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Original Research Report

Information and Communication Technology Use Is Related to Higher Well-Being Among the Oldest-Old

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Abstract

Objectives: Older adults often prioritize socially meaningful goals over informational goals. Thus, we predicted that using information and communication technology (ICT) in service of socially meaningful versus informational goals relates to higher well-being among the oldest-old.

Method: We surveyed 445 adults aged 80+ (mean = 84, range = 80–93; 64% female; 26% non-White) online or via telephone. Participants reported motivations for ICT use (connect with others, learn new information) and rated their psychological and physical well-being (i.e., life satisfaction, loneliness, goal attainment, subjective health, functional limitations). We conducted regression and mediation analyses to test our hypothesis.

Results: Participants used ICT more to connect with friends/family (M = 3.66, SD = 1.28) than to learn information (M = 2.61, SD = 1.44), $p < .001$. Overall, ICT use predicted higher well-being across outcomes, $ps \leq .008$. Motivations for use differentially mediated these effects: Social motivations mediated the relationships between ICT use and psychological well-being, whereas informational motivations mediated the relationships between ICT use and physical well-being.

Discussion: Older adults aged 80+ use ICT less than other generations, but may have much to gain. Using social versus informational technologies may enhance multiple aspects of well-being in different ways during very late life. Highlighting such benefits may increase ICT adoption among the oldest-old.

Keywords: Life satisfaction—Loneliness—Physical health—Social technology—Socioemotional selectivity theory

As people age and begin to perceive time as limited, they prioritize spending time with close others and focusing on what is meaningful in life over expanding their horizons and learning new information (Carstensen, Isaacowitz, & Charles, 1999). Empirical evidence suggests that older adults structure their social lives in accordance with these goals (e.g., English & Carstensen, 2014). Less is known, however, about the tools they may use to do so. In recent decades, information and communication technology (ICT; i.e., electronic devices and systems with micro-processors such as cell phones, e-mail, smart device applications; Charness & Boot, 2009) has become increasingly prevalent for learning information and connecting with others. Less clear, however, is whether people effectively use ICT to meet these goals and the downstream consequences for well-being, particularly among older age groups. The current study applied socioemotional selectivity theory (SST) as a guiding framework to examine whether the oldest-old (i.e., adults aged 80+) use ICT to achieve social connectedness and how this may relate to their well-being.

Social Goals Take Priority in Later Life

According to SST (Carstensen et al., 1999; Charles & Carstensen, 2010), what matters in life shifts across the

adult life span. When people are young, they perceive time as open-ended and they prioritize learning new information and expanding their horizons in order to prepare for a long and uncertain future. As people get older and begin to perceive time as more limited, they are more motivated to prioritize close social relationships over expanding their knowledge. For example, older adults disproportionately prefer to spend time with close friends and family versus novel acquaintances (e.g., an author of a book) compared with younger adults (Fredrickson & Carstensen, 1990; Fung, Carstensen, & Lutz, 1999). These motivational shifts are proposed to explain increasingly higher levels of well-being experienced with age (Carstensen, Fung, & Charles, 2003).

One consequence of this motivational shift is that social networks are restructured as people age. In old age, social networks tend to contract as people increasingly exclude casual acquaintances—who afford new experiences and information—while maintaining intimate, emotionally close partners (for a review, see Charles & Carstensen, 2010). Recent work shows that older adults who spend more time with their loved ones relative to others experience higher levels of well-being (English & Carstensen, 2014). Thus, older adults effectively seek out in-person contact with close others and ultimately experience emotional benefits as a result. Less is known about the particular methods or tools older adults use to seek out social contact. Given the increasing prevalence of social uses of ICT, might similar effects on well-being generalize to virtual contact with close others?

The Relationship Between ICT Use and Well-Being

ICT devices and applications are designed to help people meet their goals in daily life. People use cell phones and social networking websites to connect with others; they use their personal computer to complete various "to dos" like online banking, keeping up with the latest news, or learning about their health. As such, ICT use is poised to enhance well-being, particularly when used to accomplish important or meaningful goals. Indeed, there are well-documented benefits of using ICT across different contexts among younger populations (e.g., Grieve, Indian, Witteveen, Tolan, & Marrington, 2013; Kim & Lee, 2011; McDaniel, Coyne, & Holmes, 2012; Valkenburg & Peter, 2009).

