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Effects of Social Media Self-Efficacy on Informational Use, Loneliness, and Self-Esteem of Older Adults

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ABSTRACT

Social media is convenient for older adults to obtain and share information (i.e., informational use). However, a major barrier to using social media for older adults is their relatively low social media self-efficacy. The effects of this on informational use and mental well-being have not been well studied. Therefore, this study surveyed 276 older Chinese adults aged 60–90 and constructed a structural equation model. We found that higher social media self-efficacy was strongly and directly associated with more informational use, less loneliness, and higher self-esteem. It also positively affected happiness, mediated by loneliness and self-esteem. Informational use decreased loneliness but did not significantly affect self-esteem. We explained these results by the moderation effects of age and social media self-efficacy. This study confirmed the urgency of increasing older adults' social media self-efficacy for their mental well-being and successful aging. We also outlined design implications for increasing social media self-efficacy.

1. Introduction

Promoting mental health and well-being is a crucial and frequently studied issue for successful aging (World Health Organization, 2007). Common indicators of a healthier mental state are happiness, higher self-esteem, and less loneliness (Ryan & Deci, 2001). Older adults' mental health and those positive feelings can be promoted by using social media, which has become increasingly popular among older adults (Sohu, 2020; Statistics Netherlands, 2020). They use social media to both exchange information and enhance relationships with others (Sims et al., 2016). These activities on social media improve cognitive competence and social connectedness (Coelho & Duarte, 2016; Hope et al., 2014; Quinn, 2018), further reducing loneliness and enhancing feelings of self-worth or self-esteem (Hutto et al., 2015; Leist, 2013).

Older adults' use of social media can be roughly categorized into two types based on its purposes: (1) socioemotional use, that is, to keep in touch and stay connected with others (Coelho & Duarte, 2016; Hope et al., 2014); and (2) informational use, that is, to obtain or share content for functional, leisurely, or entertainment purposes (Leist, 2013; Quinn, 2018; Sims et al., 2016). Informational use is increasingly making up a significant part of older adults' social media use. In 2018, 65% of older users of WeChat used informational functions, such as reading articles published on public accounts of WeChat (Tencent Research Institute, 2018). Facebook has been adopted as a regular source of news by a third of Americans, 15% of whom are older than 65 years (Shearer & Mitchell, 2021). Many previous studies have focused on socio-emotional use (e.g., Coelho & Duarte, 2016; Hutto et al., 2015; Wilson, 2018), but little research (e.g., Jin et al., 2019) has investigate informational use of social media. It is unclear how specifically informational use can affect older adults' mental well-being (Newman et al., 2021).

Informational use requires high skills of information and communications technologies (ICTs) and high cognitive functions (Czaja et al., 2006; Quinn, 2018). However, many older adults lack, or believe that they lack, ICT skills. As a result, despite the benefits of using social media, the adoption rate of social media and other ICTs by older adults is much lower than that of young people (Perrin & Anderson, 2019). Some early research has argued that the reason for this is age-related declines in functions and skills, but later research has suggested that the principal barrier is negative attitudes and beliefs, including fear and anxiety about new technologies and low self-efficacy in terms of using ICTs (Czaja et al., 2006; B. Lee et al., 2011; Tsai et al., 2015; Vroman et al., 2015; Wang et al., 2017). Some early research has verified that older adults had much lower self-efficacy in terms of using technologies than younger adults (Posthuma & Campion, 2009; Reed et al., 2005).

Self-efficacy can be general or domain-specific. General self-efficacy is an individual's evaluation or beliefs about his or her capabilities to execute a behavior, whereas social media self-efficacy is this kind of evaluation or beliefs in the context of social media (Bandura, 1977; Hocevar et al., 2014). Many previous studies have focused on the effects or

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determinants of older adults' general self-efficacy. General self-efficacy was found to be associated with higher adoption of ICTs (Igbaria & Iivari, 1995), less loneliness (Fry & Debats, 2002; Gerino et al., 2017), and higher self-esteem (Judge & Bono, 2001; Stanley & Murphy, 1997). More domain-specific, older adults' self-efficacy in terms of using ICTs was found to be associated with more use or adoption of ICTs (Czaja et al., 2006) and, furthermore, higher adoption of ICTs was associated with less loneliness (Zhang et al., 2017; Wilson, 2018), and the promotion of successful aging.

However, little research has explored the effects of social media self-efficacy. Unlike general self-efficacy, which is relatively stable and trait-like (Chen et al., 2000), social media self-efficacy is more malleable and specific to the tasks of using social media. If it directly affects positive mental states, simply increasing social media self-efficacy will benefit older adults in terms of not only life convenience but also mental well-being. As suggested by Fry and Debats (2002), self-efficacy can be "an excellent target for interventions" for older adults with loneliness. Therefore, considering the increasing popularity of social media among older adults, it is necessary to investigate the actual effects of social media self-efficacy on the social media use and feelings of older adults.

