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## Internet use and subjective well-being in China

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FACULTY OF BUSINESS, ECONOMICS AND SOCIAL SCIENCES



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IN CHINA

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Discussion Paper 07-2015

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# Internet Use and Subjective Well-Being in China

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## Abstract

Using data from the 2010 China Family Panel Studies, we analyze the association between Internet use and various measures of subjective well-being (SWB) in a sample of 16- to 60-year-old Chinese. Our analysis shows that although intensive Internet use is significantly associated with lower levels of SWB, we hardly observe any associations when the focus is on participation in specific online activities. Nevertheless, SWB depends on perceptions of Internet use; that is, the importance that different individuals ascribe to different purposes for using the Internet and how much they believe that their Internet use is displacing other activities. Our results suggest that, contrary to previous findings, differences in beneficial outcomes (the third level digital divide) do not necessarily arise from individuals' actual Internet use (the second level digital divide) but rather may result from their *subjective perceptions* of such usage. Our findings also point to a possible cultural factor that puts Chinese Internet users at psychological risk.

JEL Classification Codes: I10, D10, J10; Q53

Keywords: China; digital divides; depression; happiness; Internet use; life satisfaction

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# Internet Use and Subjective Well-Being in China

## 1 Introduction

By 2008, China had outstripped the U.S. to become the world's largest Internet user (Wang and Li 2012), with 618 million Chinese “netizens” in 2013 (China Internet Network Information Center [CINIC] 2014). Not only did the country's Internet penetration rate (the proportion of Internet users to total population) increase dramatically from 8.5% in 2005 to 45.8% in 2013 (CINIC 2014), but with a 2013 iGDP<sup>1</sup> of 4.4%, China's Internet economy is larger than those of the U.S., Germany, and France (Woetzel et al. 2014). In fact, Internet-fueled GDP growth is projected to account for 7% to 22% of China's total GDP increase between 2013 and 2025, thereby potentially translating into 4 trillion to 14 trillion yuan in annual GDP (Woetzel et al. 2014). It is thus not surprising that the Internet has given rise to a new lifestyle fabric that has fundamentally transformed Chinese daily life (CINIC 2014).

The rapid growth of Internet use in China—combined with the use of other Information and Communication Technologies (ICTs) such as personal computers and mobile devices—may have a significant impact on individual well-being. Yet despite its growing importance, little is known about such effects among Chinese. China thus provides an interesting case study for exploring the relation between Internet use and Subjective Well-Being (SWB) in the context of a developing non-Western environment. Such is the purpose of this paper, in which we use data from the 2010 China Family Panel Studies (CFPS) to analyze Internet use and SWB among Chinese aged 16–60.

By conducting this analysis, we make several important contributions: First, by focusing on China, we expand the limited number of nationally representative studies outside the Western world. This expansion is important because the different attitudes to and perceptions of Internet use among those from different sociocultural backgrounds (see, e.g., Brosnan and Lee 1998; Li and Kirkup 2007) make it difficult to generalize results from developed societies. Second, because mixed results from prior studies are often attributable to different definitions of Internet use and/or varying measures of SWB (Valkenburg and Peter 2007), we use both positive (life satisfaction and happiness) and negative (depression) SWB measures.

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<sup>1</sup> The iGDP indicator, which measures a country's Internet economy, employs the expenditure approach to calculate GDP. Generally, it sums up all activities associated with the creation and use of Internet networks and services (Woetzel et al. 2014).

We also employ two different methods for measuring Internet use: a macro approach that examines Internet use as a whole and a micro approach that focuses on specific online activities. We are thus able to produce a more differentiated picture of the association between Internet use and SWB. Third, by examining not only Internet use in practice but also attitudes toward Internet use, we provide valuable insights into the little-known mechanisms that drive the Internet use-SWB relation (Kross et al. 2013; Valkenburg and Peter 2007).<sup>2</sup> Fourth, unlike most previous research, which studies the population as a whole or focuses on specific age groups, we investigate the Internet use-SWB association across most of the adult life span, enabling exploration of whether this relation varies among different age groups. Fifth, this analysis is a primer in combining the study of Internet use-SWB associations with the exploration of perceived displacements in daily activities. Lastly, we examine the issue of endogeneity in Internet use, which constitutes an important step toward a fuller understanding of Internet use's impact on SWB.

The remainder of this paper is structured as follows: After reviewing the relevant prior literature, we outline the data and methodologies and then report the estimation results, beginning with descriptive statistics. We next identify the associations between different SWB measures and Internet use intensity (macro results) or different online functions (micro results). We also provide evidence of Internet use's effect on SWB by evaluating user perceptions of the importance of different purposes for Internet use and the sacrifices made to spend time online. Finally, we discuss the potential endogeneity associated with Internet use and then conclude the paper.

## **2 Prior studies**

Although a burgeoning body of literature examines the Internet use-SWB relation, the nature of this association remains unclear, with some studies showing beneficial contributions and others pointing to harmful ones. These contradictions may arise for several reasons:

- First, studies use different measures of SWB, including positive measures such as life satisfaction and happiness (Katsamanis 2006; Kavetsos and Koutroumpis 2011; Kross et al. 2013; Lelkes 2013; Pénard et al. 2013; Sabatini and Sarracino 2014; Shotwell 2002) and negative measures such as depression or loneliness (Amichai-Hamburger and Ben-

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<sup>2</sup> Valkenburg and Peter (2007) identify some potential mechanisms of Internet communication and well-being via social networks among Dutch adolescents aged 10–17.

Artzi 2003; Bakken et al. 2008; Bessiere et al. 2010; Campbell et al. 2006; Cotten et al. 2012; Ford and Ford 2009; Fortson et al. 2007; Franzen 2000; Kraut et al. 1998; Morrison and Gore 2010; Nimrod 2013; Shaw and Gant 2002; Tandoc et al. 2015). We are unaware of any studies that use both positive and negative measures except for Stepanikova et al. (2010), who employ life satisfaction and loneliness as SWB proxies in the hope of shedding light on their simultaneous effects on individual well-being.

- Second, studies differ in their approaches to Internet use, with most adopting either a macro approach (i.e., use vs. nonuse or intensity of use) or a micro approach (i.e., specific online activities). The studies that employ a macro approach are numerous and include, for example, the work of Amichai-Hamburger and Ben-Artzi (2003), Bakken et al. (2008), Campbell et al. (2006), Ceyhan and Ceyhan (2008), Cotten et al. (2012), Franzen (2000), Ford and Ford (2009), Katsamanis (2006), Kraut et al. (1998), Kross et al. (2013), Lelkes (2013), Pénard et al. (2013), Sabatini and Sarracino (2014), Tandoc et al. (2015), and Wickramasinghe and Ahmad (2013). Those using a micro approach, however, are somewhat fewer (see, for example, Bessiere et al. 2010; Cotten et al. 2011; Fortson et al. 2007; Morrison and Gore 2010; Nimrod 2013; Stepanikova et al. 2010). With the exception of three U.S. studies (Bessiere et al. 2010; Kraut et al. 2002; Stepanikova et al. 2010), we know of no other research that simultaneously applies a combined macro-micro approach that is crucial for accurately identifying the effects of Internet use on SWB.
- Third, nearly all prior studies focus on behavior (i.e., actual Internet use) and SWB, with only a few exploring the intervening psychological factors, such as perceptions or attitudes toward Internet use. One exception is the study by Selfhout et al. (2009), which shows that Dutch adolescents (with an average age of 15) who have perceived low-quality friendships surf the Internet for longer and are more likely to suffer from depression and social anxiety. Combining the study of behavior with such psychological factors may provide important insights on the mechanisms by which Internet use affects well-being.
- Fourth, whereas earlier studies examine the general population (Bessiere et al. 2010; Cotten et al. 2011; Fortson et al. 2007; Franzen 2000; Kraut et al. 2002; Morrison and Gore 2010; Pénard et al. 2013; Wickramasinghe and Ahmad 2013) or specific age groups, such as adolescents (Selfhout et al. 2009; Valkenburg and Peter 2007) or older adults

(Cotten et al. 2012; Ford and Ford 2009; Katsamanis 2006; Lelkes 2013; Shotwell 2002), we know of none that explores Internet use and well-being across the lifespan. Yet because individuals in different life stages (and different cohorts) may have different psychosocial needs, such exploration may explain many contradictions. That is, not only can individuals be expected to vary in their uses for the Internet but also in the benefits they gain from it.

