excessive, poorly-controlled preoccupation with internet use (Park et al. 2014). As past studies did not apply clinical diagnoses, we use the phrase *internet overuse* rather than *internet addiction*, *pathological internet use*, *compulsive internet use*, or *internet dependence* (Starcevic and Aboujaoude 2017). Internet overuse is linked to many psychological disorders (e.g., depression, social anxiety disorders, attention deficit hyperactivity disorder, Weinstein and Lejoyeux 2010). Hence, understanding the factors that contribute to it (e.g., personality, parenting, alcohol use, Burnay et al. 2015; Lei et al. 2018, Li et al. 2018a; Shaw and Black 2008; Weinstein and Lejoyeux 2010) or protect against it is crucial to developing suitable interventions to reduce internet overuse and its harmful consequences.

In this study, we examine the relation between subjective well-being (SWB, Diener and Ryan 2009) and internet

Paper originality
- Meta-analysis of 70 studies of 68,964 students
- Students with internet overuse had more negative emotions, less subjective well-being, less life satisfaction, and less positive emotions.
- Results reject *uses and gratification theory*
- Results are consistent with *social displacement*, *social engagement*, *mood enhancement*
- Age, geographic region, and gender moderate these links
- Proposed moderation mechanisms: population density, income, entertainment options

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overuse. SWB is a person's overall cognitive and emotional assessment of his or her quality of life according to his or her own criteria. Researchers have separated out the cognitive component of assessing *life satisfaction* (LS) from the emotional experience components, *positive emotion* (PE) and *negative emotion* (NE, Diener and Ryan 2009). Past studies suggest that these components of SWB are independent of each other (Stones and Kozma 1985). To assess the relations between SWB components and internet overuse, we conducted a meta-analysis of 70 primary studies (with 68,964 participants).

SWB and Internet Overuse

Past studies found a significant negative correlation between SWB and internet overuse (Atroszko et al. 2018; Kabasakal 2015; Lachmann et al. 2016) and suggest a two-way cause-effect relation between them. On the one hand, as virtual communication reduces face-to-face communication, excessive use of the internet can reduce social interactions with family and friends (*social displacement*, Morahan-Martin and Schumacher 2003; Caplan et al. 2009; Shen and Williams 2011). Many people enjoy these social interactions, and these interactions enhance their social relationships. Hence, fewer such interactions can reduce their SWB (LS and PE) and raise their NE (Amorosi et al. 2012; Dalbudak et al. 2013).

On the other hand, people with greater SWB might be less likely to overuse the internet. People with better social and emotional skills have better social relations, more friends, better SWB, and often spend more time with friends and less time on the internet (*social engagement*, Caplan 2005; Engelberg and Sjöberg 2004). Unlike people with high SWB, high LS or high PE, people who are stressed or depressed might try to reduce their NE by (over)using the internet (e.g., online games, online chatting, *mood enhancement*, Park et al. 2013; Mei et al. 2015). More generally, people's emotional states might drive their internet use (Whang et al. 2003). In both social engagement and mood enhancement scenarios, internet overuse is linked positively with NE and negatively with SWB, LS and PE.

However, internet use's positive effects on people's emotions might substantially increase their SWB (Kraut et al. 2002; Morahan-Martin and Schumacher 2003). When individuals achieve psychological satisfaction on the internet, they tend to increase their internet use, which yielded greater internet overuse by people with greater SWB (*uses and gratifications theory*, Parker and Plank 2000). In this scenario, internet overuse is linked negatively with NE and positively with SWB, LS and PE.

As past studies of SWB and internet overuse yielded mixed results (Deng 2009), we meta-analyze them. Furthermore, Deng (2009) argued for modeling these different effect sizes with moderator variables, so we consider demographic explanatory variables that might moderate these relations.

Region Geographic region, age or gender might moderate the link between SWB and internet overuse. China's eastern region has much greater population density and income than its central and western regions (Huang et al. 2006; Li et al. 2016a; Liu et al. 2017). In high-density areas, a person meets many more people, including more people that they befriend. As a result, they are more likely to socialize in person rather than using the internet (Caplan 2005), which can weaken the link between internet overuse and SWB, LS, PE and NE.