To summarize, the present study aims to investigate how social media self-efficacy is associated with older adults' informational social media use and their loneliness, selfesteem, and emotional happiness. We conducted a survey study with 276 older adults in China to identify the relationships between these variables. The results highlighted the impacts of social media self-efficacy on mental health, including reduced loneliness, enhanced general self-esteem, and increased happiness. We also outlined proposals to increase older adults' social media self-efficacy.

2. Social media self-efficacy and associated factors

2.1. Social media self-efficacy and uses

Self-efficacy is generally defined as a person's judgment of his or her ability to execute a behavior. This judgment can be developed from four aspects according to Bandura's selfefficacy theory (Bandura, 1977), namely, one's previous performance; observing others' performances; feedback from others; and one's physical, emotional, and psychological status. Based on Bandura's self-efficacy theory, Hocevar et al. conceptualized self-efficacy in the social media context as based upon "a person's level of social media content production and consumption, perceived social media skill, and confidence in his or her ability to successfully find information online" (Bandura, 1977; Hocevar et al., 2014).

It is intuitive that an individual with higher self-efficacy for a certain activity may engage in that activity more. Furthermore, he or she may have better performance in the activity and reinforce self-efficacy. Older adults' general selfefficacy has been frequently studied and found to be strongly associated with healthy behaviors (French et al., 2014; Schwarzer & Renner, 2000) and also adoption of ICTs (Igbaria & Iivari, 1995). Some previous studies have investigated the associations between self-efficacy specific to ICTs and ICT use. Higher computer self-efficacy was found to be associated with older adults' higher adoption and use of technologies (Czaja et al., 2006), including social media (Hutto et al., 2015). Higher social media self-efficacy was found to be associated with higher adoption and use of social media in a general population (Hocevar et al., 2014). Informational use of the Internet was found to be increased by Internet self-efficacy for both nonexpert and expert older adults (Jokisch et al., 2020). Therefore, we hypothesize the following:

Hypothesis 1 (H1). Older adults' social media self-efficacy has a positive impact on their informational use of social media.

2.2. Loneliness and social media

Loneliness is a negative emotional state associated with deficient social connections (Weiss, 1973). Loneliness is generally experienced more frequently by older adults than by young people (Dykstra, 2009; Pinquart & Sorensen, 2001). It has been found to be strongly linked with poor health (Ong et al., 2016) and seen as a hidden killer of older adults (Coughlan, 2011).

Loneliness was found to be either negatively (Ballantyne et al., 2010; Yu et al., 2016) or not significantly (Aarts et al., 2015; Bell et al., 2013) associated with social media use. The relationship can be affected by the type of social media use. Previous research has suggested that more direct communication contributes to reducing loneliness (Barbosa Neves et al., 2019; Hutto et al., 2015; Wilson, 2018) but broadcasting and reading others' posts do not (Hutto et al., 2015). However, the association between loneliness and the informational use of social media has not been studied much. Only one study (Sims et al., 2016) investigated the effect of socio-emotional or informational use of ICTs on loneliness for adults older than 80; it found that less loneliness was significantly associated with more socio-emotional use but not informational use. However, informational use of social media can keep older adults updated with the latest news about others and society and allow them to learn new knowledge. Therefore, it potentially reduces older adults' loneliness.

Hypothesis 2 (H2). Older adults' informational use of social media has a negative impact on loneliness.

Though research has identified associations between social media use and loneliness in older adults, it is unclear how loneliness is associated with social media self-efficacy. Previous research has found direct negative associations among older adults' loneliness and general self-efficacy (Fry & Debats, 2002; Gerino et al., 2017). The reason is that individuals' beliefs about self-efficacy can directly shape their emotions (Bandura, 1977). Older adults with higher general self-efficacy can mobilize emotional and psychological resources to face stressful or difficult elements in lives, that is, they are more resilient, and thus are less likely to feel



Figure 1. A hypothesized framework.

lonely (Gerino et al., 2017). Similarly, it can be inferred that older adults with higher social media self-efficacy can better utilize social media to stay updated and connected with others and society (this is supported by negative associations between social media use and loneliness in previous research), and thus are less likely to feel lonely.

Hypothesis 3 (H3). Older adults' social media self-efficacy has a negative impact on loneliness.

2.3. Self-esteem and social media

Besides decreasing loneliness, using social media can also contribute to feelings of self-esteem. Self-esteem, or selfworth, is one's global evaluations and beliefs about his or her value, competence, and worth to be respected and loved. Similar to general self-efficacy, the concept of self-esteem involves an individual's perception of his or her competency (Ranzijn et al., 1998; Tafarodi & Swann, 2001). The difference is that besides competency, another important component of self-esteem is positive self-regard, that is, liking and feeling good about oneself (Murphy et al., 2020; Rosenberg, 1965).