- Fifth, the effect of Internet use on SWB depends heavily on the opportunity costs associated with the time spent online; that is, which activities are being displaced by Internet use. The various notions of media displacement suggest that an increase in the use of one medium comes at the expense of other media use and activities (symmetrical displacement) and that the functions of an old medium can be replaced by those of a new one (functional displacement). Both types of displacement are considered mechanisms that regulate media use (Newell et al. 2008). Yet, despite some research on how traditional media and social activities are displaced by new media use (Nossek et al. 2015; Mannell et al. 2005, respectively), we know of none that simultaneously examines the associations between the Internet use-SWB relation and perceived patterns of displacement. It should also be noted that exploring perceived patterns of displacement may be more valuable than actual displacement because they reflect users' *judgments* of their own behavior, which may more greatly impact SWB than the behavior itself.
- Finally, few studies actually address the causal relation between Internet use and SWB even though reverse causality and selection issues are omnipresent in such analyses. Of the few papers that address the endogeneity of Internet use, the most relevant for our study are those of Pénard et al. (2013), who analyze data from the Luxemburg section of the European Value Survey, and Sabatini and Sarracino (2014), who draw on 2010 and 2011 data from the Multipurpose Survey of Households in Italy. Pénard et al. (2013), using a two stage least squares (2SLS) approach with Internet diffusion among family as the instrument, find that Internet use has a significantly positive impact on SWB. In particular, they show that non-Internet users are less satisfied with life than Internet users and that the Internet has more influence on life satisfaction than on happiness. Sabatini and Sarracino (2014) also employ a 2SLS technique but use as their two instruments the share of the population within a residential region that has a DSL (digital subscriber line) connection or that has no fiber optics. Not only do these results indicate no association



between online networking and life satisfaction but their ordered probit estimation suggests that online networking is negatively correlated with life satisfaction.

Although the majority of the above research is for Western countries, a growing body of literature has also been emerging in China, with a primary focus on adolescence. As in Western countries, however, and for the same reasons as outlined above, the results are inconclusive. For example, Cao et al. (2011) find that, compared with normal Internet use, “problematic Internet use” (defined as scoring 50+ on the Young Internet Addiction Test<sup>3</sup>) increases the probability of psychosomatic symptoms and decreases life satisfaction levels among adolescents aged 10–24 in 8 Chinese cities. Likewise, Wu et al. (2013) show that, compared to nonaddictive adolescent Internet users, addictive adolescent users are more likely to have hyperactivity-impulsivity tendencies, while Lam and Peng (2010) identify a 2.5 times larger relative risk of depression in pathological Internet users aged 13–18 than in their nonpathological peers.<sup>4</sup> Wang and Wang (2011), in contrast, find a positive correlation between online communication and SWB among adolescents aged 15–19 from a vocational school in the southwest of China, with such effects being stronger among males than females.

Our study, therefore, constitutes the first in-depth analysis of the Internet use-SWB relation in China and possible the first overall to combine into one study positive and negative SWB measures, macro and micro approaches, behavior and attitudes toward the Internet, Internet use and well-being across the life span, and perceived displacement patterns. As the conceptual framework for this combination, we adopt the paradigm of digital divides, in which one divisional level is associated with Internet connectivity and differentiates between users and nonusers while a second is related to the skills and abilities required for ICT use and distinguishes varying skill levels *among* ICT users (Hargittai 2002). A third level suggested more recently is linked to the various benefits of ICT use (e.g., learning and productivity) and is thus assumed to arise from the second level digital divide (Wei et al. 2011). By focusing on Internet users, our analyses of the Internet use-SWB relation allows additional exploration of the association between the second and third level digital divides; that is, between differences in usage and differences in usage outcomes. We also use an

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<sup>3</sup> Each item on the 20-item Young Internet Addiction Test (YIAT) is measured on a 5-point scale ranging from “1 = not at all” to “5 = always.”

<sup>4</sup> Pathological use of the Internet is evaluated by the self-rated 20-item Young Internet Addiction Test, a 5-point scale with scores ranging from 20 to 100, which are then used to group addiction severity into three categories: normal = 20–49, moderate = 50–79, and severe = 80–100 (Lam and Peng, 2010). In Lam and Peng’s (2010) study, only 10 students scored 80 points or higher, so the researchers use a binary variable (1 = severe and moderate and 0 = normal) in their analysis.

Instrumental Variable (IV) approach to examine the endogeneity of Internet use in the first level digital divide, thereby shedding light on the causal impacts of Internet use on SWB. In doing so, this study contributes not only to our understanding of China but also to the general body of knowledge on Internet use and well-being.

### **3 Data and methods**

#### **3.1 Data**

Our analysis is based on data from the China Family Panel Studies (CFPS), administered by Peking University's Institute of Social Science Survey, which currently encompasses two waves collected in 2010 and 2012 (Xie et al. 2014). Because it covers 25 provinces/municipalities/autonomous regions<sup>5</sup> that represent 95% of the Chinese population, the CFPS is a nationally representative sample that captures both the socioeconomic development and the economic and noneconomic well-being of Chinese households (Xie, 2012). Because Internet use information is only available in the first (2010) survey wave, we restrict our analysis to these data and extrapolate a sample of 4,686 Chinese Internet users aged 16–60. Because the CFPS uses a multistage sampling design, we also take into account clustering at the village/neighborhood levels (Ren and Treiman 2014).

##### *3.1.1 SWB measures*

Our main proxies of SWB are life satisfaction, happiness, and depression. The first two, based on the questions “How satisfied are you with your life?” and “How happy are you?”, respectively, are measured on a 5-point scale ranging from 1 = very unsatisfied/very unhappy to 5 = very satisfied/very happy. Depression is measured on a scale ranging from 6 to 30 based on the summed scores for 6 items asking respondents how often in the previous month they experienced each of the following depression-related conditions:

1. Feel depressed and cannot cheer up;
2. Feel nervous;
3. Feel agitated or upset and cannot remain calm;
4. Feel hopeless about the future;
5. Feel that everything is difficult; and
6. Think life is meaningless.

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<sup>5</sup> The 2010 CFPS encompasses 14,960 Chinese households and 42,590 individuals (0<age≤110), excluding Hong Kong, Macao, Taiwan, Xinjiang, Qinghai, Inner Mongolia, Ningxia, and Hainan. Detailed information about sampling design is available in Xie (2012).

The responses are coded as follows: 1 = almost every day, 2 = two or three times a week, 3 = two or three times a month, 4 = once a month, and 5 = never.

### *3.1.2 Internet use*

Internet use is measured using the two approaches to exploring second level digital divides; namely, Internet use intensity in hours/day (macro approach) and frequency of use measured on a 4-point scale (1 = rarely, 2 = several times/month, 3 = several times/week, and 4 = almost every day) or in days/week of different online functions (micro approach). These latter include search engines (e.g., Google/Baidu), business websites, Social Networking Services (SNSs, such as Facebook/Renren), blogs, games, emails, and two portals offering a variety of online services, QQ and MSN. An example item for the measure of use is “How many days per week on average do you use MSN messenger during nonvacation time?” It should be noted that in our analysis, we employ the intensity of Internet use primarily to capture individual exposure to the Internet (Pénard et al. 2013) but use Internet participation to solve potential issues of selection bias and endogeneity.

The first online portal QQ, operated by the Chinese firm Tencent, is a popular chatting platform in China, which can also be used for blogging, playing games, listening to music, and reading news (Xiao 2009). Another popular portal is MSN, operated by the Microsoft Corporation, which is more oriented to white-collar workers and thus regarded as a good communication tool in the workplace (Meng and Zuo 2008). These two portals, however, have different privacy protection policies, with QQ having lower privacy protection than MSN and thereby establishing a low-barrier system in which strangers can contact each other more easily (Meng and Zuo 2008). Because these portals differ in their privacy protection policies, target groups, and prevalence, we include both in our analysis.

### *3.1.3 Attitudes/motivation and perceived displacement patterns*

Attitudes toward the various Internet functions were measured by rating the importance of different purposes for Internet use: “During the most recent nonvacation month, how important were the purposes below for your Internet use?”

1. Entertainment;
2. Study;
3. Work;

4. Social interaction;
5. Sharing innermost thoughts and feelings with Internet friends;
6. Seeking emotional support from Internet friends;
7. Seeking professional help from Internet friends; and
8. Diversion/distraction.

Ranking the importance could, to some extent, indicate the motivations for Internet use, a psychological factor that may help explain the Internet use-SWB associations. Although the responses are ranked on a 5-point scale from 1 = very unimportant to 5 = very important, we recode this variable into a dummy equal to 1 if the answer is important or very important and 0 otherwise.