Furthermore, people in richer areas tend to have more entertainment options beyond the internet (e.g., museums, theaters, sports events, etc.), so they are more likely to choose non-internet entertainment options (Zhang 2009). Hence, in a high-density or rich region, both overall internet use and internet overuse might be less likely, which would weaken the link between SWB and internet overuse via mood enhancement (Park et al. 2013).

Past studies provide some evidence of this moderation effect. Notably, the link between SWB and internet overuse is weaker in China's eastern region (correlation $r = -0.08$ [Wang et al. 2013]; $r = -.28$ [Li et al. 2016b]) rather than its central ($r = -.37$ [Song et al. 2014]; $r = -.46$ [Tang et al. 2015]) or western region ($r = -.37$; $r = -.50$ [Wang 2016]).

Age Age might also moderate the link between SWB and internet overuse. Based on more entertainment options among college students than high school students, we expect a weaker link between SWB and internet overuse among the former rather than the latter (Zhang 2009) via weaker mood enhancement (Park et al. 2013). Many studies show this pattern (high school students' high r: −.26 [Mei et al. 2015]; −.36 [Tian et al. 2011]; and college students' low r: −.02 [Cui et al. 2015]) but some do not (college students' high r: −.42 [Tian et al. 2011]). To clarify this issue, this study investigated the differences in the levels of SWB and internet overuse among high school students and college students.

Gender Gender might also moderate the link between SWB and internet overuse. In Western countries, females have stronger social skills than males do and hence are less likely to overuse the internet (e.g., Joiner et al. 2012). In China however, males and females often have similar social skills (Burleson et al. 2006; Wanless et al. 2013) but females value social relationships more than males do (Ying and Dai 2008). Hence, social relationship quality affects females' SWB more than males' SWB (Zhang et al. 2007), which might yield a stronger link between SWB and internet overuse among females than among males. Past studies support this claim (males: $r = -.016$ [Yuan and Luo 2007]; −.127 [Liu and Zhou 2014]; females: −.449 [Lu 2009]; −.355 [Liu 2013]).

Purpose of this Study This study synthesizes the results of previous studies on the relationship between SWB and internet overuse, and identifies factors that might influence this relationship. Specifically, there are two objectives: (a) calculate an overall effect size for the relationship between SWB and internet overuse and (b) test for significant moderation effects on the relationship between SWB and internet overuse via region, age, or gender.

Method

Literature Search We searched the following 13 databases for studies on the relations between SWB and internet overuse published during January 2004 to September 2018: China National Knowledge Infrastructure (CNKI), Chongqing VIP Information Co., Ltd. (VIP), WANFANG DATA, Chinese Selected Doctoral Dissertations and Master's Theses Full-Text Databases (CDMD), ProQuest Dissertations, Web of Science, Google Scholar, Springer, Taylor & Francis, EBSCO, PsycINFO, and Elsevier SDOL. For SWB, we searched with these keywords: "subjective well-being," "happiness," or "life satisfaction." For internet overuse, we searched for articles with these keywords: "internet overuse," "internet addiction," "compulsive internet use," "internet dependence," "excessive internet use," or "pathological internet use." These searches initially retrieved a total of 282 articles.

Next, we screened each article according to the following inclusion criteria (see flow chart of the article selection process in Fig. 1): (1) it reports the relation between SWB and internet overuse; (2) it reports either standardized regression coefficient (β) or r, T and F values that could be converted to β values; (3) it reports the sample size; (4) the sample predominantly comprises mainland Chinese students of college age or younger, excluding prisoners or sick individuals; (5) when multiple publications used the same data set, we used the one published in an academic journal, but if the journal article did not use the complete data set, then we used the original publication that analyzes the full data set (based on an examination of the article titles, abstracts, and full text). Seventy articles conformed to these inclusion criteria.