Higher self-esteem indicates well-being and a healthier mental state. It has been found to be associated with less loneliness, less anxiety about death, and a higher level of well-being in older adults (Deci & Ryan, 1995; Murphy et al., 2020; J. Zhang et al., 2019). However, older adults are likely to experience declines in self-esteem (Orth et al., 2012) due to, for example, changed social roles and declines in physical functions. Therefore, more attention needs to be paid to how to increase or maintain older adults' self-esteem.

Many studies have found that older adults' self-esteem can be increased by learning and using ICTs, such as the Internet, smart devices, and social media (Brandt et al., 2011; Damant et al., 2017; Wilson, 2018). Further, using social media, especially for informational uses, requires older adults' cognitive functions (Czaja et al., 2006; Quinn, 2018) and, thus, they can easily notice their competency (Lam & Lee, 2006) and perceive higher self-esteem. Therefore, we hypothesize the following:

Hypothesis 4 (H4). Older adults' informational use of social media has a positive impact on self-esteem .

In addition to informational use, social media self-efficacy may directly affect self-esteem. Though research about how social media self-efficacy contributes to older adults' selfesteem is still lacking, general self-efficacy is seen as strongly associated with self-esteem, since both of them are relevant to the perception of competency (Chen et al., 2004). Some studies have even collapsed general self-efficacy and selfesteem into a single construct (Judge et al., 1998). Considering that social media is becoming increasingly crucial to older adults' lives, social media self-efficacy may strongly affect self-esteem. We hypothesize the following:

Hypothesis 5 (H5). Older adults' social media self-efficacy has a positive impact on self-esteem.

In addition, strong associations have been found between less loneliness (or more social connectedness), higher selfesteem, and happiness (or less depression; Deci & Ryan, 1995; Murphy et al., 2020; Zhang et al., 2019). Therefore, in our model, we also propose the following hypotheses. The overall framework is demonstrated in Figure 1.

Hypothesis 6 (H6). Older adults' loneliness has a negative impact on self-esteem.

Hypothesis 7 (H7). Older adults' loneliness has a negative impact on happiness.

Hypothesis 8 (H8). Older adults' self-esteem has a positive impact on happiness.

2. Method

2.1. Participants

We distributed surveys both offline and online in China and received 276 valid responses (85 offline and 191 online). All of the participants were older Chinese adults aged 60–90 (M=69.84, SD=6.94). Among the participants, 156 were female and 120 were male. All of them used social media on mobile devices (mostly WeChat). The majority of the participants (n=210) lived with their spouses, 42 participants lived with other family members (e.g., their children), and 24 participants lived alone. Regarding educational backgrounds, nearly half of the participants (n=112) had bachelor's or higher degrees.

2.2. Measurement

The questionnaire in Chinese started with two questions about informational use of social media. First, it presented 22 topics that might interest older adults according to a



Figure 2. Topics of content that interested older adults.

previous explorative study (Chen & Gao, 2021) and asked older adults to check all of those in which they would be interested and with which they would interact in their daily life. As presented in Figure 2, the 22 topics involved health care, useful content for convenient life, and hobbies. This question could help older adults understand the definition and the scope of informational use. Then, the questionnaire asked the frequency of informational use by a single item: "How often do you interact with the above content on social media (e.g., WeChat)?" with five levels (i.e., very rarely, once or twice per week, once every two or three days, once every day, and several times every day). Every time "social media" is mentioned in the questionnaire, the example of WeChat is provided (e.g., "social media such as WeChat"). WeChat is the most popular (i.e., used by 1.1 billion users actively use WeChat every day) and most versatile social media in the market, integrating features of different types of social media, including instant messaging, group chatting, Facebook-like social networking, broadcasting or subscribing to content via official accounts (similar to blogging), online gaming, etc. For many of older users who are not heavy social media users, WeChat is the only social media platform they use. Therefore, we considered that it is sufficient to provide a single example of WeChat because a variety of social media types and usages are implied.

Next, the questionnaire measured participants' feelings of happiness, self-esteem, loneliness, and social media selfefficacy by five-point Likert scales ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). First, happiness was measured by a scale with three items adopted from the Short Depression-Happiness Scale (Joseph et al., 2004). The original scale involved six items asking about both happiness and depression. Three items about happiness were adopted, as listed in Table 1.

Second, the scale for self-esteem involved six items adapted from a previous study (Ranzijn et al., 1998). The original scale involved 10 items involving two subdimensions: positive self-regard and perceived usefulness or competence. To make the questionnaire easier for older participants, we removed four reverse items and adopted the remaining six items, with three in the dimension of positive self-regard and the others in the dimension of perceived usefulness.

Third, the three items for loneliness were adopted from the three-item Loneliness Scale (Hughes et al., 2004). This scale was carefully validated and was much more concise and convenient for our older participants to read than the standard UCLA Loneliness Scale.