Compared with younger cohorts, older adults overall (age 65+) have shown the greatest increase in technology use, such as using the internet and social media, in recent years (Perrin, 2015). Yet, they still lag far behind their younger counterparts (Zickhur, 2013). There are multiple pathways by which technology may enhance well-being among older groups (Charness & Boot, 2009), including managing physical health limitations (e.g., using a medical website to learn about a health condition) and social engagement (e.g., videoconferencing to see distant relatives). For instance, using social networking technology to send text messages to friends or video chatting can buffer against loneliness (Ellison, Steinfield, & Lampe, 2007; Sum, Matthews, Hughes, & Campbell, 2008), and even searching the internet for health information is related to positive outcomes such as an increase in engagement in healthy behaviors (Samal et al., 2011) and maintenance of health literacy (Kobayashi, Wardle, & von Wagner, 2014).

Evidence of the relationship between ICT use and well-being in old age is mixed, however. Some evidence indicates no association between ICT use and well-being (Fazeli, Ross, Vance, & Ball, 2013; for review, see Dickinson & Gregor, 2006), while other studies find that ICT use is positively related to well-being (Bobillier Chaumon, Michel, Tarpin Bernard, & Croisile, 2014; Cotten, Anderson, & McCullough, 2013; Cotten, Ford, Ford, & Hale, 2012, 2014; Sum et al., 2008; Tun & Lachman, 2010; for reviews, see Nef, Ganea, Müri, & Mosimann, 2013; Wagner, Hassanein, & Head, 2010). For instance, internet use among older adults 65+ has been associated with lower levels of loneliness and depression (Cotten et al., 2013, 2014). Still, other research shows mixed effects (Bell et al., 2013; Elliot, Mooney, Douthit, & Lynch, 2014; Wright, 2000; for review, see Leist, 2013). For example, Elliot and colleagues (2014) did not observe any relationship between ICT use and depression overall, but they did find that ICT use interacted with health. Specifically, ICT use offset the impact of poor health on depression among older adults. Effects also appear to vary by outcome. For instance, older users of a social networking site reported higher levels of social satisfaction than nonusers, but did not differ in loneliness (Bell et al., 2013). In a survey of internet use and well-being, greater use among older adults predicted higher levels of self-efficacy, but did not predict loneliness or life satisfaction (Erickson & Johnson, 2011). This was found for both communicative and informational internet use, although the authors did not estimate the unique effect of each by including them in the same model.

Experimental studies in which older adults are assigned to use ICT tend to produce benefits as well, particularly for cognitive well-being (Chan, Haber, Drew, & Park, 2016; Cody, Dunn, Hoppin, & Wendt, 1999; Ihm & Hsieh, 2015; Myhre, Mehl, & Glisky, 2016; Park et al., 2014; Shapira, Barak, & Gal, 2007). For instance, older adults aged 70–93 who were trained to use the internet showed higher levels of life satisfaction and lower loneliness relative to those who did not receive training, but there was no effect for physical function (Shapira et al., 2007). Similarly, in an intervention designed to teach older adults aged 60–90 years how to use an iPad, participants demonstrated improvements in cognitive function (i.e., processing speed and episodic memory) after 10 weeks (Chan et al., 2016). Older adults assigned to use a social networking site also demonstrated better executive functioning (Myhre et al., 2016). In contrast, other experiments found no significant differences between an ICT intervention and control group on quality of life (e.g., loneliness, depression, mood, physical well-being) among community dwelling older adults (Slegers, van Boxtel, &

Jolles, 2008; White et al., 2002). These studies did not distinguish among motivations for or modes of ICT use, however.

Determining how older adults are using ICT may clarify when positive associations between ICT use and well-being emerge. That is, using ICT for social versus informational purposes may yield distinct effects on well-being. Effects also appear to depend on which aspects of well-being are assessed (e.g., life satisfaction vs physical function). Moreover, across both correlational and experimental studies, young-old (i.e., 65–79) and old-old (i.e., 80+) adults were not differentiated. One notable exception was an intervention study conducted in 1999 that trained nursing home residents how to use WebTV and found that greater use predicted higher social well-being, particularly for social uses versus information/exploratory searches (Cody et al., 1999). This study was limited to internet use among a more frail population; whether these findings extrapolate to other devices and to community dwelling 80+ year olds remains unknown.