To analyze what users give up to spend time online, we first introduce a rich set of variables that capture the time spent on daily activities, including sleeping; eating; housework; taking care of family members; full-time work; reading; watching TV/videos, and listening to radio/music; engaging in sports; hobbies, and leisure activities (e.g., calligraphy, visiting museum or art galleries); and social activities (e.g., chatting with friends or visiting relatives and friends). The corresponding question is worded as follows: “In the previous nonvacation month, how many hours per day on average did you spend participating in the following activities?” This time use information is asked for weekdays and the weekend separately and then summed into one variable. It should also be noted that this measure is best regarded as an individual’s *perceived* time use because answers to such recall questions are known to be systematically biased and influenced by social desirability effects (Sousa-Poza 1999). We also employ a direct measure of the association between TV and Internet use based on the following item: “Since you began using the Internet, the time you spend watching TV has 1 = increased dramatically, 2 = increased a little, 3 = not changed, 4 = decreased a little, or 5 = decreased dramatically.” We directionally rescale this variable to range from 1 = decreased dramatically to 5 = increased dramatically.

### *3.1.4 Individual characteristics*

We complement the above variables with the following set of individual characteristics: age, gender, employment status, marital status, education, self-reported relative income, and self-reported health. Age is first grouped into five categories (1 =  $16 \leq \text{age} \leq 19$ , 2 =  $20 \leq \text{age} \leq 29$ , 3 =  $30 \leq \text{age} \leq 39$ , 4 =  $40 \leq \text{age} \leq 49$ , and 5 =  $50 \leq \text{age} \leq 60$ ) and then recoded as a dummy variable with  $16 \leq \text{age} \leq 19$  as the reference group. Gender is a dummy equal to 1 if the respondent is male

and 0 otherwise, and employment status is equal to 1 if the respondent is currently employed (0 otherwise). Marital status is measured on a 5-point scale of 1 = unmarried, 2 = married, 3 = living together, 4 = divorced, and 5 = widowed and then recoded as a dummy with unmarried as the reference category. Education levels are coded as 1 = illiterate, 2 = primary school, 3 = middle school, 4 = high school, 5 = vocational school, and 6 = university or higher and then converted to a dummy with illiterate as the reference group. Because income and health are important predictors for SWB (Frey and Stutzer 2002), we include self-reported relative income and health (as in Pénard et al. 2013). The first is measured on a 5-point scale based on the question “What is your income level in your local area?”, which is rated from 1 = very low to 5 = very high. The second is captured as follows: “How would you rate your health status? 1 = healthy, 2 = fair, 3 = relatively unhealthy, 4 = unhealthy and 5 = very unhealthy,” which we again reverse directionally so that larger values denote better self-rated health. We also introduce an urban dummy (1 = urban, 0 = rural).

### 3.2 Estimation methods

Because our measures of life satisfaction and happiness are ordinal, we adopt an ordered probit estimation based on the following model:

$$SWB_i = \beta_0 + \beta_1 IUI_i + \beta_2 IUI_i * AG + \beta_3 X_i + \beta_4 P + \beta_5 U + \varepsilon_i \quad (1)$$

where  $SWB_i$  represents the subjective well-being of individual  $i$  in terms of life satisfaction and happiness, and  $IUI_i$  denotes the intensity of individual  $i$ 's Internet use.  $AG$  is an age group dummy encompassing 1 =  $16 \leq \text{age} \leq 19$ , 2 =  $20 \leq \text{age} \leq 29$ , 3 =  $30 \leq \text{age} \leq 39$ , 4 =  $40 \leq \text{age} \leq 49$ , and 5 =  $50 \leq \text{age} \leq 60$ , with 16- to 19-year-olds as the reference group.  $X_i$  is a vector of individual  $i$ 's characteristics.  $P$  represents a provincial dummy,  $U$  denotes an urban dummy,  $\beta_1$  is the key coefficient of interest, and  $\varepsilon_i$  is the error term. We also employ an OLS estimation to measure depression and an ordered probit model to assess the impact of QQ and MSN messenger use on SWB, both with specifications similar to equation (1).

#### 3.2.1 Endogeneity

To account for any endogeneity stemming from the likelihood that some omitted variables may affect Internet use and SWB simultaneously and that more satisfied individuals may be more inclined to surf the Internet (Pénard et al. 2013), we adopt a two stage least squares

(2SLS) approach.<sup>6</sup> In doing so, we follow Sabatini and Sarracino (2014) by using one instrument that can be readily shown to be exogenous to SWB but closely related to Internet use; namely, the number of Internet broadband access terminals (IBCT, measured in 10,000s) at the provincial or municipality level (Ministry of Industry and Information Technology of the People's Republic of China 2010). For this analysis, using the conditional mixed process (CMP) estimator proposed by Roodman (2011), we employ a probit model with Internet use as a binary variable for the first stage regression and then run the second stage regression using an ordered probit model in which the dependent variable is our SWB measure. The first stage regression is modeled as follows:

$$IU_i = 1(\alpha_0 + \alpha_1 Z + \alpha_2 X_i + \omega_i > 0), \omega_i \sim N(0, 1) \quad (4)$$

where  $IU_i$  denotes whether individual  $i$  surfs the Internet with a computer and is equal to 1 if yes and 0 otherwise.  $X_i$  is a vector of the covariates of individual  $i$  excluding the instrument variable,  $Z$  represents the instrument (i.e., the number of Internet broadband access terminals), and  $\omega_i$  is the error term.

The model for the second stage estimation is written as

$$SWB_i = \begin{cases} 1, & \text{if } y_i \leq 0 \\ 2, & \text{if } 0 < y_i \leq \pi_1 \\ \vdots & \\ 5, & \text{if } \pi_5 < y_i \end{cases} \quad (5)$$

where  $0 < \pi_1 < \pi_2 < \dots < \pi_5$ , and the subscript  $i$  indicates individual  $i$ .  $\pi_i$  are unknown parameters to be estimated.

For the second stage,

$$SWB_i = \beta_0 + \beta_1 \widehat{IU}_i + \beta_2 X_i + \varepsilon_i, \varepsilon_i \sim N(0, 1) \quad (6)$$

where  $SWB_i$  denotes individual  $i$ 's subjective well-being (life satisfaction and happiness),  $\widehat{IU}_i$  is the predicted probability from the first stage regression of the individual surfing the Internet with a computer,  $X_i$  is a vector of covariates, and  $\varepsilon_i$  is the error term. For our depression measure, we employ a traditional 2SLS estimation (using the CMP estimator) whose specification is similar to equations 5 and 6.

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<sup>6</sup> Because a considerable share of our respondents do not use the Internet and the decision to do so may be related to reported SWB, our analysis may be subject to sample selection bias.

To differentiate the purposes of Internet use, we estimate the following model:

$$SWB_i = \beta_0 + \beta_1 IP_i + \beta_2 IP_i * AG + \beta_3 X_i + \beta_4 P + \beta_5 U + \varepsilon_i \quad (7)$$

where  $SWB_i$  represents the depression, life satisfaction, or happiness of individual  $i$ .  $IP_i$  is a binary variable indicating the importance of the different purposes of individual  $i$ 's Internet use (i.e., entertainment; study; work; social interaction; sharing thoughts/feelings, seeking emotional support, or seeking professional help from Internet friends; and diversion/distraction).  $AG$  represents an age group dummy encompassing the five age groups (1 =  $16 \leq \text{age} \leq 19$ , 2 =  $20 \leq \text{age} \leq 29$ , 3 =  $30 \leq \text{age} \leq 39$ , 4 =  $40 \leq \text{age} \leq 49$ , and 5 =  $50 \leq \text{age} \leq 60$ ) with 16- to 19-year-olds as the reference category.  $X_i$  is a vector of individual  $i$ 's characteristics,  $P$  represents a provincial dummy,  $U$  denotes an urban dummy, and  $\varepsilon_i$  is the error term.

To assess how Internet use influences (perceived) time arrangements for 10 daily activities (sleeping; eating; housework; taking care of family members; full-time work; reading; watching TV/videos or listening to radio/music; engaging in sports; hobbies, or leisure activities; and social activities), we introduce the following double-log model:

$$LOGTDA_i = \alpha_0 + \alpha_1 LOGIUI_i + \varepsilon_i \quad (8)$$

where  $LOGTDA_i$  and  $LOGIUI_i$ , respectively, denote the translog time (hours/day) that individual  $i$  spends on these 10 daily activities or surfing the Internet.  $\varepsilon_i$  is the error term.