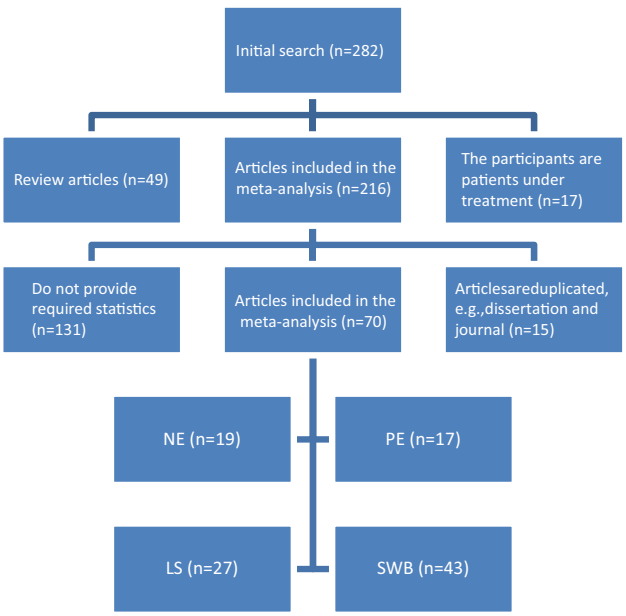

Fig. 1 Flow chart of the study selection process

Coding Variables As summarized in Table 1, the collected articles were coded for the following features: author information, participant characteristics (region, age [youth vs. undergraduate], gender), sample size, and publication date. Effect size was calculated only once, based on each independent sample.

The standardized regression coefficient (beta) between SWB and internet overuse was encoded first. If the same sample yielded multiple effect sizes for SWB and internet overuse, only the overall effect size was selected. Second, the relation between each aspect of SWB (namely, life satisfaction, PE, and NE) and internet overuse was encoded. Third, the relation between SWB and internet overuse was encoded among different groups of participants. If there were multiple methods for measuring the relation between SWB and internet overuse in the article, the most statistically accurate one was used. Comparison of the final results among the above encoding methods showed generally high consistency with one another.

Effect Size Calculation A meta-analysis of standardized regression coefficients in the articles yielded the effect size. Specifically, Fisher's z-transformation was applied, weighted based on the sample size with 95% confidence intervals: $Z = 0.5 * \ln[(1 + \beta) / (1 - \beta)]$, where the variance of Z is $VZ = 1/n - 3$ and the standard deviation of Z is SEZ = square root of $(1/n - 3)$ (Lei et al. 2018).

Data Processing and Analysis We used Comprehensive Meta-Analysis software (CMA Version 2.0) to analyze the data. Homogeneity tests determined whether each result differed significantly from the overall effect size, and informed the selection of a fixed-effect model versus a random-effect model. If a homogeneity test indicated that the effect size was homogeneous, we used a fixed-effect model. If the homogeneity test showed significantly high heterogeneity in the effect size, we used a random-effect model. The random-effect model assumes that the selected studies are random samples from a larger population and seeks to generalize these findings. Also, substantial heterogeneity in the effect size indicates the potential for moderation effects (Card 2011; Lipsey and Wilson 2001).

