

## Article

# Does ICT Usage Have a Positive or Negative Effect on Taiwanese Older Adults' Emotional Experiences? The Moderating Role of Basic Psychological Needs Satisfaction

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**Abstract:** While some studies have found that older adults' use of information and communications technology (ICT) contributes to their positive emotions, others have not. According to previous research, basic psychological needs satisfaction may help us explore the relationships between older adults' ICT usage and their emotional experience. This study aimed to investigate the moderation effect of older adults' basic psychological needs satisfaction on the relationship between ICT usage and emotional experience using the experience sampling method via the communication application, Line. At the first phase of the study, we surveyed each participant's age, gender and satisfaction with basic psychological needs, and afterward, each participant needed to complete their current situation each day throughout the 10-day period. A total of 788 daily experiences of 32 participants (Mage = 63.13; SDage = 5.97, ranging from 52 to 75; 81% women) were collected, and hierarchical linear modeling (HLM) was conducted. Results revealed that ICT usage generally enhanced older adults' positive emotional experience. Those with satisfied competence needs had stable and positive emotional experiences with or without using ICT, while those without could further promote their positive emotional experience by using ICT. Those with satisfied relatedness needs had more positive emotional experiences when using ICT, while those without had similar emotional experiences with or without ICT.



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**Keywords:** older adults; ICT usage; emotional experience; communication application; basic psychological needs satisfaction

## 1. Introduction

With the increase in human lifespan and the growth of the older population, improving humans' wellbeing in an aging society is regarded as an increasingly important research topic. Past studies have found that using information and communications technology (ICT) is related to older adults' daily life (Coelho 2022; Damant et al. 2017; Hargittai et al. 2019). Continued use of ICT by older adults can also boost their technological literacy and interest (Castilla et al. 2018). The motives for using ICT are different for each person, but judging from the results of use, it may lead to different emotional experiences. If older adults use ICT to socialize and connect with family and friends, it may save them from negative emotions such as loneliness or social isolation (Khosravi et al. 2016; Masi et al. 2011). They may also use ICT to make their lives more convenient, such as by searching for information, using online financial services, etc., similar to young people. However, it has also been found that when ICT is excessively involved in the lives of older adults, it can result in feeling negative emotions (Kwak et al. 2014). Moreover, there may be negative consequences for older adults when operating an unfamiliar technology (Caspi et al. 2019). However, some studies have found that ICT intervention may not have any impact on certain groups of older adults (Cid et al. 2020). The literature indicates that the relationship between ICT usage and older adults' emotions is not entirely positive or negative. Therefore, the current study aimed to explore older adults' ICT use and their daily emotional experience.

Prior studies have focused on the direct impact of ICT usage on emotion, but other points of concern have not been addressed. Past studies have elucidated that basic psychological needs satisfaction is helpful for individual growth (Deci and Ryan 2000; Ryan and Deci 2000). Research in the past had indicated that individuals have three different basic psychological needs: autonomy, competence, and relatedness (Deci and Ryan 2000; Ryan and Deci 2000). Autonomy refers to people's choices in determining their actions and behaviors; competence is related to a person's confidence in their ability to face the environment or the ability to achieve expected results; relatedness is defined as the degree to which people feel connected to other individuals and groups in a social environment. Additionally, it has been discussed that when basic psychological needs are satisfied, the use of ICT for learning will result in a more positive experience (Fang et al. 2019). However, when people's basic psychological needs are not satisfied, they may experience negative feelings when using ICT (Allen and Anderson 2018). In short, basic psychological needs satisfaction may cause people to have different experiences when using ICT. For this reason, the current research used basic psychological needs satisfaction as a moderator to explore whether older adults' basic psychological needs moderate the relationship between emotional experience and ICT usage.

### *1.1. The Relationship between Older Adults' ICT Usage and Emotional Experience*

The increase in the number of older adults using mobile applications can bring convenience to their lives. Some studies suggest that using ICT is beneficial for older adults; for example, Cotten et al.'s (2013) study indicated that older adults' motivation to use the Internet is to connect with relatives and friends, as they often need more intimate relationship support in their daily lives (Glass and Vander Plaats 2013; Strom and Strom 2015). By using these technologies to connect with others, negative emotions can be reduced (Choi et al. 2012; Morris et al. 2014).

However, not all older adults who use ICT have positive emotional experiences. For example, the complex interface of digital technology is an important reason for the reluctance of older adults to use it (Hutto et al. 2015; Jung et al. 2017). In addition, ICT use can induce negative emotions in older adults who do not want to admit that they need ICT for assisted living (Bright and Coventry 2013). Factors including the lack of help or support, physical aging, and difficulty coordinating with their lifestyle can lead to older adults experiencing negative emotions when using ICT (Kim 2012). Hence, the question remains as to whether the use of ICT increases older adults' positive emotions.