Forth, social media self-efficacy was measured by a fivepoint Likert scale with four items derived from Hocevar et al. (2014) study. Based upon the generic framework of Bandura's self-efficacy theory, Hocevar et al. argued that there are four sources of information to inform judgments about social media self-efficacy, i.e., (a) perceived social media skill, (b) confidence in ability to successfully find information online, (c) level of social media content production, and (d) level of social media content consumption. The original items, however, either involve comparisons against a large general population (e.g., "I am much better than other Internet users"), which is difficult for older adults to draw, or ask about the frequency of using specific interactive functions from a variety of social media services, (e.g., "How often do you create or update your own blog/write or change some information on Wikipedia?"), which are

Table	1.	Items of	f happiness, s	elf-esteem,	loneliness,	and social	media se	elf-efficacy v	with mean	values,	standard	deviations,	and	CFA	loading	s.
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Variables	Items	M (SD)	Loadings
Happiness			
hp1	I feel happy.	4.14 (0.91)	0.80
hp2	I feel pleased with the way I am.	4.32 (0.82)	0.89
hp3	I feel that life is enjoyable.	4.23 (0.92)	0.95
Self-esteem			
es1	I feel that I'm a person of worth, at least on an equal plane with others.	4.06 (0.91)	0.75
es2	I feel that I have a number of good qualities.	4.26 (0.81)	0.77
es3	I take a positive attitude toward myself.	4.39 (0.73)	0.82
es4	I am able to do things as well as most other people.	4.26 (0.88)	0.90
es5	I am a useful person to have around.	4.29 (0.83)	0.91
es6	When I do a job, I do it well.	4.31 (0.83)	0.77
Loneliness			
ln1	I feel I lack companionship.	2.23 (1.09)	0.76
ln2	I feel left out by others and the society.	2.01 (1.01)	0.90
ln3	I feel isolated from others.	1.93 (1.05)	0.90
Social media self-efficacy			
ef1	I feel confident about my skills to use social media.	3.43 (1.11)	0.82
ef2	I feel confident about my ability to find desired information on social media.	3.43 (1.20)	0.89
ef3	I often produce content on social media.	3.11 (1.26)	0.86
ef4	l often consume content on social media.	3.39 (1.20)	0.90

unnecessarily cumbersome for assessing older adults' overall judgment of their capabilities. Therefore, instead of adopting the original items, we designed a straightforward single item for each of the four dimensions, as shown in Table 1.

The reliability of these measures was tested by a confirmatory factor analysis (CFA; see the results in Section 4.1). In addition to these variables, the questionnaire asked about demographic information, including age, gender, and educational background.

2.3. Data analysis

Before verifying the hypothesized model, we first summarized the descriptive statistics about informational use, especially the topics, since the topics were not included in further modeling. We counted the number of the participants who were interested in a topic to identify the topics that were widely of interest for older adults. We also examined the Pearson's correlation among the number of topics a participant checked and the participant's social media selfefficacy to preliminarily show the relationship between informational use and self-efficacy.

We adopted a two-step procedure (Anderson & Gerbing, 1988) to analyze the direct and mediation effects of social media self-efficacy on happiness. First, a CFA was conducted to assess whether the four latent variables could be well measured by the observed indicators. Then, structural equation modeling was conducted to test the relationships between happiness, self-esteem, loneliness, and social media self-efficacy. These analyses were conducted with R. CFA and structural equation modeling were mainly constructed by the R package lavaan.

We used the following measures to assess the goodness of fit of the models: the chi-square statistic (χ 2), the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), and the comparative fit index (CFI; Hu & Bentler, 1999). Similar to many studies on older adults (e.g., Tian, 2016; Zhang et al., 2020), we adopted the following criteria for goodness: the ratio of χ^2 to degree of freedom was less than 5, RMSEA and SRMR were less than 0.08, and CFI was more than 0.95.

For CFA, besides the goodness of fit, we also tested the convergent validity, discriminant validity, and potential multicollinearity. Convergent validity was measured by Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). We adopted the following criteria for convergent validity: for each construct, Cronbach's alpha and CR were larger than 0.60 (Fornell & Larcker, 1981), and AVE was larger than 0.50 (Flynn et al., 1990). The measures for discriminant validity included the square root of AVE (sqrtAVE), pairwise Pearson correlations among constructs, and maximum shared variance (MSV) of each construct. The criteria were that sqrtAVE was larger than any of the correlations among constructs, and the MSV of each construct was smaller than its AVE (Hair et al., 2009). Multicollinearity was assessed by the variance inflation factors (VIFs). To avoid multicollinearity, VIFs should be less than 10 (Diamantopoulos & Siguaw, 2006).

3. Results

3.1. Descriptive statistics for informational use

Figure 2 presents the topics of informational use, that is, the topics in which participants were interested and with which they interacted. The content about which they were most concerned was health, such as diet (N=217) and fitness (N=189), followed by useful information for convenient living, such as news (N=201) and cooking (N=166). Despite the increasing importance of ICT use in daily life, only a third of the participants were interested in the content of ICT use (N=94, 34%). Regarding frequency of use, nearly half of the participants (N=136, 49%; 44 offline and 92 online) used social media for informational purposes more than once per day.