## 4 Results

### 4.1 Descriptive statistics

Our sample of Internet users consists of 4,686 Chinese individuals aged 16–60 who reported using a computer to surf the Internet.<sup>7</sup> Consistent with the results from the 2014 SRIDC (CINIC 2014) and reflecting the relative newness of Internet technology in China, these users are predominantly male (56%) and were relatively young (average age = 31.43) at the time of survey. Most were employed (70%) and married (65%), and reported high levels of education and income, as well as good health. Most users (73%) also resided in urban areas (for more details, see Appendix Table A1).

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<sup>7</sup> This number suggests an Internet penetration rate of approximately 20% (i.e., 4686/23836), which is lower than the 34% reported in the 2014 *Statistical Report on Internet Development in China* (SRIDC), primarily because our study only considers individuals that surf the Internet with a computer, which excludes those that do so using, for example, a mobile device.

On average, respondents reported spending around 2.3 hours per day surfing the Internet with a computer. The most time-consuming online activities (measured in days/week) were using multiservice web portals (QQ and MSN) and emails, while the least popular activities were blogging and visiting business websites. It is also worth noting that the intensity of QQ use was slightly stronger (about 5 days/week) than that of MSN messenger use (3.9 days/week), suggesting a possible preference for local information and communication and/or for lower privacy protection that enables easier contact with strangers (Meng and Zuo 2008). Among the different perceived purposes for Internet use, use for work or study were relatively important, whereas sharing thoughts or feelings or seeking emotional support and professional help from Internet friends were less important. As to the primary location for Internet use, the home was still the most common access site (66% of all users) compared to the workplace (17%) or Internet cafés (10%).<sup>8</sup>

#### 4.2 Internet use and SWB

Our analysis of the association between Internet use intensity (a macro measure) and SWB reveals no significant association between such intensity and life satisfaction (see Table 1, columns 1–2). We do, however, note a negative association between Internet use intensity and happiness, with marginal effects equal to about 2.7%. One interesting observation is that this negative effect is almost completely attenuated by the interaction terms with age, implying that the negative association between Internet use intensity and happiness is predominantly driven by the young reference group aged 16–19. In older age groups, little evidence emerges that Internet use intensity is associated with happiness. Similarly, and consistent with several prior studies (see Bessiere et al. 2010; Fortson et al. 2007; Stepanikova et al. 2010), there is a negative association between Internet use intensity and depression scores (see columns 5 and 6), which, although the magnitudes are quite small, implies that more Internet use is associated with slightly higher levels of depression. Once again, the interaction terms with age indicate that this association is primarily driven by the youngest group (aged 16–19). We also note in passing a nonlinearity in the nexus between age and SWB—particularly, life satisfaction and happiness (see columns 1–4)—which is well in line with certain other studies (see, e.g., Blanchflower and Oswald 2008).

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<sup>8</sup> These unreported results are available from the authors upon request.



**Table 1** Ordered probit estimates/OLS for Internet use on subjective well-being (adults aged 16–60)

Variable	Ordered probit model (marginal effects)				OLS	
	LS	LS	Happiness	Happiness	Depression	Depression
	(1)	(2)	(3)	(4)	(5)	(6)
IUI	-0.007 (0.006)	-0.005 (0.006)	-0.027** (0.011)	-0.026** (0.011)	-0.232*** (0.077)	-0.215*** (0.075)
20-29	-0.099*** (0.019)	-0.090*** (0.019)	-0.132*** (0.041)	-0.122*** (0.041)	-0.603** (0.258)	-0.416* (0.249)
30-39	-0.105*** (0.022)	-0.089*** (0.021)	-0.213*** (0.044)	-0.189*** (0.044)	-0.494* (0.290)	-0.150 (0.276)
40-49	-0.107*** (0.023)	-0.082*** (0.023)	-0.261*** (0.047)	-0.222*** (0.047)	-0.668** (0.330)	-0.120 (0.314)
50-60	-0.070*** (0.027)	-0.039 (0.027)	-0.238*** (0.055)	-0.190*** (0.054)	-0.477 (0.377)	0.175 (0.363)
IUI X 20-29	0.007 (0.006)	0.006 (0.006)	0.029** (0.012)	0.028** (0.012)	0.210** (0.084)	0.197** (0.082)
IUI X 30-39	0.007 (0.006)	0.006 (0.007)	0.028** (0.012)	0.027** (0.012)	0.207** (0.086)	0.197** (0.083)
IUI X 40-49	0.003 (0.007)	0.001 (0.007)	0.034** (0.014)	0.031** (0.014)	0.158 (0.125)	0.131 (0.118)
IUI X 50-60	-0.006 (0.009)	-0.006 (0.009)	0.024 (0.018)	0.024 (0.017)	0.401*** (0.104)	0.394*** (0.103)
Unhealthy		0.070 (0.087)		-0.183 (0.154)		-1.427 (0.876)
Relatively unhealthy		0.074 (0.083)		-0.149 (0.150)		-0.148 (0.756)
Fair		0.128 (0.082)		-0.067 (0.148)		1.390** (0.633)
Healthy		0.200** (0.082)		0.063 (0.147)		2.713*** (0.636)
<i>N</i>	4686	4686	4471	4471	4664	4664
Pseudo $R^2$ /Adj. $R^2$	0.040	0.052	0.033	0.047	0.029	0.100

*Note.* The dependent variable is life satisfaction (measured on a 5-point scale), happiness (measured on a 5-point scale), or depression (measured on a scale ranging from 6 to 30). The controls for models (1), (3), and (5) are Internet use intensity (IUI, hours/day), an age group dummy, the interaction of the age group dummy with Internet use intensity, male, employment status, marital status, education, relative income, and an urban dummy. The controls for models (2), (4), and (6) are the same as those for (1) but with the addition of self-reported health. Marginal effects are reported for life satisfaction (very satisfied) and happiness (very happy). Village/neighborhood-clustered robust standard errors are in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

### 4.3 Online functions use and SWB

In contrast to the macro approach, our micro approach to analyzing the Internet use-SWB relation reveals only a few negative associations (see Table 2 for a summary of the main findings). In fact, the time spent on the various online functions barely correlates with any of our three SWB measures. For the population in general, we do note that longer time exposure to MSN use is significantly linked with a decrease in happiness, albeit at a quite small magnitude (with a marginal effect of around 0.12, see Appendix Table A2). However, once time spent on MSN use is interacted with different age groups, happiness consistently increases, especially among working-age individuals (20–49). Because MSN messenger, although less popular in China than QQ, is significantly and positively associated with SWB while QQ is not, it is possible that the opportunities for international information and communication that it offers, especially for working-age Chinese, provides them with a sense of being part of the world community and enhances their well-being.

**Table 2** A general summary of online functions and SWB

Online functions	SWB indicators		
	LS	Happiness	Depression
QQ	Not significant	Not significant <i>Positive effect only</i>	Not significant
MSN	Not significant	<i>among working-age</i>	Not significant
Email	Not significant	Not significant	Not significant
Blog	Not significant <i>Negative effect only</i>	Not significant <i>Negative effect only</i>	Not significant <i>Negative effect only</i>
Social networking site	<i>among older users</i>	<i>among older users</i>	<i>among older users</i>
Search engine	Not significant	Not significant	Not significant
Game website	Not significant	Not significant	Not significant
Business website	Not significant	Not significant	Not significant

*Note.* The table is based on regressions in which the dependent variable is life satisfaction (LS, measured on a 5-point scale), happiness (measured on a 5-point scale), or depression (measured on a scale from 6 to 30). Results for MSN and social networking sites are given in Appendix Tables A2 and A3. Other regression results are available upon request. Significance is at the 5% level.

Among older citizens (>50), however, social networking generally gives rise to negative associations, which contradicts previous reports of a positive link between social use of the Internet and SWB in later life (e.g., Cotten et al. 2012; Ford and Ford 2009; Lelkes 2013). Given that these latter studies were conducted primarily in Western societies, this contradiction may suggest a culture-related difference. For example, intense use of a social

networking site by older Chinese adults might reflect an unsuccessful attempt to compensate for few or unsatisfying social interactions and social isolation.

By showing that most online functions are unassociated with SWB—and that the few associations found are not necessarily negative and limited to specific age groups—our findings reveal a considerable contrast between the macro and micro analyses. Hence, we cannot attribute the negative association between Internet use and SWB in China to a specific harmful online activity. This suggests that it is not what people *do* online, but rather how they *feel* about using the Internet more generally, that may explain the negative associations between Internet use and SWB found in this study.

#### 4.4 Possible mechanisms by which Internet use affects SWB

We propose two possible mechanisms by which Internet use may affect users' feelings about their usage and consequently their SWB: the perceived importance of different purposes for Internet use, which may indicate user motivations, and perceived sacrifices for more time spent online, which may throw more light on user attitudes or motivations than on behavior.