Table 1 Characteristics of the studies included in the meta-analysis

Name (year)	Region	Age	β_{SWB}	β_{LS}	β_{PE}	β_{NE}	N	Female %
Bi (2017)	eastern	undergraduate	NA	NA	−.308	NA	2184	65%
Cao and Su (2007)	central	youth	NA	NA	NA	.329	128	17%
Chen and Fan (2008a, 2008b)	central	undergraduate	−.149	NA	NA	NA	705	48%
Chen and Fan (2008a, 2008b)	central	undergraduate	−.156	NA	NA	NA	437	46%
Cui et al. (2015)	eastern	undergraduate	−.016	−.095	−.095	.108	200	44%
Deng (2009)	NA	youth	−.220	−.158	−.182	−.065	399	34%
Deng et al. (2015)	central	undergraduate	−.480	NA	NA	NA	1477	43%
Gao et al. (2018)	eastern	undergraduate	NA	NA	−.122	.202	360	54%
Ge (2016)	eastern	undergraduate	−.300	NA	NA	NA	995	16%
Guo (2014)	central	youth	−.255	−.191	NA	NA	1551	58%
Hou (2017)	western	youth	NA	NA	−.087	.470	831	49%
Hu (2014)	central	undergraduate	−.471	NA	NA	NA	1517	43%
Huang (2012)	eastern	undergraduate	NA	−.165	NA	NA	572	44%
Huang et al. (2006)	eastern	youth	−.847	NA	NA	NA	1263	43%
Huang et al. (2014)	central	undergraduate	−.490	NA	NA	NA	1392	43%
Ji et al. (2014)	eastern	undergraduate	−.152	NA	NA	NA	163	66%
Kan (2015)	eastern	undergraduate	NA	−.114	NA	NA	430	86%
Li et al. (2015)	western	undergraduate	NA	−.146	NA	NA	348	68%
Li et al. (2017)	eastern	undergraduate	−.170	NA	NA	NA	598	45%
Li et al. (2018b)	eastern	undergraduate	NA	.167	NA	NA	463	53%
Li and Zheng (2017)	western	undergraduate	−.328	NA	NA	NA	511	53%
Li et al. (2016a, 2016b)	central	undergraduate	−.458	NA	NA	NA	1620	43%
Liang et al. (2006)	NA	undergraduate	−.389	NA	NA	NA	341	NA
Lin et al. (2018)	NA	undergraduate	NA	NA	−.193	.284	1200	59%
Liu (2007)	central	youth	−.545	NA	NA	NA	580	46%
Liu (2013)	western	youth	−.355	NA	NA	NA	279	70%
Liu and Zhou (2014)	central	undergraduate	−.127	−.180	−.111	.191	503	36%
Lu (2009)	eastern	undergraduate	0.444	NA	NA	NA	100	79%
Lu and Zheng (2011)	eastern	undergraduate	−.262	NA	NA	NA	283	55%
Mei et al. (2015)	central	youth	−.255	NA	NA	NA	1551	58%
Ni (2018)	eastern	undergraduate	−.337	NA	NA	NA	550	66%
Ni et al. (2009)	western	undergraduate	NA	NA	NA	.297	3557	32%
Ouyang (2017)	central	undergraduate	NA	−.148	NA	NA	2502	53%
Ouyang et al. (2017)	NA	undergraduate	−.409	−.304	−.304	.229	990	0%
Peng (2011)	western	undergraduate	−.204	NA	NA	NA	347	29%
Qiu et al. (2014)	central	undergraduate	NA	NA	−.229	.533	376	60%
Song et al. (2014)	central	undergraduate	−.371	NA	NA	NA	2675	48%
Tang et al. (2015)	eastern	undergraduate	−.278	NA	NA	NA	966	57%
Tian et al. (2011)	eastern	undergraduate	−.416	NA	NA	NA	526	51%
Wang (2016)	western	undergraduate	−.502	NA	NA	NA	134	56%
Wang (2017)	western	undergraduate	−.181	NA	NA	NA	937	53%
Wang and Xu (2011)	western	youth	NA	NA	NA	.353	500	56%
Wang and Zhang (2015)	eastern	undergraduate	−.270	−.150	−.130	.230	3738	66%
Wang et al. (2017)	eastern	undergraduate	−.165	NA	NA	NA	465	78%
Wang et al. (2013)	eastern	undergraduate	−0.082	−.278	−.326	.305	9532	49%
Wei and Yu (2017)	central	undergraduate	−.304	NA	NA	NA	512	42%
Wen et al. (2016)	NA	undergraduate	NA	.120	NA	NA	339	78%
Wu et al. (2008)	eastern	undergraduate	NA	NA	−.297	−.049	1030	60%
Xia and Chen (2008)	eastern	undergraduate	NA	−.304	NA	NA	679	63%

Table 1 (continued)