The Oldest-Old Can Shed Light on How ICT Use Relates to Well-Being

The majority of studies examining ICT use among the oldest-old typically do not distinguish between young-old and old-old adults (e.g., Carpenter & Buday, 2007; Czaja et al., 2006; Mitzner et al., 2010; Olson et al., 2011; Russell, Campbell, & Hughes, 2008; Selwyn, 2004; Selwyn, Gorard, Furlong, & Madden, 2003). Collapsing across younger and oldest old adults, however, may contribute to some of the mixed findings reviewed previously (Dickinson & Gregor, 2006). In addition, there are important theoretical and practical reasons to focus in on the oldest-old population.

First, different models of aging make unique predictions about whether and how the oldest-old might benefit from using ICT. From a sociodevelopmental perspective, the oldest-old have the most limited future time perspective of any age group because they are nearest to the end of life. According to SST, those who perceive time as limited are especially likely to prioritize socially meaningful goals over expanding their horizons, and thus are especially motivated to connect with others (vs learn new information). Therefore, using ICT in the pursuit of socially meaningful goals should be associated with well-being more than using it to facilitate knowledge-related goals. In contrast, biological models of aging depict the oldest-old as experiencing the greatest losses in terms of cognitive and physiological functioning (Baltes & Smith, 2003). Therefore, the oldest-old may have as much, if not more to gain from using ICT to learn new information than connecting with others. As such, nonsocial or informational uses of ICT might be as or even more strongly linked to well-being than social uses.

Second, focusing on the oldest-old is valuable from a practical standpoint for several reasons: (a) they are not well characterized in the ICT literature despite being the fastest growing segment of the U.S. population (Federal Interagency Forum on Aging-Related Statistics, 2012); (b) they have the lowest rates of technology use of any age group and therefore, the most need for technological support (Zickuhr, 2013); and (c) due to declines experienced at this stage of life (Carstensen et al., 2011; Gerstorf, Ram, Röcke, Lindenberger, & Smith, 2008; Salthouse, 2013), ICT use may be particularly helpful, as has been observed among other, more vulnerable, subgroups of the older adult population (i.e., those with limited functional or cognitive abilities; Cotten et al., 2014; Tun & Lachman, 2010). Thus, oldest-old adults are uniquely in need of investigation and potentially well suited for intervention.

The Current Study

Using SST as a theoretical framework, we examined two distinct purposes for ICT use among the oldest-old and how each relates to different aspects of well-being (i.e., physical and mental). Applying SST to the context of ICT, we predicted that the oldest-old will prioritize using ICT to connect with loved ones more than using ICT to learn new information. Specifically, we hypothesized that (a) oldest-old adults will report ICT use to connect with other people more often than to learn new information; and as a result, (b) using ICT to connect with others will be more positively related to oldest-old adults' well-being than using ICT to learn new information.

Method

Participants

A nationally representative sample of 445 participants aged 80 and older (M = 84 years, SD = 3, range = 80–93) living in the United States was recruited via phone or e-mail by Kelton Global. Multiple research panels were aggregated via online (30%) and telephone (70%) databases. Telephone respondents were sampled from listed households compiled primarily from telephone directories. Online respondents were recruited from opt-in online panels advertised primarily through e-mail and website marketing. We oversampled subgroups so that the final sample was representative of Americans over 80 in terms of gender (64% female), minority status (26% non-White), education (45% greater than high school education), and internet use (27%). All participants were screened for cognitive impairment via orientation to time items (year, month, day of week). We limited the screener to this single item to minimize response burden. We chose time orientation because previous research has established it as a valid indicator of dementia (O'Keeffe, Mukhtar, & O'Keeffe, 2011). The response rate was 10% for the online panels and more than 60% for those contacted over the phone. Eighty-five percent of people contacted met the sampling criteria and passed the cognitive screener and thus, were included in the study.

Measures

Mental well-being

Mental well-being was assessed in terms of life satisfaction and loneliness. Life satisfaction was measured using the Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985). Participants rated agreement with five statements (e.g., "*In most ways, my life is close to my ideal.*") on a 1 (*strongly disagree*) to 5 (*strongly agree*) scale. All five items were averaged to create a composite score. Internal consistency was high (α = .80). We used an abbreviated version of the UCLA loneliness scale (Hughes, Waite, Hawkley, & Cacioppo, 2004) to measure loneliness. Participants rated three items: "*How often do you feel that you lack companionship?*" "*How often do you feel left out?*" and "*How often do you feel isolated from others?*" on a 1 (*hardly ever*) to 3 (*often*) scale. Items were aggregated to obtain a composite loneliness score. Internal consistency was moderate (ordinal α = .57).