Nevertheless, what is known from past research is that basic psychological needs satisfaction may moderate the relationship between ICT use and emotion (Allen and Anderson 2018; Przybylski et al. 2009; Fang et al. 2019; James et al. 2022; Partala and Kallinen 2012; Pettersson et al. 2021). For example, Przybylski et al. (2009) found that when people's basic psychological needs are satisfied, they will have a better experience when playing games on ICT; however, when their satisfaction with basic psychological needs is low, they will experience negative emotions such as stress when playing games with ICT. James et al.'s (2022) study indicated that people who are satisfied with their basic psychological needs promote their positive learning emotions when learning with ICT, while people with unsatisfied basic psychological needs are more likely to experience learning anxiety when they use ICT to learn.

From this, it can be inferred that the basic psychological needs satisfaction may be an essential factor moderating the relationship between ICT use and emotional experience. Therefore, the current study intends to use basic psychological needs satisfaction as a moderating variable. The moderation effect of basic psychological needs satisfaction on the relationship between ICT usage and emotional experience is hereinafter discussed.

## 1.2. Moderation Effects of Basic Psychological Needs Satisfaction on the Relationship between ICT Usage and Emotional Experience

Reis et al. (2000) found that personal daily happiness is affected by these three basic psychological needs; hence, basic psychological needs may affect an individual's emotional experience. The same situation occurs when using ICT (Partala and Kallinen 2012). In recent years, researchers have been investigating older adults' basic psychological needs satisfaction (Heissel et al. 2019), and studies have adjusted and verified the psychological needs satisfaction scale for older adults (Heissel et al. 2019; Vanhove-Meriaux et al. 2020). This shows that satisfying basic psychological needs is still important to older adults.

According to the definition of the three basic psychological needs and the past research results, the current study considers that basic psychological needs satisfaction will moderate the relationship between ICT usage and emotional experience. The following assumptions assume that the satisfaction of the three basic psychological needs may be a moderator.

### 1.2.1. Autonomy Needs Satisfaction

Current research states that autonomy needs satisfaction may moderate the association between ICT use and emotional experience for older adults. Pettersson et al.'s (2021) study using an exercise app as a research tool found that when older adults' autonomy needs were satisfied, they felt that it was very meaningful to use the app. Conversely, when older adults' autonomy needs were not met, they experienced negative emotions such as anxiety when using ICT (Di Giacomo et al. 2019). Therefore, the current study proposes the following hypothesis:

**H1.** *When the autonomy needs of older adults are satisfied, they will have a more positive emotional experience when using ICT. Conversely, if their autonomy needs are not satisfied, they will have less positive emotional experiences when using ICT.*

### 1.2.2. Competence Needs Satisfaction

Older adults' competence needs satisfaction is important for their emotional experience when using ICT, especially for those whose competence needs are not met. Previous research has indicated that competence needs satisfaction interferes with the experience of older adults using ICT (Terp et al. 2021). In addition, Korlat et al. (2021) found that people whose competence needs are met have better psychological adaptation and learning attitudes when using ICT to learn. However, older adults with unsatisfied competence needs can have a better emotional experience when using ICT with proper guidance (Choudrie et al. 2020). In case of insufficient ability to use ICT, older adults can still experience more positive emotions through the use of ICT with the help of relatives and friends (Seifert 2020). Therefore, we hypothesize that:

**H2.** *Older adults whose competence needs are satisfied may have positive and stable emotional experiences with or without ICT use, while older adults whose competence needs are not satisfied may have more positive emotional experiences if they are assisted in integrating ICT use into their daily activities.*

### 1.2.3. Relatedness Needs Satisfaction

Satisfaction or dissatisfaction with relatedness needs moderates the association between ICT use and emotional experience in older adults. Strutt et al.'s (2022) study showed that older adults whose relatedness needs are satisfied experienced more positive emotions when using ICT. Conversely, older adults are more likely to experience negative emotions when using ICT when their relatedness needs are not met (Delello and McWhorter 2016). Therefore, the current study proposes the following hypothesis:

**H3.** *When the relatedness needs of older adults are satisfied, they will have more positive emotional experiences when using ICT to integrate into their daily activities. Conversely, when the relatedness needs of older adults are not satisfied, using ICT will not affect their daily emotional experience.*

Through the above, we deduced the possible emotional experience of using ICT when the three basic psychological needs of older adults are and are not satisfied. To investigate the daily emotional experiences of older adults in a timelier fashion, we chose to conduct this study using the experience sampling method (ESM) paired with a communication app (Line). The methodological design of the current study will be illustrated below.