The total number of topics in which a participant was interested was also significantly associated with social media self-efficacy (Pearson's r = 0.35, p < 0.001), indicating that the higher social media self-efficacy an older adult perceived,

Table 2. Cronbach's alpha, CR, and AVE of the confirmatory factor analysis.

Constructs	Cronbach's alpha	Composite reliability (CR)	Average variance extracted (AVE)
Happiness	0.91	0.91	0.78
Self-esteem	0.92	0.92	0.67
Loneliness	0.88	0.89	0.72
Social media self-efficacy	0.92	0.93	0.76

the more topics he or she was interested in. For most topics, the participants who were interested in a topic had significantly higher social media self-efficacy than those who were not interested (the p values of t-tests < 0.05). Nevertheless, "diet and health," "Chinese medicine," and "news and politics" attracted participants with both high and low levels of social media self-efficacy.

3.2. Descriptive statistics for feelings and CFA

The full measurement model consisted of the four latent constructs (i.e., happiness, self-esteem, loneliness, and social media self-efficacy) and 16 observed variables. The fit measures indicated an acceptable fit to data: χ^2 (98, N=276) = 225.26; RMSEA = 0.07, p (RMSEA < 0.05) = 0.005; SRMR = 0.04; and CFI = 0.96. We examined the VIFs to ensure there was no significant multicollinearity. VIF values of indicators ranged from 1.23 to 4.93 and were smaller than the threshold of 10.0 (Diamantopoulos & Siguaw, 2006). The standardized loadings for indicators on the latent variables are presented in Table 1, and all of them were significant (p < 0.001).

To test the convergent validity of the model, we calculated Cronbach's alpha, CR, and AVE of each construct, as shown in Table 2. The Cronbach's alpha coefficients ranged from 0.88 to 0.92, and the CR values ranged from 0.89 to 0.93. Both were above the recommended level of 0.60 (Fornell & Larcker, 1981). The AVE values ranged from 0.67 to 0.78, which were above the recommended level of 0.50 (Flynn et al., 1990). All of these results indicated a satisfactory convergent validity.

We also tested the discriminant validity. As shown in Table 3, the sqrtAVEs ranging from 0.82 to 0.88 were larger than any of the pairwise Pearson correlations. The MSV values ranging from 0.15 to 0.38 were also smaller than the AVE of each construct, indicating a good discriminant validity (Hair et al., 2009).

In addition, Table 3 presents descriptive statistics for the variables. The correlations between any of the variables were significant (p values < 0.01). Loneliness was negatively associated with other variables, whereas the other associations were significantly positive.

3.3. Structural model

We constructed a model that had a good fit to the data, χ^2 (110, N=276) = 262.89; RMSEA = 0.07, p (RMSEA < 0.05) = 0.001; SRMR = 0.04; and CFI = 0.96. In addition to direct effects, we also adopted the bootstrap estimation with 1,000 samples to test the mediating effects of (1) self-esteem and loneliness between self-efficacy and happiness

 Table 3.
 Inter-construct correlations.

		<i>M</i> (SD)	MSV	1	2	3	4
1	Happiness	4.23 (0.81)	0.38	0.88			
2	Self-esteem	4.26 (0.71)	0.38	0.62	0.82		
3	Loneliness	2.05 (0.95)	0.26	-0.47	-0.51	0.85	
4	Social media self-efficacy	3.34 (1.08)	0.15	0.27	0.39	-0.29	0.87
5	Informational use	4.15 (1.08)	-	0.22	0.21	-0.21	0.16

MSV: maximum shared variance. All the p values of the Pearson correlation analysis < 0.01.

and (2) informational use between self-efficacy and self-esteem or loneliness.

Figure 3 and Table 4 show the direct and indirect effects with the 95% confidence intervals. Social media self-efficacy had significant direct effects on self-esteem (standardized effect = 0.26, p < 0.001), loneliness (-0.29, p < 0.001), and the frequency of informational use of social media (0.17, p = 0.007). Social media self-efficacy did not have a significant direct effect on happiness, but the indirect effects of self-efficacy on happiness through self-esteem and loneliness were significant (p values < 0.05). The frequency of informational use had a significant association with self-esteem. The results also showed a marginal significant indirect effect of informational use between social media self-efficacy and loneliness.

4. Discussion

Social media has become important in older adults' lives to the extent that even social media self-efficacy can strongly affect older adults' general feelings of loneliness, self-esteem, and happiness. We found that social media self-efficacy directly reduced loneliness and improved self-esteem. Furthermore, it increased older adults' happiness, mediated by self-esteem and loneliness. All of these results indicated that social media self-efficacy may have become a fundamental rather than advanced belief for older adults now. Below, we outline and discuss three key findings.