##### 4.4.1 Attitudes/motivation

Table 3 reports the importance ascribed to the different purposes for Internet use and their association with life satisfaction. As the table shows, considering the Internet to be important for study or work is positively related with life satisfaction, with marginal effects of 7.2% and 4.6%, respectively (columns 2 and 3), suggesting that when the Internet is seen as a means for attaining a valuable goal, its use is positively associated with life satisfaction. The interaction terms in the lower half of the table further indicate that the positive coefficient associated with Internet use for study is being driven by the youngest respondents (aged 16–19). On the other hand, those who see the Internet as important for diversion or distraction are less likely to be very satisfied with life, with a marginal effect of 3.5% (column 8). This outcome may imply that, conversely, when the Internet is perceived as a means for reaching a nonvaluable goal, its use is negatively correlated with life satisfaction.<sup>9</sup>

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<sup>9</sup> Nevertheless, it is important to emphasize that causality may be the opposite: individuals that are less satisfied with life may perceive the Internet as an important means for diversion and distraction.

**Table 3** Ordered probit estimates for the importance of different purposes for Internet use on life satisfaction (adults 16–60)

Variable	Entertainment (1)	Study (2)	Work (3)	Social interaction (4)	Share thoughts (5)	Emotional support (6)	Professional help (7)	Diversion /distraction (8)
Importance	0.012 (0.024)	0.072*** (0.019)	0.046** (0.022)	-0.009 (0.021)	0.015 (0.029)	-0.014 (0.035)	0.043 (0.031)	-0.035* (0.021)
20-29	-0.082*** (0.016)	-0.051*** (0.017)	-0.072*** (0.017)	-0.106*** (0.017)	-0.083*** (0.014)	-0.085*** (0.014)	-0.073*** (0.014)	-0.097*** (0.016)
30-39	-0.083*** (0.019)	-0.055*** (0.019)	-0.072*** (0.019)	-0.096*** (0.020)	-0.082*** (0.016)	-0.085*** (0.016)	-0.076*** (0.016)	-0.096*** (0.018)
40-49	-0.088*** (0.020)	-0.056*** (0.020)	-0.081*** (0.020)	-0.092*** (0.020)	-0.076*** (0.017)	-0.084*** (0.017)	-0.072*** (0.018)	-0.100*** (0.019)
50-60	-0.063*** (0.023)	-0.022 (0.025)	-0.046* (0.024)	-0.066*** (0.023)	-0.048** (0.021)	-0.054** (0.021)	-0.048** (0.022)	-0.072*** (0.023)
Interactions of the importance dummy with age group dummy								
X 20-29	0.001 (0.025)	-0.062*** (0.022)	-0.023 (0.024)	0.045** (0.022)	0.010 (0.031)	0.032 (0.037)	-0.041 (0.033)	0.039* (0.023)
X 30-39	-0.003 (0.026)	-0.058*** (0.022)	-0.026 (0.025)	0.024 (0.024)	-0.010 (0.037)	0.011 (0.046)	-0.037 (0.035)	0.028 (0.026)
X 40-49	0.022 (0.031)	-0.050** (0.024)	-0.002 (0.027)	0.021 (0.027)	-0.051 (0.042)	0.025 (0.069)	-0.049 (0.036)	0.052* (0.030)
X 50-60	0.033 (0.035)	-0.064* (0.033)	-0.012 (0.033)	0.031 (0.039)	-0.064 (0.059)	-0.108** (0.053)	-0.019 (0.044)	0.055 (0.038)
N	4985	4984	4982	4982	4979	4979	4977	4982
Pseudo R <sup>2</sup>	0.053	0.054	0.054	0.053	0.053	0.052	0.052	0.052

*Note.* The dependent variable is life satisfaction (measured on a 5-point scale). The controls are a dummy for the importance of the different purposes of surfing the Internet, an age group dummy, and the interaction of the age group dummy with the importance dummy, male, employment status, marital status, education, self-reported income ladder, an urban dummy, and self-reported health. Marginal effects are reported for life satisfaction (very satisfied). Village/neighborhood-clustered robust standard errors are in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

We then estimate how the importance of various purposes for Internet use affects happiness (see Table 4). As in the case of life satisfaction, respondents who consider the Internet important for study or work are more likely to report higher levels of happiness, with marginal effects of approximately 0.16 and 0.1, respectively (columns 2 and 3), perhaps again indicating the importance of achieving a valuable goal.

**Table 4** Ordered probit estimates for the importance of different purposes of Internet use on happiness (adults 16–60)

Variable	Entertainment (1)	Study (2)	Work (3)	Social interaction (4)	Share thoughts (5)	Emotional support (6)	Professional help (7)	Diversion /distraction (8)
Importance	-0.024 (0.054)	0.161*** (0.052)	0.098** (0.050)	-0.020 (0.049)	-0.011 (0.051)	0.011 (0.074)	0.083 (0.071)	-0.021 (0.049)
20-29	-0.077** (0.033)	-0.017 (0.033)	-0.045 (0.034)	-0.108*** (0.037)	-0.069** (0.030)	-0.062** (0.028)	-0.051* (0.030)	-0.076** (0.036)
30-39	-0.135*** (0.037)	-0.074** (0.037)	-0.102*** (0.039)	-0.160*** (0.042)	-0.125*** (0.035)	-0.125*** (0.032)	-0.112*** (0.034)	-0.126*** (0.039)
40-49	-0.189*** (0.039)	-0.082** (0.040)	-0.130*** (0.040)	-0.195*** (0.042)	-0.161*** (0.037)	-0.154*** (0.034)	-0.134*** (0.036)	-0.172*** (0.040)
50-60	-0.171*** (0.045)	-0.089* (0.047)	-0.113** (0.046)	-0.175*** (0.046)	-0.147*** (0.043)	-0.137*** (0.041)	-0.132*** (0.042)	-0.130*** (0.047)
Interactions of importance dummy with age group dummy								
X 20-29	0.041 (0.057)	-0.107** (0.054)	-0.036 (0.052)	0.090* (0.050)	0.039 (0.054)	0.014 (0.078)	-0.053 (0.074)	0.039 (0.052)
X 30-39	0.019 (0.059)	-0.129** (0.056)	-0.055 (0.055)	0.070 (0.054)	-0.054 (0.063)	-0.041 (0.090)	-0.087 (0.076)	-0.019 (0.056)
X 40-49	0.097 (0.063)	-0.169*** (0.059)	-0.051 (0.057)	0.106* (0.059)	0.004 (0.079)	-0.080 (0.116)	-0.130 (0.083)	0.050 (0.062)
X 50-60	0.109 (0.073)	-0.110* (0.064)	-0.037 (0.066)	0.122 (0.075)	0.141 (0.108)	0.131 (0.157)	0.028 (0.098)	-0.044 (0.076)
<i>N</i>	4741	4740	4738	4738	4735	4735	4733	4738
Pseudo $R^2$	0.045	0.047	0.047	0.048	0.045	0.045	0.046	0.045

*Note.* The dependent variable is happiness (measured on a 5-point scale). The controls are a dummy for the different purposes of surfing the Internet, an age group dummy, and the interaction of the age group dummy with the importance dummy, male, employment status, marital status, education, self-reported income ladder, an urban dummy, and self-reported health. Marginal effects are reported for life satisfaction (very satisfied). Village/neighborhood-clustered robust standard errors are in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Finally, we evaluate the association between the different purposes and depression (see Table 5). In contrast to our other two SWB measures, the likelihood of depression decreases in both those that consider the Internet important for entertainment and those who value it for seeking professional help, although at the relatively small magnitudes of 0.72 and 0.58, respectively (columns 1 and 7). Interestingly, the interaction terms indicate that the association between depression and valuing the Internet for entertainment is absent in the 50- to 60-year-old sample (column 1), which may imply that older users are more conservative or even fail to see the value of Internet use in alleviating depression.