### *1.3. Investigating the Daily Experience of Older Adults Using a Communication Application: The Experience Sampling Methodology*

ESM refers to a technology that captures transient states in daily natural environments (Soong et al. 2015) and is one of the techniques for repeatedly measuring older adults' daily experiences. It captures the transient state of the daily natural environment (Soong et al. 2015) by requiring individuals to record and report their time states, such as emotional experiences, behaviors, and activities, when they occur. The data collected when using the ESM method are similar to the data obtained through a diary, but they are more immediate. In addition, the data collected using this method are less dependent on memory. ESM allows us to understand how individuals respond at different times and in different situations, similar to natural observations, but it is not as invasive as direct observations (Hektner et al. 2007). To use the ESM method to collect data more efficiently, the current research used Line, the most popular instant communication app in Taiwan. Previous studies on the use of communication apps by older adults in Taiwan also used Line as the subject of research (Chen 2019; Yu 2020). For the current research, the benefits of choosing this app are as follows. First, this study aimed to explore the relationship between ICT use and emotional experiences of older adults. It is possible to collect more immediate data by using the Line app to perform such investigations. Furthermore, such a study design fits with Pihlainen et al.'s (2021) suggestion that further research should capture behavioral and emotional changes in older adults when using technology.

Second, it is possible to interact with older adults through communication apps to increase their willingness to take the initiative to fill in survey data. The interactive content includes an introduction to ICT safety, sharing of a common sense of life, and related knowledge on the mental health of older adults. This way, older adults feel that this app is not simply used to record their data but has other more practical uses. Third, older adults can use the app to collect points to redeem rewards at the end of the study. Such an operation can prevent ESM research from being considered a burden. While assisting with the research, older adults can continue to participate to win rewards. This greatly increases their motivation to complete daily surveys.

In summary, it is a trend for older adults to use ICT in their daily lives. Past studies have also shown that ICT usage plays a role in the lives of older adults. The current research, therefore, aimed to explore the emotional impact of the instant experience of older adults using ICT in the natural environment through ESM, using Line, the most commonly used communication app by older adults in Taiwan, as a way to collect ESM data. The level of individual differences in basic psychological needs was also added to determine whether this difference has a moderating effect.

## **2. Materials and Methods**

### *2.1. Participants*

This study recruited 32 older adults in Taiwan through Line and Facebook posts. Participation conditions include (1) having a smartphone, (2) age over fifty and (3) voluntary participation. The average age was 63.13 years ( $SD = 5.97$ , ranging from 52 to 75), and 81% were women (i.e., 26 women and 6 men). The current study participants were predominantly female. *The composition of such research participants is similar to some past studies on the ICT use behavior of older adults, with more female participants than male participants* (e.g., Bakshi and Bhattacharyya 2021; Mulasso et al. 2019; Pihlainen et al. 2021; Zhang et al. 2019). For example, the study participants of Bakshi and Bhattacharyya (2021) and Mulasso et al. (2019) consisted of 60% women. In addition, women accounted for 70% of the participants

in the study by [Vroman et al. \(2015\)](#). Moreover, the proportion of female participants in the above-mentioned studies exceeds 60%. It can be seen that it is not uncommon for women to participate more actively in similar studies. In order to eliminate the sample bias, the current research uses gender as a control variable and statistically controls the possible impact of gender on the current results. All participants were from metropolitan areas of Taiwan. 96.9% of the participants reported that they used ICT on average multiple times per day, and 3.1% said that they used ICT about once per day. This indicates that the vast majority of participants use ICT daily to a high degree. In addition, 18.8% of the participants reported that they had a graduate degree or higher, 28.1% had a college degree, 40.6% had a high school degree, 9.4% had a junior high school degree, and 3.1% chose not to report their academic qualifications. The basic information about the participants is shown in Table 1.