4.1. Social media self-efficacy and loneliness

This study suggested that loneliness perceived by older adults was negatively and directly affected by both social media self-efficacy and the informational use of social media. Both associations have rarely been studied in previous research. The direct effect of social media self-efficacy on loneliness can be explained by the similar reason pertaining to the effect of general self-efficacy (Fry & Debats, 2002; Gerino et al., 2017). That is, older adults with high levels of social media self-efficacy believed that they could easily stay updated and connected with others and the world via social



Figure 3. Structural model with standardized estimated effects.

Table 4. Co	onfidence	intervals	for	the	model.
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			95% confide		
	Model pathways	Standardized estimated effect	Lower bounds	Upper bounds	p value
	Direct effect				
H1	Self-efficacy \rightarrow Informational use	0.172	0.046	0.297	0.007
H2	Informational use \rightarrow Loneliness	-0.175	-0.314	-0.035	0.014
H3	Self-efficacy \rightarrow Loneliness	-0.285	-0.412	-0.158	< 0.001
H4	Informational use \rightarrow Self-esteem	0.061	-0.043	0.166	0.252
H5	Self-efficacy \rightarrow Self-esteem	0.261	0.154	0.369	< 0.001
H6	Loneliness \rightarrow Self-esteem	-0.440	-0.576	-0.304	< 0.001
H7	Loneliness \rightarrow Happiness	-0.209	-0.372	-0.046	0.012
H8	Self-esteem \rightarrow Happiness	0.525	0.382	0.669	< 0.001
	Indirect effects				
	Self-efficacy \rightarrow Self-esteem \rightarrow Happiness	0.142	0.063	0.221	< 0.001
	Self-efficacy \rightarrow Loneliness \rightarrow Happiness	0.068	0.008	0.129	0.027
	Self-efficacy \rightarrow Informational use \rightarrow Self-esteem	0.011	-0.008	0.029	0.265
	Self-efficacy \rightarrow Informational use \rightarrow Loneliness	-0.030	-0.061	0.001	0.056

media and, thus, they directly perceived less loneliness. The effect of informational use on loneliness was also in line with previous research about the effect of general social media use (Ballantyne et al., 2010; Yu et al., 2016).

However, this association was affected by age. To the best of our knowledge, a previous study with adults older than 80 (Sims et al., 2016) found that less loneliness was significantly associated with more socio-emotional use of social media but not informational use. This finding was supported by our data of the participants older than 80: for these oldest-old (i.e., adults older than 80, n=29 in this study), the Pearson correlation for informational use and loneliness was 0.06 (p=0.77). However, for participants younger than 80 years (n=247), the correlation was significant (r=-0.24, p<0.001). A similar effect of age also emerged in the association between social media self-efficacy and loneliness: for the participants older than 80, the correlation was -0.14 (p=0.47), whereas for the participants younger than 80, the correlation was -0.30 (p<0.001). A possible reason for this is that, when people get older, they will perceive time as more limited and thus prioritize close social relationships rather than learning new information, as suggested by the socio-emotional selectivity theory (Carstensen et al., 1999; Charles & Carstensen, 2010). As a result, compared with young-old, the oldest-old adopted social media much less (M. Anderson & Perrin, 2017; Hunsaker & Hargittai, 2018) and used social media more for socio-emotional use to avoid loneliness (Sims et al., 2016). This suggests that our finding about the effect of social media self-efficacy on loneliness might not be generalized to the oldest-old, which requires further verification.

4.2. Social media self-efficacy and self-esteem

We found a direct positive association between social media self-efficacy and self-esteem. In our initial hypothesis, older adults with higher social media self-efficacy may have used social media for informational purposes more, which required cognitive functions (Czaja et al., 2006; Quinn, 2018), and, thus, they would perceive higher competency and self-esteem. However, our results suggested a direct association without the mediation of informational use of social media. In fact, the correlation between self-esteem and social media self-efficacy (r = 0.39) in our study was close to or even as strong as that between self-esteem and general self-efficacy in previous research (e.g., 0.37 in Hajloo, 2014, and 0.59 in Chen et al., 2004).

According to Bandura (1977), self-efficacy to perform a specific task could influence perceptions of self-esteem when the task is heavily tied in with one's self-worth. For older people, being able to learn and use digital technologies can be considered a sign of competency, which is a major component of self-esteem (Ranzijn et al., 1998). Some earlier research reported that older people experience a sense of accomplishment and feelings of pride from various forms of digital engagement, e.g., using email and the Internet (Damant et al., 2017; Wilson, 2018). Furthermore, aging is often associated with social withdraw due to reasons such as retirement, loss of mobility, and declining health (Kim & Moen, 2001). Social withdraw, or in extreme cases social isolation, can result in lowered self-esteem (Bobillier Chaumon et al., 2014; Mcmellon & Schiffman, 2002). Older people who are capable of using social media, however, are empowered to interact with both close relationships and broader communities through social media technologies (Delello & Mcwhorter, 2017; Shepherd & Lane, 2019), and such interaction has been found to be positively related to self-esteem (Lee & Shehan, 1989).