Physical well-being

Physical well-being was measured in terms of subjective health and functional limitations. To assess subjective health, we administered a widely used single-item measure: "*In general, would you say your health is…?*" Participants rated their health on a 1 (*excellent*) to 5 (*poor*) scale. Responses were reverse-coded so that higher scores indicated better health. To assess functional limitations, we assessed ability to perform five activities and instrumental activities of daily living (adapted from Spector & Fleishman, 1998): bathing, light physical activity (e.g., walking), daily chores (e.g., light household cleaning), grocery shopping, and driving. We limited this measure to five items to minimize participant burden. Participants indicated the level of help needed for each activity on a 1 (*able to do on my own*) to 3 (*significant help needed*) scale. Internal consistency was high (ordinal α = .94) and a composite index of functional limitations was calculated based on an average of these five items.

Goal attainment

To assess the extent to which people were achieving important goals, we adapted items from Lang and Carstensen (2002) representing both physical and psychological well-being. Participants rated to what extent they agreed with the following six statements on a five point scale (1 = *strongly disagree*, 5 = *strongly agree*): *I feel happy, I am independent, I am physically active, I have a clear sense of purpose and meaning in my life, I am healthy, I am mentally sharp*. Internal consistency was high (α = .79). Items were averaged to obtain a composite score.

Number of ICT devices/applications used

As part of a larger survey, participants also indicated whether or not they regularly used (at least monthly) each of 16 types of technology: cell phone, text messaging, video or computer games you play with other people, social media sites, programs for making video calls, personal computer, tablet, video streaming services, wearable health monitor/fitness tracker, digital music, internet-based music players, video or computer games you play by yourself, digital books, online banking, voice-to-text programs, and online websites/applications to help learn about health. (We also classified devices/applications into two categories: social vs nonsocial and examined the frequency of use and effects on well-being. See online supplement for description of analyses and results.) Due to positive skew, we transformed the total number of devices/apps used (skewness = 1.26, *SE* = .12) into a 3-point ordinal scale in order to achieve normality: 0 = *no device/app*, 1 = *one device/app*, 2 = *two or more devices/apps*.

Motivation for ICT use

To assess motivations for ICT use, participants reported the extent to which they agreed (1 = *strongly disagree* to 5 = *strongly* agree) with several statements describing how they use technology. Two of these statements were designed to specifically test our hypotheses: *Technology helps me be connected with family and friends* and *Technology helps me learn new information and skills*.

Procedure

Participants were recruited to participate in a 15-min survey of "technology use and well-being" in exchange for monetary compensation either online or over the phone. After providing consent, participants rated their health, satisfaction with life, loneliness, and goal attainment. Participants then reported their use of ICT. At the end of the survey, participants reported functional limitations and demographic information.

Data Analysis

We used SPSS version 23 for all analyses. To test our first hypothesis, we compared older adults' motivations for ICT use. To do so, we conducted a paired-sample *t*-tests comparing motivation to use ICT for social versus informational purposes and calculated *R*-squared to estimate the magnitude of the difference.

To test our second hypothesis, we first examined the association between overall ICT use and well-being and then estimated whether this association was accounted for by motivation to use ICT for social and informational purposes. To do so, we conducted a multiple mediation analysis using Model 4 of the PROCESS SPSS macro (Hayes, 2014). We entered the total number of devices/apps used as the independent variable and endorsement of technology helps connect with others and learn new information items as the mediator variables. Each of the five well-being outcomes (i.e., life satisfaction, loneliness, well-being, subjective health, functional limitations) was entered as the dependent variable in five separate regression models.

We included age, gender, ethnicity (minority vs White), level of education (less than high school diploma vs more), and urbanicity (urban/suburban vs rural/small town) as covariates in all models. Bias-corrected standard errors and confidence intervals were calculated based on 1,000 bootstrap resamples. Indirect effects are significant if the corresponding 99% confidence interval does not include zero.