**Table 1.** Basic information about the participants of current study.

	N (%)		N (%)
<b>Gender</b>		<b>Age Group</b>	
Male	6 (18.8%)	50 to 59	9 (28.1%)
Female	26 (81.2%)	60 to 69	19 (59.4%)
		over 70	4 (12.5%)
<b>Education</b>		<b>Frequency of using ICT</b>	
graduate degree or higher	6 (18.8%)	many times per day	31 (91.2%)
college degree	9 (28.1%)	Once per day	1 (2.9%)
high school degree	13 (40.6%)	every two to three days	0 (0%)
junior high school degree	3 (9.4%)	once a week	0 (0%)
not reported	1 (3.1%)	barely used	0 (0%)

To enhance the motivation to participate in the research, the researcher provided 100 NT dollars and practical merchandise (such as a pedometer or mobile phone holder) to participants as gifts for participating in the research. The gift choice was based on the degree of cooperation of participants within 10 days. The form of rewards given was determined with reference to past studies ([Christian et al. 2014](#); [Spence et al. 2014](#)). In addition, to cope with the problems that may be encountered during the 10-day (in May 2019) research period, and to improve the accuracy of the research data, we provided our contact details to the participants. One participant dropped out before finishing the whole study; therefore, 32 participants completed the study’s diary records. Each participant needed to complete their records every day for 10 days. After deleting the missing data, a total of 788 valid records were collected.

*2.2. Design: Experience Sampling Methodology*

The procedure for experience sampling methodology involves different types of evaluation plans for different research purposes in ESM: (a) interval sampling, which means that the evaluation is carried out at a fixed time point; (b) sampling of accompanying signals, which means that the evaluation is usually performed by signal triggers that occur at different time intervals throughout the day; (c) incidental sampling of events, which refers to evaluations triggered by the occurrence of a predetermined event; and (d) any combination of the above ([Hektner et al. 2007](#)). Among these methods, we adopted the method of incidental sampling of signals, requiring the participants to report their experience when receiving online reminder messages on Line.

### 2.3. Ethical Considerations

Before the start of the study, all participants submitted their written informed consent, and a comprehensive report was prepared after the study.

### 2.4. Procedures

First, 15 of the participants were invited to our laboratory for a meeting. They were provided with a research plan and a guidebook, which contained all the steps and information they needed. This research design is also in line with what Pihlainen et al. (2021) pointed out, guiding older adults to use ICT will enhance their willingness and confidence. In the current study, this was very important, as an effort was made to avoid older adults dropping out of the study due to lack of confidence or fear of using ICT. Next, we invited 17 other participants who were not invited to the first meeting to participate in a second meeting with the same content. All participants were assured that their responses would remain completely confidential. They were also taught how to use the communication app, Line, to record their daily lives.

Next, according to the ESM, participants received reminder stickers three times per day for 10 days. The three stickers were sent at semi-random times throughout the day (one each in the morning, afternoon, and evening). Participants did not know when they would receive the message. Each sticker was designed to remind participants to complete the record. In this record, we asked them to reflect on their emotional experience or the current situation and their basic psychological needs satisfaction regarding what had just happened by using a sliding scale when they received the reminder sticker.

Finally, participants returned to the laboratory. According to their performance throughout the research process, they were asked to score the diary records of the past 10 days (i.e., the difficulty in recording). This was the end of the experiment.

### 2.5. Experience Level Measures

Each time participants received a message on the Line app, the researcher would ask them to report the current situation, current activity, and emotional experience over the preceding 30 min (Prentice et al. 2020). The messages contained the following: (1) **ICT Usage**: “Did you use ICT (mobile phones, tablets, computers) to assist you in this activity?” (a. yes; b. no). In this study, participants who answered “a. yes” were coded as 1; participants who answered “b. no” were coded as 0 (61% answered Yes). (2) **Emotional Experience**: “How are you currently feeling” (M = 5.29, SD = 1.19; 1 = very negative, 4 = Normal, 7 = very positive). ICT usage was regarded as the independent variable in the current research, and emotional experience was regarded as the dependent variable.

### 2.6. Individual Level Measures

#### 2.6.1. Basic Psychological Needs Satisfaction

Based on the framework of the Basic Psychological Needs theory (Deci and Ryan 2000), the satisfaction of the three basic psychological needs, i.e., autonomy, competence, and relatedness, are very important for individuals. When basic psychological needs are met, the individual’s development, performance, and happiness are considered to be positively affected. After the participants filled in the basic psychological needs scale, we calculated the scores (Max = 7; Min = 1) of the three dimensions and obtained the results (autonomy: M = 5.29, SD = 0.72; competence: M = 5.44, SD = 0.85; relatedness: M = 5.72, SD = 0.8).

#### 2.6.2. Control Variables

We used the gender and age of the participants as control variables in the current study, where men were coded as 1 and women as 0.

### 2.7. Data Analysis

The current study used SPSS version 23.0 and HLM 8.0 as the statistical analysis tools. The statistical methods used include descriptive statistics, correlation analysis, and

hierarchical linear modeling. Descriptive statistics were used to calculate the average and standard deviation of each variable to understand the distribution. Correlation analysis was used to test the linear relationships between variables.