Name (year)	Region	Age	β_{SWB}	β_{LS}	β_{PE}	β_{NE}	N	Female %
Xie (2015)	central	undergraduate	NA	NA	−.152	.39	691	63%
Xie and Ji (2010)	eastern	undergraduate	−.210	NA	NA	NA	140	81%
Xu (2016)	central	youth	NA	−.189	NA	NA	300	42%
Xu et al. (2014)	central	undergraduate	−.301	NA	NA	NA	1542	50%
Yan (2012)	central	youth	NA	−.004	NA	NA	425	55%
Yan et al. (2006)	eastern	undergraduate	−.725	−.138	−.229	.104	692	54%
Yang and Xue (2008)	eastern	undergraduate	−.365	NA	NA	NA	603	41%
Yang et al. (2016)	central	undergraduate	−.309	NA	NA	NA	262	NA
Ye (2009)	eastern	undergraduate	−.309	−.158	−.218	.324	1060	45%
Yuan (2014)	central	youth	NA	−.405	NA	NA	960	55%
Yuan and Luo (2007)	eastern	undergraduate	−.189	NA	NA	NA	200	64%
Zeng (2014)	eastern	undergraduate	−.234	−.151	−.125	.181	857	78%
Zhang (2014)	eastern	youth	NA	−.078	NA	NA	358	49%
Zhang et al. (2015)	central	undergraduate	−.308	NA	NA	NA	1455	50%
Zhang et al. (2010)	eastern	undergraduate	−.216	NA	NA	NA	389	42%
Zhao (2004)	eastern	youth	NA	−.334	NA	NA	104	21%
Zheng (2010)	central	undergraduate	NA	−.499	NA	NA	654	54%
Zhou (2013)	eastern	undergraduate	NA	−.500	NA	NA	451	64%
Zhou et al. (2017)	eastern	youth	NA	−.097	.040	.248	3044	55%
Zhou et al. (2008)	western	undergraduate	NA	−.605	NA	NA	256	42%
Zhou and Zhou (2017)	central	undergraduate	NA	−.185	NA	NA	1313	57%

Results

Effect Sizes The 70 articles included 68,964 students, and their sample sizes ranged from 100 to 9532. The random-effect model showed internet overuse's significant negative betas with SWB (−.313; 95% CI: −.377 to −.246; $z = -8.761$; $p < .001$), LS (−.210; 95% CI: −.258 to −.162; $z = -8.301$; $p < .001$), and PE (−.183; 95% CI: −.248 to −.118; $z = -5.403$; $p < .001$). The model also showed a significant positive beta between internet overuse and NE (.251; 95% CI: .201 to .300; $z = 9.499$; $p < .001$) (Table 2).

Moderator Analysis We tested for significant moderation by region, age, and gender. To test for moderation effects of categorical variables (three regions and two age ranges), we used a meta-analysis of variance. To test for moderation effects of a continuous variable (proportion of females), we used a meta-regression analysis

Region As expected, region moderated the link between student internet overuse and negative emotions. Specifically, the homogeneity test for the link between student internet overuse and negative emotions showed significant differences across regions (see Table 3: $Q_{BET\ NE} = 12.897$, $p < .01$), with stronger links in Central China ($\beta = .368$) and Western China ($\beta = .374$) than in Eastern China ($\beta = .189$). However, the homogeneity tests for student internet overuse's relations to their SWB, LS, and PE were all not significant across regions (Eastern, Central, Western, and mixed) ($Q_{BET\ SWB} = .915$, $p > .05$; $Q_{BET\ LS} = 5.256$, $p > .05$; $Q_{BET\ PE} = .794$, $p > .05$).

Age As expected, age moderated the link between student internet overuse and both SWB and PE. The homogeneity test for the links between student internet overuse and both SWB and PE showed significant differences across age (see Table 3: $Q_{BET\ SWB} = 3.939$, $p < .05$; $Q_{BET\ PE} = 4.531$, $p < .05$), with stronger, negative links among youths than undergraduates ($\beta_{SWBy} < \beta_{SWBu}$: −.461 < −.288; $\beta_{PEy} < \beta_{PEu}$: −.209 < −.070). However, the homogeneity test for students' internet overuse's relations to both LS and NE were not significant across age ($Q_{BET\ LS} = .534$, $p > .05$; $Q_{BET\ NE} = .269$, $p > .05$).