To minimize the possibility of Type I error by examining multiple outcomes, we performed a Bonferroni correction by adjusting alpha to .01 (.05/5 = .01) similar to Carpenter and Buday (2007). We also confirmed findings reported below using structural equation modeling in which we examined all five outcomes in one model while covarying them with one another. Across analyses, controlling for physical well-being when looking at mental well-being (and vice versa) did not change the results reported below.

Results

Hypothesis 1: Oldest-Old Adults Will Be Most Motivated to Use ICT for Social Versus Informational Purposes

See Table 1 for means, standard deviations, and bivariate correlations across all variables. For motivations for ICT use, participants indicated that technology helped them connect to friends and family more than learn new information, $t(444) = 16.44$, $p < .001$. Thus, oldest-old adults used ICT more for social purposes than for informational purposes.

Hypothesis 2: Social ICT Use Will Be More Positively Linked to Well-Being Than Informational ICT Use Among Oldest-Old Adults

Unstandardized beta coefficients and standard errors for associations between ICT use and each well-being outcome as well as *R*-squares for each model are shown in Table 2.

Overall, we found using more devices/applications was associated with higher life satisfaction, lower loneliness, higher goal attainment, better subjective health, and fewer functional limitations (all ps ≤ .008). Using more devices/apps was also associated with motivation to use technology to help connect to loved ones, $B = 0.90$, $SE = .06$, $t = 14.33$, $p < .001$, and to learn new information, $B = 1.02$, $SE = .07$, $t = 15.38$, $p < .001$. Above and beyond number of devices/apps used, using technology to connect to loved ones was significantly related to higher life satisfaction, lower loneliness, and greater goal attainment (ps ≤ .004), whereas it was not related to subjective health ($p = .137$) or functional limitations ($p = .574$). Using technology to learn new information was not significantly associated with life satisfaction or loneliness (ps ≥ .864), whereas it was marginally associated with greater goal attainment ($p = .012$) and significantly associated with better subjective health and fewer functional limitations (ps ≤ .006).

When including motivations in the model, the effect of overall ICT use was no longer significant for life satisfaction, $p = .725$, loneliness, $p = .370$, goal attainment, $p = .056$, and was marginally significant for subjective health, $p = .015$. The effect of overall ICT use still significantly predicted functional health, although this effect was significantly reduced, $p < .001$. Moreover, we observed a significant indirect effect of overall ICT use through using technology to connect to loved ones on mental well-being (life satisfaction indirect effect = .089, $SE = .032$, 99% *CI* [.003, .169]; loneliness indirect effect = –.051, $SE = .019$, 99% *CI* [–.102, –.006]) and goal attainment indirect effect = .081, $SE = .027$, 99% *CI* [.019, .151]), but no indirect effect for physical well-being outcomes. In contrast, we observed a significant indirect effect of overall ICT use through using technology to learn new information on physical well-being (subjective health indirect effect = .100, $SE = .037$, 99% *CI* [.008, .212]; functional limitations indirect effect = –.090, $SE = .018$, 99% *CI* [–.148, –.044]), but no indirect effect for goal attainment and mental well-being outcomes.

Table 1. Bivariate Correlations Between Variables in Analyses ($N = 445$)

	1	2	3	4	5	6	7	8
1. No. of devices/applications used	1	.600**	.656**	.178**	–.190**	.382**	.376**	–.502**
2. Use technology to connect with family and friends	.600**	1	.514**	.238**	–.225**	.371**	.314**	–.341**
3. Use technology to learn new information and skills	.656**	.514**	1	.155**	–.146**	.364**	.364**	–.492**
4. Satisfaction with life	.178**	.238**	.155**	1	–.385**	.591**	.342**	–.251**
5. Loneliness	–.190**	–.225**	–.146**	–.385**	1	–.492**	–.243**	.274**
6. Goal attainment	.382**	.371**	.364**	.591**	–.492**	1	.607**	–.547**
7. Subjective health	.376**	.314**	.364**	.342**	–.243**	.607**	1	–.486**
8. Function limitations	–.502**	–.341**	–.492**	–.251**	.274**	–.547**	–.486**	1
Mean	1.23	3.66	2.61	3.57	1.46	3.79	2.87	1.56
SD	0.83	1.28	1.44	0.69	0.41	0.64	0.87	0.50

Note: **$p < .01$. *$p < .05$.