To solve the problem of independence of data structure, we analyzed the data using HLM 8.0 with a hierarchical linear modeling (HLM) framework (Raudenbush and Bryk 2002). In this study (a repeated measures situation), HLM is suitable because it can check the transient state changes over time. The HLM method also allowed us to account for the independence of multiple measures for each individual. As a result, the current research regressed the emotional experience using HLM. For each of the outcome models, Level 1 depicted the experience level involving the current condition (i.e., ICT usage) and emotional experience. Level 2 depicted the individual level involving the control variables (i.e., gender and age) and the basic psychological needs satisfaction (i.e., autonomy, competence, and relatedness).

### 3. Results

Table 1 shows the descriptive statistics of the mean and standard deviation and the correlation analysis between the variables. Among them, Level 1 contains 788 samples, and Level 2 contains 32 samples. The following sections aim to discuss the results and the significance of the analysis individually.

#### 3.1. Correlation Analysis

In Table 2, the results of the correlation analysis show that ICT usage and emotional experience revealed a positive correlation. This may represent that older adults' emotional experience becomes more positive when using ICT. It is also likely that older adults who currently have positive emotional experiences tend to use ICT. In addition, it shows a positive correlation between the three basic psychological needs variables. Additionally, a positive correlation between age and autonomy in basic psychological needs emerged, which means that as age increases, older adults' autonomy also increases. The coefficient of correlation analysis showed that ICT usage had a low correlation with emotional experience (i.e., 0.09). Therefore, it is more appropriate to use the moderation effect to examine the correlation between two variables in different situations in such circumstances.

**Table 2.** Descriptive statistics and correlation analysis.

	Mean	SD	MIN	MAX	Correlation Analysis					
<b>Level 1 (N = 788)</b>					1	2				
1. ICT usage	0.61	0.49	0	1	-					
2. Emotional experience	4.2	0.98	1	7	0.09 *	-				
<b>Level 2 (N = 32)</b>					3	4	5	6	7	
3. Gender	0.19	0.40	0	1	-					
4. Age	63.13	5.97	52	75	0.26	-				
5. Autonomy	5.29	0.72	3.86	6.71	0.11	0.35 *	-			
6. Competence	5.44	0.85	3.83	7	-0.09	0.15	0.46 **	-		
7. Relatedness	5.72	0.80	4.25	7	-0.22	0.07	0.51 **	0.65 **	-	

\*  $p < 0.05$ , \*\*  $p < 0.01$ .

#### 3.2. The Relationship between Older Adults' ICT Usage and Emotional Experience

Table 3 presents the HLM analysis results. Model A shows the influence of the control variables; Model B shows the relationship between ICT usage and emotional experience; Model C further analyzes whether the basic psychological needs satisfaction had a moderating effect on Model B. As can be observed in Table 2, Model B shows regression analysis predicting emotional experience by using ICT ( $b = 0.18$ ,  $p < 0.05$ ). This result indicates that when older adults use ICT (such as using communication apps), their emotional experience becomes more positive. Overall, the current research showed that when older adults use ICT, they have more positive emotional experiences.

**Table 3.** Hierarchical linear modeling analysis of using ICT to predict emotional experience.

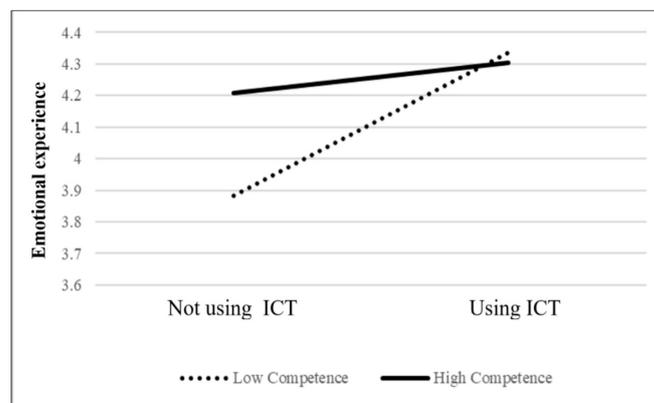
Level 1	Emotional Experience		
	Model A	Model B	Model C
ICT usage (X1)		0.18 *	0.16 *
<b>Level 2</b>			
Gender (M1)	−0.29	−0.22	−0.22
Age (M2)	0.05 **	0.04 *	0.04 *
Autonomy (M3)		0.16	0.16
Competence (M4)		0.14	0.14
Relatedness (M5)		0.03	0.03
<b>Moderating effect of Level 1 and Level 2</b>			
X1 × M3			0.003
X1 × M4			−0.21 *
X1 × M5			0.21 *

\*  $p < 0.05$ , \*\*  $p < 0.01$ . Note: To reduce the table space, each variable is followed by a code (e.g., X1 stands for “ICT usage,” Y1 stands for “emotional experience,” and M1 stands for “gender”). In addition, in the column representing the moderating effect, an “×” symbol is added between the two codes to indicate which two variables have the moderating effect.