**Table 5** OLS estimates for the importance of different purposes for Internet use on depression (adults 16–60)

Variable	Entertainment	Study	Work	Social interaction	Share thoughts	Emotional support	Professional help	Diversion /distraction
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Importance	0.719*** (0.270)	0.123 (0.336)	-0.329 (0.310)	0.063 (0.310)	-0.435 (0.346)	-0.488 (0.434)	0.582* (0.353)	-0.453 (0.318)
20-29	0.346 (0.244)	0.094 (0.283)	-0.036 (0.229)	0.103 (0.265)	0.049 (0.219)	0.041 (0.213)	0.176 (0.228)	-0.022 (0.243)
30-39	0.595** (0.275)	0.417 (0.308)	0.249 (0.261)	0.388 (0.291)	0.282 (0.249)	0.320 (0.242)	0.478* (0.256)	0.221 (0.267)
40-49	0.576* (0.302)	0.402 (0.365)	0.217 (0.297)	0.431 (0.319)	0.269 (0.277)	0.312 (0.271)	0.427 (0.292)	0.201 (0.299)
50-60	1.299*** (0.337)	0.783** (0.396)	0.806** (0.332)	1.029*** (0.348)	0.979*** (0.295)	1.031*** (0.294)	1.221*** (0.312)	0.896*** (0.327)
Interactions of the importance dummy with the age group dummy								
X 20-29	-0.698** (0.299)	-0.051 (0.356)	0.265 (0.329)	-0.063 (0.341)	0.083 (0.382)	0.344 (0.482)	-0.542 (0.381)	0.239 (0.350)
X 30-39	-0.678** (0.316)	-0.187 (0.370)	0.213 (0.340)	-0.133 (0.346)	0.161 (0.426)	-0.096 (0.606)	-0.759* (0.387)	0.252 (0.369)
X 40-49	-0.768** (0.360)	-0.265 (0.430)	0.155 (0.402)	-0.523 (0.448)	-0.421 (0.588)	-1.798 (1.392)	-0.821 (0.525)	0.081 (0.456)
X 50-60	-0.525 (0.453)	0.673 (0.458)	0.670 (0.426)	0.261 (0.462)	0.724 (0.635)	0.711 (1.148)	-0.916 (0.579)	0.522 (0.469)
Constant	23.192*** (1.147)	23.461*** (1.159)	23.683*** (1.143)	23.499*** (1.148)	23.678*** (1.149)	23.576*** (1.143)	23.475*** (1.159)	23.716*** (1.142)
<i>N</i>	4963	4962	4960	4961	4958	4958	4956	4960
Adj. <i>R</i> <sup>2</sup>	0.098	0.098	0.097	0.098	0.099	0.100	0.097	0.098

*Note.* The dependent variable is depression (measured on a scale ranging from 6 to 30). The controls are a dummy for the importance of different purposes for surfing the Internet, an age group dummy, and the interaction of the age group dummy with the importance dummy, male, employment status, marital status, education, self-reported income ladder, an urban dummy, and self-reported health. Village/neighborhood-clustered robust standard errors are in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

In this analysis of the associations between various perceptions of Internet uses and SWB, two key points are worth highlighting: First, for the positive measures, we do observe significant associations with valuable uses such as work and study, suggesting that a sense of “doing the right thing” via the Internet may contribute to SWB. For the negative measure, we see significant associations with such therapeutic uses as entertainment and receiving professional help, meaning that in cases of depression, more Internet use may help mitigate depression, which is well in line with Nimrod (2013) and Tandoc et al. (2015).

#### 4.4.2 Perceived displacement

To analyze users' perceptions of what is given up to spend time online, we run a double-log model (in which the coefficients represent elasticities) to determine how time spent using the Internet relates to perceived time spent on different daily activities. As Table 6 shows, in general, time spent using the Internet is negatively associated with perceived time spent sleeping, doing household chores, taking care of family, and working, with elasticities of 0.5%, 5.3%, 4.9%, and 2.1%, respectively. The results here are consistent with the interpretation of results in the previous section. That is, heavy Internet users may be less happy and more depressed because they feel guilty for neglecting important responsibilities such as work, housework, or taking care of family, especially given that, in spite of rapid modernization, the Chinese still believe in strong traditional values. Additionally, longer time exposure to the Internet is positively associated with perceived time spent eating, reading, or engaging in sports and social activities, with elasticities of 1.5%, 3.1%, 4.7%, and 2.3%, respectively, which suggests that Internet use is also perceived as a hedonic activity. We observe no association, however, between time exposure to the Internet and watching TV (perhaps signaling no media displacement) or engaging in hobbies.<sup>10</sup>

**Table 6** Double-log estimates for Internet use on daily activities (adults 16–60)

Variable	Sleeping	Eating	Housework	Caring for family	Work	Reading	Watching TV	Sports	Hobbies	Social activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
TIU	-0.005** (0.002)	0.015* (0.008)	-0.053*** (0.011)	-0.049*** (0.018)	-0.021* (0.012)	0.031** (0.013)	0.016 (0.011)	0.047*** (0.015)	-0.009 (0.019)	0.023* (0.014)
Constant	2.783*** (0.003)	0.896*** (0.012)	0.921*** (0.015)	1.184*** (0.021)	2.683*** (0.014)	0.665*** (0.016)	1.255*** (0.013)	0.601*** (0.017)	0.970*** (0.020)	0.831*** (0.016)
<i>N</i>	4747	4739	2913	1815	1253	2195	3477	1268	1173	2301
Adj. <i>R</i> <sup>2</sup>	0.001	0.001	0.006	0.004	0.002	0.002	0.000	0.007	0.000	0.001

*Note.* The dependent variables are translog time (hours/day) spent on various daily activities during the weekdays/weekends; namely, sleeping, eating, household chores, taking care of family members, work, reading, watching TV, engaging in sports or hobbies, and social activities. The only control is translog time (hours/day) spent on Internet use (TIU). Village/neighborhood-clustered robust standard errors are in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Overall, the impacts of Internet use intensity on SWB are quite heterogeneous, especially once we introduce the various attitudes and perceived displacements of Internet use. In fact, based on the findings reported in Sections 4.3 and 4.4, it is not what users do online but rather

<sup>10</sup> Because the 2010 CFPS provides information on the substitution between Internet use and time spent watching TV (by asking whether the latter has increased or decreased substantially since Internet use began), we also run an ordered probit model with TV watching as the dependent variable. We find that time spent on Internet use decreases the probability of spending more time watching TV, implying that longer Internet exposure may reduce viewing time. The estimation results, although not reported here, are available from the authors upon request.

how they perceive and judge their Internet use that is associated with their well-being. More specifically, our findings indicate that Chinese Internet users perceive their usage as a frivolous activity that often distracts them from doing more important things such as working and/or taking care of their homes and families. This observation may explain the negative association between Internet use and SWB in China. It also seems that individuals only feel good about Internet use when its purpose is to achieve valuable goals (e.g., study or work), connect them with the outside world (MSN messenger), and/or alleviate depression, thereby contributing to their performance in the important life domains of home and work.

#### 4.5. Endogeneity

When we apply Roodman's (2011) mixed process estimator to our three SWB measures, the IV estimates reveal that participation in Internet use is correlated with an increase in both life satisfaction and happiness but also with an increase in depression (see Table 7). The difference between these results and those based on Internet use intensity in Table 1 suggests that participation may have a different effect on SWB than intensity of use. In fact, combining these first stage IV estimates with the test of joint significance of the coefficients underscores the relevance of the number of Internet broadband access terminals as an instrumental variable. As might be expected, such telecommunication facilities increase Internet access and boost the probability of surfing the Internet.

**Table 7** Conditional mixed process (CMP) 2SLS estimates for Internet use on subjective well-being (adults 16–60)

Variable	Life satisfaction	Happiness	Depression
	CMP (1)	CMP (2)	2SLS (3)
Internet use participation	0.123* (0.068)	0.420*** (0.060)	-4.878*** (0.085)
Instrumental variable			
Terminals	0.362*** (0.109)	0.386*** (0.108)	0.318*** (0.094)
<i>F statistics</i>	102.15	84.53	151.20
<i>Chi2</i>	11011.90	10720.36	17796.64
<i>N</i>	29361	29361	29361

*Note.* The dependent variable is life satisfaction (measured on a 5-point scale), happiness (measured on a 5-point scale), or depression (measured on a scale ranging from 6 to 30). The controls are participation in Internet use, age, age squared, male, employment status, marital status, education, self-reported income, an urban dummy, and self-reported health. The instrumental variable is the number of Internet broadband access terminals (in 10,000s) at the provincial/municipality level. Standard errors are in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .



## 6 Conclusions

This study extends the existing literature by focusing on a non-Western developing country, incorporating both positive and negative measures of SWB, and employing a novel combination of macro and micro approaches to measuring Internet use. It also combines measures of practical Internet use with attitudes toward such use, examines the association between Internet use and SWB in different age groups, and addresses the selection and endogeneity issues associated with the Internet use-SWB relation. Not only does this multidimensional approach enable a thorough and accurate examination of the Internet use-SWB association in China, it contributes important insights to the general body of knowledge on Internet use and well-being.