Table 2. Unstandardized Betas (Standard Errors) Indicating Associations Between ICT Use and Well-Being Among Adults Aged 80+ (*N* = 445)

		Mental well-being			Physical well-being	
Technology use		Satisfaction with life	Loneliness	Goal attainment	Subjective health	Functional limitations
Model 1	No. of devices/applications used	.11 (.04)*	−.08 (.03)*	.24 (.04)**	.31 (.05)**	−.25 (.03)**
	R^2	.06	.05	.19	.18	.32
Model 2	Use technology to connect with family and friends	.10 (.03)*	−.06 (.02)*	.09 (.03)*	.06 (.04)	−.01 (.02)
	Use technology to learn new information and skills	.00 (.03)	.00 (.02)	.06 (.03)†	.10 (.04)*	−.09 (.02)**
	No.of devices/applications used	.02 (.06)	−.03 (.03)	.09 (.05)	.16 (.07)†	−.15 (.03)**
	R^2	.08	.07	.23	.21	.36

Note: All models include as covariates age, gender, ethnicity (minority vs White), level of education (less than high school diploma vs high school diploma or more), and urbanicity (urban/suburban vs rural/small town). Based on Bonferroni correction: $*p < .01$, $**p < .001$, $^{\dagger}p < .05$.

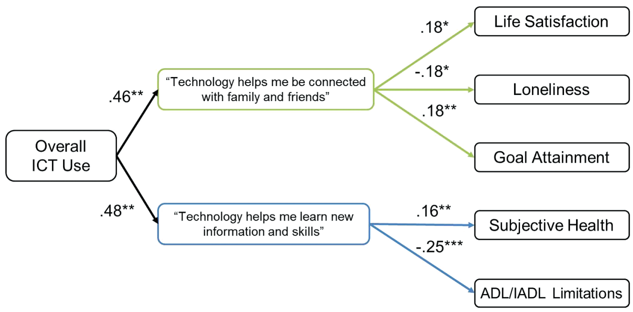

Figure 1. Mediation model depicting the relationship between motivation for ICT use and well-being. *Note.* Values represent standardized beta coefficients. Missing arrows between mediators and dependent variables represent nonsignificant paths (α = .01).

In sum, using ICT to connect with family and friends mediated the relationships between number of ICT devices and applications used and life satisfaction, loneliness, and goal attainment, whereas using technology to learn new information did not. Conversely, using technology to learn new information mediated the relationships between number of devices/apps used and subjective health and functional limitations, whereas using technology to connect with family and friends did not. See Figure 1 for illustration of each model and standardized betas.

Discussion

In support of our first hypothesis, we observed that ICT use is more commonly used to connect with loved ones than to learn new information among oldest-old Americans. In support of our second hypothesis, we found that using more ICT devices and applications was related to higher levels of mental and physical well-being among the oldest-old, which was mediated by their motivations to use technology. Whereas using ICT to connect with family and friends was associated with greater life satisfaction, lower loneliness, and higher goal attainment, learning new information was associated with better subjective health and fewer functional limitations.

Contrary to expectation, motivation to use technology to learn new information was associated with physical health whereas motivation to use ICT to connect with others was not. This may be because when people report using ICT to learn new information, they are doing so to learn about or better manage their health (Kobayashi et al., 2014; Samal et al., 2011). In contrast, using ICT to connect with others may be done to garner social support (Wright, 2000). Future work exploring the behavioral mechanisms underlying the relationship between motivations to use ICT and well-being can shed light on these and other possibilities. Additionally, the effect of ICT use on physical well-being remained significant in our mediation models, which suggests that other uses of ICT play a role. For instance, people who use ICT to sustain autonomy and independence (Hernández-Encuentra, Pousada, &

Gómez-Zúñiga, 2009) may be better able to compensate for physical decline (e.g., ordering products online when one is unable to go to the store).

These results underscore the need to align the purpose of ICT use with older adults' goals in order to maximize its benefits (Rogers & Fisk, 2010). Results from this study may also speak to the mixed findings produced by earlier studies. Namely, benefits to mental well-being may be greatest when older adults are using ICT connect with close others. In contrast, benefits to physical well-being may be greatest when older adults are using ICT to learn new information. Thus, research on ICT use among older adults should assess both motivations for ICT use and multiple aspects of well-being.