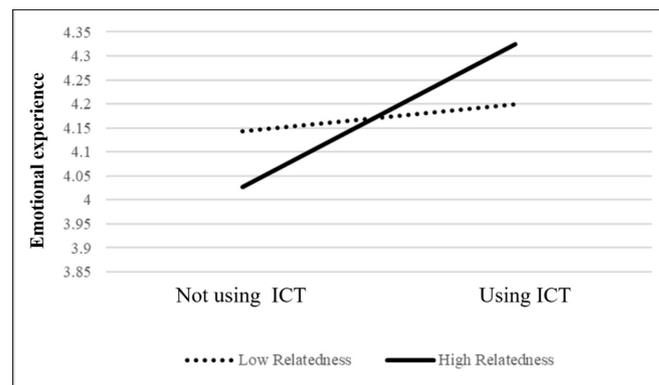
### 3.3. Moderation Effects of Basic Psychological Needs Satisfaction on ICT Usage and Emotional Experience

As presented in Table 2, Model C shows that autonomy needs did not have a moderating effect on ICT usage and emotional experience ( $b = 0.003, p > 0.05$ ). This indicates that our H1 is not supported.

Moreover, as shown in Table 2 and Figure 1, Model C shows the moderating effect of competence needs satisfaction on ICT usage and emotional experience ( $b = -0.21, p < 0.05$ ). This result indicates that when older adults’ competence needs are satisfied, their emotional experiences tend to be positive. However, when the competence needs of older adults are not satisfied, their emotional experience when using ICT is significantly positive compared to when not using ICT. This supports our H2 that older adults whose competence needs are not satisfied significantly improve their emotional experience using ICT compared with those whose competence needs are satisfied. Finally, as shown in Table 2 and Figure 2, Model C shows a moderating effect of relatedness needs satisfaction on ICT usage and emotional experience ( $b = 0.21, p < 0.05$ ). This supports our H3 that when older adults’ relatedness needs are satisfied, they are more inclined to have more positive emotional experiences when using ICT in their daily lives. This means that when older adults use ICT to connect with relatives and friends, they may have more positive emotional experiences.



**Figure 1.** Moderating effect of ICT usage and competence on emotional experience.



**Figure 2.** Moderating effect of ICT usage and relatedness on emotional experience.

#### 4. Discussion

The current study shows that the communication app, Line, used on mobile phones is a feasible tool for measuring the daily experience of older adults. First, this data collection method can help obtain more immediate data than paper questionnaires. In addition, past studies have shown that online versions of questionnaires are considered more satisfactory than paper versions (Touvier et al. 2010). Furthermore, older adult participants were more committed to participating in the investigation because we made proper use of the communication app to interact with them and to design a collection of points to make them more willing to use it. Participants in the current study who successfully reported valid data reached a very high percentage. This success can be attributed to the fact that the researchers designed the app based on the needs of older adults and used game design elements, including incentive systems (Plass et al. 2015). The abovementioned data collection results also represent an effective survey tool designed for the current research. This method has seldom been used to measure the emotional experiences of older adults in previous studies. Past studies have also shown that the use of ESM for older adults requires further development (Myin-Germeys et al. 2018). The current research provides an innovative way to use ESM with older adults and can be a reference for future studies. In addition, the current research reveals the daily experiences of older adults and their use of ICT. It is indicated that their experience may be related to their emotional experience. The highlights of this study are discussed below.

##### 4.1. Older Adults Have a More Positive Emotional Experience When They Use ICT

It was found that the daily transient experiences of older adults are related to their emotional experiences. When older adults use ICT, they have a more positive emotional experience. This finding is similar to past research showing that using ICT can enhance the positive emotions of older adults (Morris et al. 2014; Tkatch et al. 2021). Moreover, some studies have pointed out that ICT use is positively related to the mental health of older adults (Amoah et al. 2022). Previous research has also pointed out that in the life of older adults, technology can be considered a friend to promote their emotional health (Lee and Kim 2020). In addition, the quarantine policy implemented as a response to COVID-19 has caused older adults to face emotional problems. Past studies have shown that ICT use by older adults can help improve this situation (Llorente-Barroso et al. 2021). However, the association between ICT use in older adults and their feelings still requires more evidence (Wiwatkunapakarn et al. 2022) and careful interpretation of the current study results.