Though the association between informational use and self-esteem was not significant in the structural model, this association may have been moderated by social media self-efficacy. For the participants who rated higher social media self-efficacy (higher or equal to 4, n=90), self-esteem was associated less with informational use (r=0.15, p=0.15). On the contrary, for the participants who rated lower social media self-efficacy (less or equal to 2, n=40), self-esteem was associated more with informational use (r=0.29, p=0.07). This indicated that informational use can be more positively influential for self-esteem for older adults with lower social media self-efficacy, which needs further verification.

4.3. Difference between our findings and prior research in younger populations

Our study focused on older people, a population of which the relationship between social media use and self-esteem has been rarely studied. The overall social media self-efficacy is positively associated with self-esteem. Furthermore, the two items about the level of usage (ef3 and ef4 for the frequency of content production and consumption on social media) are also positively associated with self-esteem (Pearson's correlations > 0.34, p values < 0.01). It is interesting to relate our findings to the often-reported negative impacts of social media use on self-esteem for younger populations, which have been attributed to the prevalence of upward social comparisons in social media (Jan et al., 2017; Midgley et al., 2021; Vogel et al., 2014, 2015).

A couple of recent meta-analysis studies found that, despite of many public critics about the negative impacts of social media, results from empirical studies on such impacts are mixed, and the pooled relationship between social media usage and self-esteem is close to zero (Liu & Baumeister, 2016; Valkenburg et al., 2021). A close investigation into these studies suggests that this relationship is moderated by different social media usage and individual characteristics. Whereas selectively presenting oneself and receiving likes from others can promote self-esteem (Burrow & Rainone, 2017; Gonzales & Hancock, 2011; Marengo et al., 2021), being exposed to idealized self-representations of others and engaging in upward social comparisons results in a negative influence on self-esteem (Jan et al., 2017; Jang et al., 2016; Steinsbekk et al., 2021; Vogel et al., 2014). The relationship between social media use and self-esteem is also moderated by a number of individual differences, especially the tendency to compare themselves to others, i.e., social comparison tendency (SCO; Burrow & Rainone, 2017; Vogel et al., 2015). People with different levels of SCOs respond to positive posts from others in opposite ways: whereas high-SCO individuals may suffer from negative impacts, i.e., envy, anxiety, and lower self-esteem, low-SCO individuals may be inspired or cheered up by positive posts due to the emotional contagion effect (de Vries et al., 2018). Nevertheless, prior research agrees that engaging in upward social comparison via social media has a detrimental impact on selfesteem but disagrees on whether upward social comparison dominates social media use for different types of users.

Our study focused on older people, a population for which the relationship between social media use and selfesteem has been rarely studied. A possible reason for the positive association between social media usage and selfesteem for this population is that they may have lower tendencies to engage in social comparison, compared with younger people. According to the socio-emotional selectivity theory (Carstensen et al., 1999), socialization behaviors of older people are mainly driven by the need for emotion regulation, whereas younger people, particularly adolescents, are driven by the need for self-concept development and the need for new information. It implies that older people may select to avoid emotionally meaningless social activities, such as upward social comparison. A recent study found that people with high SCOs tend to be younger than those with low SCOs (Gomez et al., 2021).

If older people can be considered as low-SCO individuals in general, viewing positive posts is likely to benefit their self-evaluation and mental well-being (de Vries et al., 2018). It should be noted that the current study provides only hints for this possibility but no solid evidence supporting it. Furthermore, participants in this study had a relatively high level of education (i.e., half of them had a bachelor's degree or above) and enjoyed good health in general. It is also possible that they engage in social media comparison as much as younger people do but their comparisons are lateral or downward comparison, which do not harm self-esteem. More research is needed to verify if older people have a low level of SCO or not.

4.4. Need for enhancement of social media self-efficacy

This study also confirmed the previous survey findings about computer self-efficacy (e.g., Czaja et al., 2006; Tsai et al., 2015) that, currently, older adults' social media self-efficacy is relatively low. In this study, older participants rated an average of three on a five-point Likert scale of social media self-efficacy, which was much lower than ratings for other constructs, such as self-esteem and happiness. Furthermore, the older population would likely perceive even lower social media self-efficacy. The reason for this is that our sample had higher educational levels than the current older population in China and the globe (National Survey Research Center, 2016; Roser & Ortiz-Ospina, 2016), whereas education levels were positively associated with social media self-efficacy as our data suggested (Pearson's r = 0.299, p < 0.001).