Gender Gender moderated student internet overuse's relation with SWB, LS, and PE (see Table 4; SWB: Q_{Model} [1, k = 42] = 84.186; $p < .001$; LS: Q_{Model} [1, k = 26] =19.739; $p < .001$; PE: Q_{Model} [1, k = 16] = 33.191; $p < .001$). Specifically, internet overuse's negative links with SWB, LS and PE are all much larger for an all-female sample (−.525, −.339, and − .439) than those for an all-male sample (−0.108, −.145, and − .042) (see Table 4). Meanwhile, gender did not moderate the relationship between internet overuse and negative emotion (Q_{Model} [1, k = 18] = .026; $p > .05$).

Table 2 Random model of beta links between subjective well-being and internet overuse

	k	Mean β	95% CI for *r*		Homogeneity test			Tau-squared			Test of null (two-tailed)
			LL	UL	$Q(\beta)$	*p*	I-squared	Tau-squared	SE	Tau	z-Value
SWB	43	−.313	−.377	−.246	2407.715	.00	98.256	.057	.020	.238	−8.761***
LS	27	−.210	−.258	−.162	479.413	.00	94.577	.016	.008	.126	−8.307***
PE	17	−.183	−.248	−.118	445.270	.00	96.407	.019	.010	.136	−5.403***
NE	19	.251	.201	.300	325.476	.00	94.470	.012	.007	.111	9.499***

SWB Subjective well-being, *LS* Life satisfaction, *PE* Positive emotion, *NE* Negative emotion, ***$p < .001$

Publication Bias To detect publication bias (Lei and Cui 2016), we draw a funnel plot and run Egger's regression (Egger et al. 1997). The funnel plot indicated that the 43 effect sizes were symmetrically distributed on both sides of the average effect size (see Fig. 2). Egger's regression revealed no significant bias ($t_{SWB(41)} = 1.185$, $p = .243$; $t_{LS(25)} = .311$, $p = .758$; $t_{PE(15)} = 1.299$, $p = .213$; $t_{NE(17)} = 0.775$, $p = .449$). Hence, these tests showed no evidence of publication bias.

Discussion

Internet Overuse and SWB, LS, PE, and NE The meta-analysis results show that internet overuse is linked positively with NE and negatively with SWB, LS and PE. Specifically, students in China with greater internet overuse than other students have lower SWB, lower LS, lower PE or greater NE. Hence, these results reject the inferences from uses and gratification theory that internet overuse should link to greater SWB, LS or PE and less NE (Parker and Plank 2000).

Instead, these results are consistent with three hypotheses: (a) internet overuse might reduce social interactions, which in turn enhance SWB (*social displacement*, Morahan-Martin and Schumacher 2003), (b) students in China with better skills have better social relations, spend more time with their peers and spend less time on the internet (*social engagement*, Caplan 2005), or (c) students in China who are stressed or depressed spend more time on the internet to reduce their negative emotions (*mood enhancement*, Park et al. 2013). As these cross-sectional results do not indicate direction of causality, they cannot provide more evidence for one of these hypotheses over the others. Longitudinal studies with suitable measures of social interactions can further test the validity of these three hypotheses.

Moderating Effects The homogeneity tests showed significant differences in effect sizes across studies, supporting Deng's (2009) argument about the need to study moderator variables. Indeed, the results show that several demographic variables (region, age, gender) moderated internet overuse's links with SWB, LS, PE and NE.

Region As expected, region moderated the link between internet overuse and NE; specifically, this link was weaker in Eastern China than in Central China and Western China. This result is consistent with differences in both population density and income across these regions (Li et al. 2016a, 2016b; Liu et al. 2017). In the denser regions of Eastern China (Liu et al. 2017), a student often meets and befriends more people than students in Central China and Western China, thereby increasing social engagement (Engelberg and Sjöberg 2004), reducing internet (over)-use, weakening the impact of social displacement (Morahan-Martin and Schumacher 2003), and reducing the need for mood enhancement (Park et al. 2013). Longitudinal studies with suitable measures of social interactions can further test the validity of this moderation effect across these three mechanisms.