##### 4.2. Using ICT Helps Older Adults Whose Competence Needs Are Not Satisfied to Have More Positive Emotional Experiences than Those Whose Competence Needs Are Satisfied

Competence needs satisfaction moderates the relationship between older adults' ICT usage and emotional experience. The findings of the current research show that when older adults' competence needs are not satisfied, the use of ICT can further promote their positive emotional experience. Moreover, past studies have shown that when older adults

are not familiar with the operation and use of digital technology, they experience negative emotional stress such as anxiety or technological panic (Di Giacomo et al. 2019). However, proper guidance on the use of ICT in older adults can effectively improve their digital self-efficacy (Gatti et al. 2017) and allow them to have better psychological adaptation to ICT use. Therefore, the current findings also point to a meaningful direction for future research to promote positive emotions by assisting older adults whose competence needs are not satisfied to use ICT.

#### *4.3. Older Adults Whose Relatedness Needs Are Satisfied Have More Positive Emotional Experiences When Using ICT than Those Whose Relatedness Needs Are Not Satisfied*

Relatedness needs satisfaction moderates the relationship between older adults' ICT usage and emotional experience. Older adults whose relatedness needs are satisfied and use ICT to integrate into their daily activities often have more positive emotional experiences. Based on this finding, we tried to provide an explanation. Research by Cotten et al. (2013) indicated that the main motivation of older adults to use the Internet is to establish contact with relatives and friends. This means that older adults tend to use digital devices to establish connections with friends and family. The results of the current research show that the use of ICT in this way may replace actual social activities with friends and family. For example, in the study of Lüders and Gjevjon (2017), their qualitative interview analysis found that older adults believed that social interaction can increase their willingness to use ICT. It is similar to the abovementioned substitution effect of the use of ICT by older adults for social activities. In addition, the frequency of ICT use among older adults was also found to be negatively associated with their social isolation (Stockwell et al. 2021). Therefore, future research should further explore how to increase the ability of older adults to use ICT, so that they can be more familiar with ICT products while meeting their needs for socializing with relatives and friends and reducing their negative emotions. Intergenerational digital learning has been reported to facilitate communication, solidarity, and social bonding among members of a generation, and the shared use of ICTs has further facilitated intergenerational relationships (Derboven et al. 2012).

Autonomy needs did not moderate the relationship between ICT use and emotional experience. This may be due to the current study design, which encouraged participants to participate voluntarily and did not force them to take our daily survey every time. Instead, we used a designed reward system to encourage them to participate (Zhong and Huang 2016). Older adult participants willingly used our designated app. This design resulted in meeting the autonomy needs of the participants (Goh et al. 2017). Therefore, the above-mentioned reasons may have caused the older adult participants in the current study to have small differences in autonomy needs satisfaction, thereby failing to show a moderating effect.

## **5. Conclusions and Limitations**

The current findings should be interpreted with caution. We list some limitations and recommendations based on the current research results and hope to provide some suggestions for future research directions.

First, participants were limited by whether the communication software (Line) could be used frequently. This means that participants in the current study may all be active Line app users. Therefore, we suggest that future research may target older adults who are less adept at using ICT to further investigate the relationship between ICT usage and their daily emotional experience. Alternatively, qualitative methods can be used to explore the associations between older adults' ICT use and their emotions in-depth, to obtain generalized findings.

Second, the current study participants comprise a high proportion of women. Even though the current findings are statistically controlled for the potential influence of gender, the current results should be interpreted cautiously. In the future, male older adults

should be more actively promoted to participate in related research, so as to make a more comprehensive interpretation of older adults with different demographic characteristics.

Furthermore, findings from the current study indicate that older adults whose competence needs are not satisfied or whose relatedness needs are satisfied appear to be the groups recommended for ICT use. Future research may design specific ICT use programs for those with the above characteristics to maximize the benefits of ICT use by older adults.