The analysis is, however, subject to certain limitations, including a lack of the longitudinal data that are crucial to furthering our understanding of the Internet's impact on SWB (Kraut et al. 2002). Our data are also restricted to computer-based Internet use, which prevents exploration of SWB's association with Internet usage on mobile devices. Methodologically, we admit that multiple item measures of SWB would be preferable, although the type of single item SWB indicators used here is quite common in economics. We also admit that in our attempt to explore the causal relation between Internet use and SWB, we cannot completely rule out endogeneity. As regards any attempt to analyze the displacements caused by Internet use, of course the ideal would be to use precise time-use information. Nevertheless, our data on perceived time use provide valuable information on displacement-related *perceptions*, which may be more relevant than actual displacements when assessing Internet use's effect on SWB.

In particular, the study yields the following important findings. First, the association between Internet use intensity and SWB is negative: in general, intense use is unassociated with life satisfaction, negatively associated with happiness, and conjunct with higher levels of depression. These outcomes are well in line with several studies from Western countries (see, e.g., Bessiere et al. 2010; Fortson et al. 2007; Stepanikova et al. 2010). Second, and also in line with earlier research (e.g., Selfhout et al. 2009; Valkenburg and Peter 2007), we identify certain cross-generational differences that suggest younger cohorts may be more vulnerable to the potentially negative effects of Internet use on well-being. Finally, although we observe no significant negative associations between use of specific online functions and SWB, our analyses do indicate that Chinese users' perceptions of Internet use are rather negative. More

specifically, unless the Internet is used to pursue such (perceived to be) valuable goals as work or study, Chinese may regard it as a hedonic activity that distracts users from pursuing more worthwhile activities.

Our findings thus imply that the specific reason for surfing the Internet (rather than whether or not the activity is performed) is an important nuance in any analysis of the Internet use-SWB relation. In other words, it is not what individuals *do* online but rather how they *perceive* Internet usage that may affect their SWB. This observation throws new light on an important principle from digital divide paradigm. That is, it suggests that, rather than the third level digital divide (the various ICT use outcomes) necessarily arising from the second level digital divide (actual ICT use) as suggested by Wei et al. (2011), it may instead stem from how individuals *perceive* the uses to which the Internet is put.

Nevertheless, when discussing the Internet use-SWB connection in China, we must take into account that Chinese Internet users are rather novice and should thus be regarded as “digital immigrants” (Prensky 2001). It is therefore quite probable that the Internet use-SWB associations in China will change over time as the Internet becomes more prevalent and users become more experienced. Nor can we ignore the role of cultural factors. In spite of rapid modernization and greater openness to the world, China is still a traditional culture with strong work and family ethics. Hence, as long as Internet use is perceived as a negative activity that distracts users from valuable life goals, the negative associations identified here should be regarded as a threat to SWB in China. Thus, future research should explore not only causality and trends (in Internet usage and perceptions, as well as their effects) but also possible interventions to change negative perceptions. Such interventions, by helping Chinese users see the Internet as a means for attaining valuable goals and performing significant roles, could turn the Internet into an instrument that positively impacts both the economy and quality of life.

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## Appendix:

**Table A1** Descriptive statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
<b>SWB indicators</b>					
Life satisfaction	4686	3.415	0.994	1	5
Happiness	4471	4.028	0.896	1	5
Depression	4664	27.380	3.121	8	30
<b>Internet use indicators</b>					
Internet use intensity (hours/day)	4686	2.295	2.121	0.02	14
QQ use intensity (days/week)	3948	5.013	2.298	1	7
MSN use intensity (days/week)	457	3.882	2.512	1	7
Email use intensity (days/week)	2181	3.393	2.445	1	7
Blog	1233	2.015	1.160	1	4
Social networking site	679	2.440	1.250	1	4
Search engine	3709	2.915	1.231	1	4
Game website	1670	2.411	1.256	1	4
Business website	1748	2.173	1.165	1	4
<b>Perceived importance of various purposes for Internet use</b>					
Entertainment	4683	3.195	1.203	1	5
Study	4683	3.354	1.183	1	5
Work	4680	3.313	1.376	1	5
Social interaction	4680	3.140	1.226	1	5
Sharing innermost thoughts/feelings	4677	2.133	1.183	1	5
Seeking emotional support	4677	1.733	0.992	1	5
Seeking professional help	4675	2.216	1.280	1	5
Diversion/distraction	4680	2.745	1.362	1	5
<b>Individual characteristics</b>					
Age	4686	31.433	10.195	16	60
Gender	4686	0.561	0.496	0	1
Employment status	4686	0.705	0.456	0	1
Educational level					
Illiterate	4686	0.011	0.106	0	1
Primary school	4686	0.076	0.265	0	1
Middle school	4686	0.315	0.465	0	1
High school	4686	0.275	0.447	0	1
Vocational school	4686	0.182	0.386	0	1
University	4686	0.140	0.347	0	1
Marital status					
Unmarried	4686	0.322	0.467	0	1
Married	4686	0.650	0.477	0	1
Living together	4686	0.007	0.084	0	1
Divorced	4686	0.017	0.130	0	1
Widowed	4686	0.003	0.056	0	1
Relative income levels					
Very low	4686	0.235	0.424	0	1
Low	4686	0.243	0.429	0	1
Middle	4686	0.455	0.498	0	1
High	4686	0.060	0.238	0	1
Very high	4686	0.007	0.086	0	1
Self-reported health					
Very unhealthy	4686	0.002	0.046	0	1
Unhealthy	4686	0.016	0.124	0	1

Relatively unhealthy	4686	0.029	0.169	0	1
Fair	4686	0.337	0.473	0	1
Healthy	4686	0.616	0.486	0	1
Urban	4686	0.728	0.445	0	1

Source: *China Family Panel Studies 2010*.

*Note.* Life satisfaction is measured on a 5-point scale ranging from 1 = very unsatisfied to 5 = very satisfied, happiness is measured on a 5-point scale ranging from 1 = very unhappy to 5 = very happy, and depression is measured on a scale ranging from 6 to 30. Internet use intensity is measured in terms of hours per day. Participation in Internet use is a dummy (1 = yes, 0 = no). The importance of various purposes of surfing the Internet (entertainment; study; work; social interaction; sharing innermost thoughts and feelings, seeking emotional support, or seeking professional help from Internet friends; and diversion/distraction) is a binary variable (1 = very important/important, 0 otherwise), gender (1 = male, 0 = female), employment status (1 = currently employed, 0 = currently unemployed), and the dummy for urban resident (1 = urban, 0 = rural). Marital status is measured on a 5-point scale (1 = unmarried, 2 = married, 3 = living together, 4 = divorced, and 5 = widowed, with unmarried as the reference). Education is measured on a 6-point scale (1 = illiterate, 2 = primary school, 3 = middle school, 4 = high school, 5 = vocational school, and 6 = university or higher, with illiterate as the reference). Both relative income level (from 1 = very low to 5 = very high) and self-reported health are also measured on 5-point scales (the latter as 1 = very unhealthy, 2 = unhealthy, 3 = relatively unhealthy, 4 = fair and 5 = healthy, with very unhealthy as the reference).



**Table A2** Ordered probit estimates/OLS for MSN use on subjective well-being (adults aged 16-60)

Variable	Ordered probit model (marginal effects)		OLS
	LS	Happiness	Depression
MSN use	0.025 (0.043)	-0.115** (0.052)	0.132 (0.737)
20-29	-0.156 (0.099)	-0.765*** (0.185)	0.448 (1.761)
30-39	-0.153 (0.101)	-0.801*** (0.186)	0.700 (1.805)
40-49	-0.052 (0.132)	-0.897*** (0.245)	1.555 (2.252)
50-60	-0.011 (0.136)	-0.860*** (0.261)	2.023 (2.255)
MSN use X 20-29	-0.021 (0.043)	0.124** (0.052)	-0.130 (0.740)
MSN use X 30-39	-0.019 (0.043)	0.122** (0.051)	-0.129 (0.758)
MSN use X 40-49	-0.034 (0.045)	0.152*** (0.058)	-0.122 (0.769)
MSN use X 50-60	-0.049 (0.046)	0.139** (0.063)	-0.116 (0.771)
Male	-0.057*** (0.016)	-0.131*** (0.035)	-0.002 (0.303)
Employed	-0.037 (0.028)	-0.054 (0.057)	-0.030 (0.433)
Educational level			
Primary school	-0.115 (0.123)	0.075 (0.193)	-7.527*** (1.789)
Middle school	0.029 (0.070)	0.584*** (0.172)	-2.718** (1.293)
High school	0.102 (0.070)	0.608*** (0.165)	-2.868** (1.268)
Vocational school	0.076 (0.069)	0.537*** (0.173)	-3.234** (1.272)
University or higher	0.095 (0.069)	0.585*** (0.169)	-3.238** (1.253)
Marital status			
Married	0.037* (0.021)	0.179*** (0.041)	1.295*** (0.333)
Living together	-0.028 (0.057)	0.489** (0.220)	1.531*** (0.549)
Divorced	-0.023 (0.066)	-0.178 (0.119)	0.773 (0.804)
Widowed			
Income ladder 2nd	0.070*** (0.027)	0.058 (0.070)	0.767 (0.610)
Income ladder 3rd	0.119*** (0.027)	0.122* (0.065)	1.207* (0.554)
Income ladder 4th	0.195*** (0.035)	0.145* (0.085)	0.928 (0.713)
Income ladder 5th	0.297*** (0.035)	0.244*** (0.073)	4.344*** (0.826)
Urban	0.004 (0.026)	0.059 (0.057)	0.102 (0.497)
Self-reported health			
Unhealthy	-0.108 (0.070)	-0.399*** (0.121)	-3.001 (2.371)
Relatively unhealthy	-0.043 (0.057)	-0.137 (0.123)	-
Fair	-0.047*** (0.016)	-0.050 (0.036)	0.387 (1.070)
Healthy	-	-	1.998* (1.062)
N	457	441	455