Also, this weaker NE-internet overuse link in Eastern China than in other China regions is consistent with income differences and quantity of entertainment options competing with the internet. In richer Eastern China (Li et al. 2016a, 2016b), students tend to have and use more non-internet entertainment options (Zhang 2009), which weakens the mood enhancement link (Park et al. 2013), compared to students in other regions of China.

The Moderating Role of Age As expected, age moderated internet overuse's negative link with SWB and PE. Specifically, this link was weaker among university students than among younger students. This result is consistent with more entertainment options among university students than among younger students, which reduces the use and impact of the mood enhancement mechanism via internet (over)use (Park et al. 2013).

The Moderating Role of Gender As expected, gender moderated internet overuse's links with SWB, LS, and PE,

Table 3 Region and age moderators of the association between subjective well-being and internet overuse

	Between-group effect (Q_{BET})	k	Mean β	SE	95% CI for β		Homogeneity test within each group (Q_W)
					LL	UL	
Subjective well-being							
Region	.915						
Eastern		20	−.288	.060	−.385	−.184	1938.590***
Central		15	−.339	.008	−.445	−.224	291.115***
Western		5	−.316	.012	−.498	−.106	24.205**
Mixed		3	−.342	.013	−.564	−.075	12.916*
Age	3.939*						
Younger		6	−.461	.152	−.5944	−.303	912.577***
University		37	−.288	.013	−.355	−.217	1219.532***
Life satisfaction							
Region	5.256						
Eastern		14	−.173	.010	−.243	−.101	255.085***
Central		8	−.233	.014	−.321	−.140	147.184***
Western		2	−.394	.150	−.550	−.213	44.789***
Mixed		3	−.199	.011	−.345	−.042	12.602***
Age	.534						
Younger		8	−.181	.013	−.272	−.087	99.430***
University		19	−.222	.009	−.279	−.163	358.309***
Positive emotion							
Region	0.794						
Eastern		10	−.185	.016	−.272	−.095	410.334***
Central		3	−.164	.003	−.323	.005	3.203(.202)
Western		1	−.087	.000	−.360	.200	0.011*
Mixed		3	−.228	.006	−.380	−.064	9.006*
Age	4.531*						
Younger		14	−.209	.006	−.261	−.155	187.075***
University		3	−.070	.014	−.186	.049	24.456***
Negative emotion							
Region	12.897**						
Eastern		9	.189	.011	.114	.263	162.911***
Central		4	.368	.028	.257	.470	35.850***
Western		3	.374	.012	.254	.483	28.164**
Mixed		3	.160	.023	.027	.288	38.493***
Age	.269						
Younger		5	.275	.034	.169	.375	97.436***
University		14	.243	.011	.182	.303	227.523***

*$p < .05$, **$p < .01$, ***$p < .001$

showing stronger links for female students than for male students in China. These results are consistent with past studies showing that while male and female students in China have similar social skills (Burleson et al. 2006; Wanless et al. 2013), female students value social relationships more than male students do (Ying and Dai 2008), so social relationship quality affects the SWB of female students more than that of male students (Zhang et al. 2007). Together these results of past studies undergird the stronger link between SWB and internet overuse among female students than among male students. These results contrast with those in Western countries, in which females often have stronger social skills than males do, have better social relationships, and are less likely to overuse the internet (e.g., Joiner et al. 2012). Hence, the meta-analysis results highlight the importance of studies in multiple countries to test the universality of conclusions based on evidence in a single country.