Therefore, we encourage future work to increase older adults' social media self-efficacy. Bandura's self-efficacy theory (1977) suggested that an individual's self-efficacy can be determined by four sources of information: previous successful performance, the success of other people similar to the individual, encouragement, and physiological feedback of emotional-arousal events. Based on this theory, social media self-efficacy can be increased by successful experiences of using social media and learning together with others, especially those with strong-tie relationships. Based on this self-efficacy theory, Lam and Lee (2006) provided encouragement and support in offline computer training courses for older adults. Through a longitudinal study with 1,000 participants, Lam and Lee confirmed that encouragement and support can improve older adults' Internet self-efficacy. Similarly, later research designed and conducted offline workshops in the community to promote ICT learning and intergenerational communication, which can potentially increase ICT self-efficacy and self-esteem (Andreoletti & Howard, 2018; Carucci & Toyama, 2019; Cucinelli et al., 2018). Even short-term, basic smartphone training can prevent early technology rejection (Harte et al., 2018) and may potentially increase social media self-efficacy.

However, there are several barriers for older adults to ICT training or learning. First, offline educational resources and support for older adults are scarce, though many older adults preferred offline rather than online interactions (Yuan et al., 2016) to obtain direct and immediate support as well as to perceive more social presence when encountering problems. For example, in China, on average over 250 million older adults share 76,000 universities of the Third Age (ITJUZI.com, 2020). Second, older adults attempt to avoid bothering people with whom they are close (Chen & Gao, 2021; Lindley et al., 2009), although they actually encounter many problems, especially when beginning to use ICT. Third, users prefer to learn a new technology via self-directed exploration (Kiani et al., 2019; Rieman, 1996),

including older adults (Mahmud et al., 2020; Pang et al., 2021), although older adults can make more errors and take more time for exploration and thus feel disappointment (Mahmud et al., 2020).

To solve these problems, future research may explore two possible directions. One is to offer older adults online training and support via social media or remote communication tools. Increasing educational resources and support are available for older adults. For example, some older adults in China take informal learning and even enroll in online courses via WeChat (Chen & Gao, 2021). Older adults can also be connected with peers and offer and obtain tangible or emotional support from others in online communities or social network services (Burmeister, 2012; Morrison & McCutheon, 2019). For example, on SeniorNet,¹ tech-savvy older volunteers provide ICT support for other older adults in the community. A recent study (Al Mahmud et al., 2021) designed an application named ElderConnect to help older adults learn about loneliness and keep or expand social connections. In China, older adults can make friends and learn ICTs or other knowledge on applications such as Middle-Aged and Elderly Life.² There should be future exploration about how to better design these platforms and services for older adults to learn technologies informally with peers.

The other direction is to improve the usability, especially the ease of learning or learnability, of ICT products or services for older adults to explore and begin using them. Currently, ICT products or services change and update quickly, but the interfaces are not easy for older adults to quickly learn and use. Thus, they may frustrate older adults (Carroll & Carrithers, 1984) and further reduce social media self-efficacy. Future research may explore how to design functions and interfaces to support older adults in the early stages of learning platforms, for example, by multimodal interactions (Mihajlov et al., 2015; Pandya & El-Glaly, 2018) and enhanced action feedback (Mahmud et al., 2020).

It should be noted that there may be differences between younger older adults and the oldest old, i.e., those older than 80 years, and caution needs to be exercised to generalize our results to those oldest old. Age may moderate the relationships among social media self-efficacy, informational use, and other variables. For example, a recent study (Ma et al., 2021) shows that perceived ease of use does not affect the oldest-old's acceptance of technology as much as it affects the young-older adults' acceptance. Only 29 of our participants, however, were older than 80 years. This small sample size, combined with the high education background (i.e., 17 out of the 29 oldest old hold a bachelor's degree or higher), does not support fair and valid comparisons across age groups of older people. Further investigation is needed about whether our findings can be generalized to the oldest old. Furthermore, we provided a single example of social media services, i.e., WeChat, due to the consideration that WeChat is versatile and represents a variety of social media services and usages. There is, however, a risk that some participants' understanding of social media may be limited by this single example and they might not consider other types of social media services they were using. Possible approaches

to avoid such bias include providing a brief introduction of different types of social media services at the beginning of the questionnaire or asking participants to select ones they are using from a list of major social media platforms. These should be considered in future studies in this vein.

5. Conclusion

Through a survey study with 276 older Chinese adults, this study has confirmed the significant and direct associations between their social media self-efficacy and less loneliness and higher self-esteem. Older adults' loneliness may be alleviated and self-esteem may be enhanced by increasing their social media self-efficacy. However, currently, older adults perceive themselves to have low levels of social media selfefficacy. This underlines the importance and urgency of increasing older adults' social media self-efficacy for their mental well-being and successful aging. Future research is needed to involve older adults with higher social isolation, and innovative design of social media platforms is required to better support older adults in learning social media or other technologies.

Notes

- 1. https://seniornet.org/
- 2. https://apps.apple.com/cn/app/id1294560880

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