Pseudo $R^2$ / Adj. $R^2$	0.110	0.109	0.157
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*Note.* The dependent variable is life satisfaction (measured on a 5-point scale), happiness (measured on a 5-point scale) and depression (measured on a scale ranging from 6 to 30). Controls are MSN use intensity (days/week), dummies of age groups (1=16-19, 2=20-29, 3=30-39, 4=40-49 and 5=50-60, 16-19 as the reference group), the interaction of dummies of age groups and MSN use intensity, male (1=male, 0=female), employment status (1=currently employed, 0=currently unemployed), marital status (measured on a 5-point scale, 1=unmarried, 2=married, 3=living together, 4=divorced and 5=widowed, unmarried as the reference), education (measured on a 6-point scale, 1=illiterate, 2=primary school, 3=middle school, 4=high school, 5=vocational school and 6=university or higher, illiterate as the reference), self-reported income ladder (measured on a 5-point scale, from 1=very low to 5=very high), urban dummy (1=urban, 0=rural), provincial dummies (Beijing as the reference) and self-reported health (measured on a 5-point scale, 1=very unhealthy, 2=unhealthy, 3=relatively unhealthy, 4=fair and 5=healthy, very unhealthy as the reference). Marginal effects are reported for life satisfaction and happiness. Village/neighborhood-clustered robust standard errors are in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

**Table A3** Ordered probit estimates/OLS for social networking site (SNS) use on subjective well-being (adults aged 16-60)

Variable	Ordered probit model (marginal effects)		OLS
	LS	Happiness	Depression
SNS: several times/month	-0.001 (0.069)	-0.024 (0.227)	1.117 (0.949)
SNS: several times/week	0.026 (0.062)	-0.325 (0.219)	1.638* (0.861)
SNS: almost every day	0.009 (0.067)	-0.106 (0.242)	-0.739 (1.004)
20-29	-0.097* (0.050)	-0.144 (0.139)	0.561 (0.734)
30-39	-0.102* (0.055)	-0.274* (0.144)	-0.576 (0.865)
40-49	-0.062 (0.067)	-0.304* (0.167)	-0.950 (1.198)
50-60	-0.011 (0.095)	0.107 (0.262)	2.944 (1.828)
20-29 X SNS: several times/month	0.012 (0.075)	0.049 (0.236)	-1.470 (1.052)
20-29 X SNS: several times/week	-0.017 (0.066)	0.329 (0.225)	-1.989** (0.927)
20-29 X SNS: almost every day	0.019 (0.069)	0.142 (0.243)	0.391 (1.044)
30-39 X SNS: several times/month	-0.046 (0.090)	-0.104 (0.254)	-0.092 (1.060)
30-39 X SNS: several times/week	-0.042 (0.070)	0.287 (0.228)	-1.897 (1.281)
30-39 X SNS: almost every day	-0.003 (0.075)	0.119 (0.248)	0.397 (1.248)
40-49 X SNS: several times/month	0.020 (0.107)	0.257 (0.284)	-1.016 (1.832)
40-49 X SNS: several times/week	0.002 (0.086)	0.232 (0.263)	-0.100 (1.544)
40-49 X SNS: almost every day	0.019 (0.122)	0.178 (0.273)	4.013*** (1.440)
50-60 X SNS: several times/month	-	-	-
50-60 X SNS: several times/week	-	-	-
50-60 X SNS: almost every day	-1.039*** (0.139)	-0.842*** (0.269)	0.859 (1.865)
Male	-0.030** (0.014)	-0.049 (0.030)	0.131 (0.240)
Employed	-0.023 (0.021)	0.007 (0.042)	0.163 (0.367)
Educational level			
Primary school	-0.110 (0.109)	0.204 (0.157)	1.750 (1.437)
Middle school	-0.095 (0.099)	0.178 (0.137)	1.535 (1.272)
High school	-0.111 (0.098)	0.133 (0.127)	2.518* (1.289)
Vocational school	-0.103 (0.098)	0.167 (0.126)	1.753 (1.258)
University or higher	-0.099 (0.098)	0.141 (0.122)	1.933 (1.299)
Marital status			
Married	0.058*** (0.017)	0.218*** (0.032)	1.070*** (0.279)
Living together	-0.048 (0.063)	0.219 (0.138)	0.062 (1.420)
Divorced	-0.089 (0.056)	0.018 (0.114)	1.865** (0.773)
Widowed	0.002 (0.146)	-0.263 (0.229)	0.334 (1.907)
Income ladder 2nd	0.037* (0.037)	0.016 (0.037)	-0.255 (0.037)

	(0.021)	(0.048)	(0.390)
Income ladder 3rd	0.077 <sup>***</sup>	0.058	0.441
	(0.021)	(0.044)	(0.379)
Income ladder 4th	0.078 <sup>**</sup>	0.075	1.470 <sup>**</sup>
	(0.034)	(0.079)	(0.616)
Income ladder 5th	0.255 <sup>***</sup>	0.355 <sup>**</sup>	1.922 <sup>***</sup>
	(0.078)	(0.143)	(0.722)
Urban	-0.018	0.038	-0.197
	(0.017)	(0.042)	(0.339)
Self-reported health			
Unhealthy	0.154	-1.533 <sup>***</sup>	2.670
	(0.117)	(0.243)	(2.347)
Relatively unhealthy	0.237 <sup>***</sup>	-1.547 <sup>***</sup>	3.066
	(0.088)	(0.243)	(2.402)
Fair	0.299 <sup>***</sup>	-1.453 <sup>***</sup>	4.691 <sup>***</sup>
	(0.077)	(0.219)	(1.657)
Healthy	0.365 <sup>***</sup>	-1.298 <sup>***</sup>	6.247 <sup>***</sup>
	(0.078)	(0.218)	(1.650)
<i>N</i>	679	618	674
Pseudo $R^2$ /Adj. $R^2$	0.072	0.096	0.122

*Note.* The dependent variable is life satisfaction (measured on a 5-point scale), happiness (measured on a 5-point scale), or depression (measured on a scale from 6 to 30). the controls are social networking site (SNS) use intensity (1 = rarely, 2 = several times/month, 3 = several times/week and 4 = almost every day), an age group dummy (1 = 16–19, 2 = 20–29, 3 = 30–39, 4 = 40–49, and 5 = 50–60, with 16–19 as the reference group), the interaction of the age group dummy and social networking site use intensity, male (1 = male, 0 = female), employment status (1 = currently employed, 0 = currently unemployed), marital status (measured on a 5-point scale: 1 = unmarried, 2 = married, 3 = living together, 4 = divorced and 5 = widowed, with unmarried as the reference), education (measured on a 6-point scale: 1 = illiterate, 2 = primary school, 3 = middle school, 4 = high school, 5 = vocational school and 6 = university or higher, with illiterate as the reference), self-reported income ladder (measured on a 5-point scale from 1 = very low to 5 = very high), an urban dummy (1 = urban, 0 = rural), a provincial dummy (with Beijing as the reference), and self-reported health (measured on a 5-point scale: 1 = very unhealthy, 2 = unhealthy, 3 = relatively unhealthy, 4 = fair, and 5 = healthy, with very unhealthy as the reference). Marginal effects are reported for life satisfaction and happiness. Village/neighborhood-clustered robust standard errors are in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

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