Table 4 Meta-regression analyses of gender

	Variable	Parameter	Estimate	SE	z-value	95% CI for *b*	
						LL	UL
Subjective well-being	Female (%)	β_0	−.525	.023	−22.477	−.571	−.479
		β_1	.364	.037	9.844	.292	.437
		$Q_{Model}(1, k = 42) = 84.186, p < .001$					
Life satisfaction	Female (%)	β_0	−.339	.028	−12.050	−.394	−.284
		β_1	.230	.052	4.443	.128	.331
		$Q_{Model}(1, k = 26) = 19.739, p < .001$					
Positive emotion	Female (%)	β_0	−.439	.038	−11.435	−.515	−.364
		β_1	.397	.069	5.761	.262	.532
		$Q_{Model}(1, k = 16) = 33.191, p < .001$					
Negative emotion	Female (%)	β_0	.279	.021	13.018	.237	.331
		β_1	−.006	.039	−.160	−.083	.070
		$Q_{Model}(1, k = 18) = .026, p > .05$					

Limitations and Future Studies

This study's limitations include its original studies' limitations, moderators, cross-sectional data, young participants, single country, and inadequate publication bias tests. The limitations in the original studies (e.g., unstandardized surveys, inadequate reliability checks, demand characteristics/hypothesis guessing, single-responder bias, few variables controlled) constrain the quality of this study's meta-analysis of them and reduce our confidence in the results, especially as the effect size was not large. Hence, we echo many researchers' calls for preregistration of research designs and open science. As this study only tested demographic information for moderation effects, future studies can test whether other variables moderate internet overuse's links with SWB, LS, PE and NE (especially number of available entertainment options, income, and social relationships). Also, this study only analyzed cross-sectional data, which limited testing of social displacement, social engagement, and mood enhancement hypotheses. Future studies can test their validity along with causality via longitudinal studies and appropriate measures. As this meta-analysis only included data on university students or younger students, future research can test whether these findings hold for older participants. Likewise, all participants in these studies were in China, so future studies can examine people in other countries. While our tests do not show publication bias, they are less sensitive for original studies with large samples, so publication bias is still a possibility.

Conclusion

Meta-analysis of 70 studies with 68,964 students in China showed that student internet overuse was linked positively

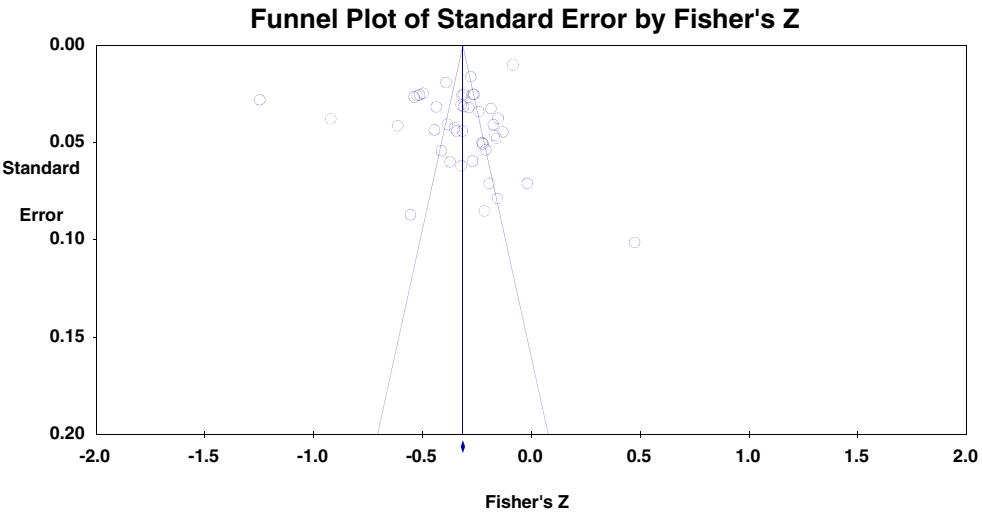

Fig. 2 Funnel plot of effect sizes of the betas between subjective well-being and internet overuse

with negative emotion and negatively with subjective well-being, life satisfaction, and positive emotion. Furthermore, participants' region, age, and gender moderated these relationships. There was a stronger link between negative emotions and internet overuse in studies of participants in Central China and Western China than those of participants in Eastern China. In addition, internet overuse had stronger links to subjective well-being and positive emotions in studies of younger students than in studies of university students. Finally, internet overuse's negative links with subjective well-being, life satisfaction, and positive emotion were stronger in samples with more females than in other samples.

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