Theoretical and Practical Implications

These findings add to our understanding of SST and older adults' socioemotional functioning. First, in line with SST, we found 80+ year olds prioritized connecting with close others over learning new information in the context of ICT use. This is in contrast to a model of biological aging in which using technology to learn new information might be prioritized (or at least valued similarly to social connection) in order to stave off or compensate for cognitive or physical deficits. Second, whereas previous research has well established preferences for socioemotional versus informational goals in old age, here, we show utilization of ICT as a tool for effectively pursuing such goals. Third, on average the oldest-old show decreases in mental well-being compared with younger-old (and tremendous variability therein); our results indicate that 80+ year olds who are able to connect with loved ones using ICT experience higher levels of mental well-being than 80+ year olds who are not. These findings suggest that decreases in well-being often observed in late life may be less pronounced or undetectable among ICT users.

The current research also elucidates avenues for promoting well-being through ICT adoption among the oldest-old. We observed significant associations with well-being despite this population's limited experience with ICT compared with other generations (Zickuhr, 2013). This, coupled with work showing older adults' attitudes toward technology are more positive than negative (e.g., Mitzner et al., 2010), signifies the viability of ICT interventions targeting the oldest-old. Further, with the rising prevalence of ICT use, concerns have been raised about whether it is helpful or harmful in the context of older adults' daily lives (Leist, 2013). Comparing social use of ICT to in-person interactions can provide a clearer estimate of the impact of social ICT use on quality of life (Grieve et al., 2013). Yet, our findings are at least indicative that virtual interactions offer a promising supplement for those that may be unable to meet loved ones in person. These findings are also consistent with previous research showing that ICT use may offset loneliness and depression among older adults and extends this work by showing that ICT use possibly offsets physical decline in late life as well depending on the purpose of use.

Limitations

Although this is the first study to apply SST to understand the links between different motivations to use ICT and different dimensions of well-being among the oldest-old, our findings should be interpreted in light of limitations inherent to our survey design. The current study is correlational and thus, we cannot infer causality. It may be that higher levels of well-being facilitate ICT use. That is, those who are more capable physically or mentally may be better able to access and use ICT. However, positive associations between ICT use and mental well-being persisted when controlling for physical well-being, and vice-versa, which speaks against this possibility. To better establish the directionality of this relationship, longitudinal interventions designed to increase ICT use could evaluate change in oldest-old adults' well-being over time (e.g., Cotten et al., 2014).

Additionally, while the current findings suggest that the oldest-old may benefit more from social versus informational ICT use as predicted by SST, we did not include a younger adult comparison sample. Extending the present research to incorporate younger age groups would provide a more rigorous test of the theory and a more comprehensive examination of whether the relationships between ICT and well-being depend on the extent to which it serves age-specific goals. Moreover, in future studies it would be useful to include more objective measures of technology use (e.g., number of text messages, size of social media networks) and well-being (e.g., number of hospital visits, depression diagnosis) and assess which types of technology use have the most impact on well-being independent of other uses of technology (e.g., use of phone for texting vs talking).

Because we did not assess participants' expertise in using ICT, it remains unclear whether this was a newly acquired skill or a familiar activity. This distinction is important in the context of research demonstrating that learning new skills (i.e., productive engagement) and participating in familiar activities (i.e., receptive engagement) differentially influence older adults' functioning (Park, 2007). Future work could compare older adults learning how to use ICT for the first time either to acquire knowledge or to engage with others. In addition to ICT experience, it would be important to assess attitudes toward ICT use (Charness & Boot, 2009; Mitzner et al., 2010) as a possible moderator of our findings as well as other motivations for ICT use such as doing so to maintain independence (Hernández-Encuentra et al., 2009) to ascertain the relative importance of using ICT to connect with loved ones. Relatedly, future work should consider how these findings may vary as a function of other characteristics including culture and socioeconomic status (e.g., Ihm & Hsieh, 2015). For example, associations between social ICT use and well-being may be less pronounced in contexts that particularly value or necessitate in-person interpersonal interactions.

Conclusion

Understanding how and why the oldest-old use ICT can aid in the development of more refined interventions and policy aimed at increasing ICT adoption for optimizing well-being in late life. Our findings suggest that emphasizing the social benefits of ICT use may be particularly effective in promoting adoption of technology in this population (Melenhorst, Rogers, & Bouwhuis, 2006). Our findings also indicate that ICT use can be a low-cost, effective means for oldest-old adults to maximize time spent with close others and ultimately offset significant challenges to well-being encountered in the latest stage of life.

Supplementary Material

Supplementary data is available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

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