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## References

- Allen, Johnie J., and Craig A. Anderson. 2018. Satisfaction and frustration of basic psychological needs in the real world and in video games predict internet gaming disorder scores and well-being. *Computers in Human Behavior* 84: 220–29. [\[CrossRef\]](#)
- Amoah, Padmore Adusei, Annabella Osei-Tutu, and Stephen Baffour Adjei. 2022. Socio-economic and technological aspects of mental health of older persons: The role of strong and weak ties in Ghana. *Ageing and Society*, 1–23. [\[CrossRef\]](#)
- Bakshi, Trisha, and Asmita Bhattacharyya. 2021. Socially Distanced or Socially Connected? Well-being through ICT Usage among the Indian Elderly during COVID-19. *Millennial Asia* 12: 190–208. [\[CrossRef\]](#)
- Bright, Aimée K., and Lynne Coventry. 2013. Assistive technology for older adults: Psychological and socio-emotional design requirements. Paper presented at 6th International Conference on Pervasive Technologies Related to Assistive Environments, Rhodes, Greece, May 29–31.
- Caspi, Avner, Merav Daniel, and Gitit Kavé. 2019. Technology makes older adults feel older. *Aging & Mental Health* 23: 1025–30. [\[CrossRef\]](#)
- Castilla, Diana, Cristina Botella, Ignacio Miralles, Juana Bretón-López, Andrea Maria Dragomir-Davis, Irene Zaragoza, and Azucena Garcia-Palacios. 2018. Teaching digital literacy skills to the elderly using a social network with linear navigation: A case study in a rural area. *International Journal of Human-Computer Studies* 118: 24–37. [\[CrossRef\]](#)
- Chen, Cheih-Ying. 2019. Using an eye tracker to investigate the effect of sticker on LINE APP for older adults. In *Human-Computer Interaction. Recognition and Interaction Technologies*. Edited by Masaaki Kurosu. Orlando: Springer International Publishing, pp. 225–34.
- Choi, Mona, Saelom Kong, and Dukyoo Jung. 2012. Computer and Internet interventions for loneliness and depression in older adults: A meta-analysis. *Healthcare Informatics Research* 18: 191–98. [\[CrossRef\]](#)
- Choudrie, Jyoti, Sutee Pheeraphuttrangkoon, and Soheil Davari. 2020. The digital divide and older adult population adoption, use and diffusion of mobile phones: A quantitative study. *Information Systems Frontiers* 22: 673–95. [\[CrossRef\]](#)
- Christian, Michael, Noah Eisenkraft, and Chaitali Kapadia. 2014. Dynamic associations among somatic complaints, human energy, and discretionary behaviors: Experiences with pain fluctuations at work. *Administrative Science Quarterly* 60: 66–102. [\[CrossRef\]](#)
- Cid, Alejandro, Rafael Sotelo, Mariana Leguisamo, and María Ramírez-Michelena. 2020. Tablets for deeply disadvantaged older adults: Challenges in long-term care facilities. *International Journal of Human-Computer Studies* 144: 102504. [\[CrossRef\]](#)
- Coelho, Ana Rita. 2022. Modes of relating to the new ICTs among older internet users: A qualitative approach. *Ageing and Society*. Advance online publication. [\[CrossRef\]](#)
- Cotten, Shelia R., William A. Anderson, and Brandi M. McCullough. 2013. Impact of Internet use on loneliness and contact with others among older adults: Cross-sectional analysis. *Journal of Medical Internet Research* 15: e39. [\[CrossRef\]](#) [\[PubMed\]](#)
- Damant, Jacqueline, Martin Knapp, Paul Freddolino, and Daniel Lombard. 2017. Effects of digital engagement on the quality of life of older people. *Health & Social Care in the Community* 25: 1679–703. [\[CrossRef\]](#)

- Deci, Edward L., and Richard M. Ryan. 2000. The “What” and “Why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry* 11: 227–68. [\[CrossRef\]](#)
- Delello, Julie A., and Rochell R. McWhorter. 2016. Reducing the digital divide: Connecting older adults to ipad technology. *Journal of Applied Gerontology* 36: 3–28. [\[CrossRef\]](#)
- Derboven, Jan, Mieke Van Gils, and Dirk De Grooff. 2012. Designing for collaboration: A study in intergenerational social game design. *Universal Access in the Information Society* 11: 57–65. [\[CrossRef\]](#)
- Di Giacomo, Dina, Jessica Ranieri, Meny D’Amico, Federica Guerra, and Domenico Passafiume. 2019. Psychological barriers to digital living in older adults: Computer anxiety as predictive mechanism for technophobia. *Behavioral Sciences* 9: 96. [\[CrossRef\]](#)
- Fang, Jiaming, Lufen Tang, Jingjing Yang, and Min Peng. 2019. Social interaction in MOOCs: The mediating effects of immersive experience and psychological needs satisfaction. *Telematics and Informatics* 39: 75–91. [\[CrossRef\]](#)
- Gatti, Fabiana M., Eleonora Brivio, and Carlo Galimberti. 2017. The future is ours too”: A training process to enable the learning perception and increase self-efficacy in the use of tablets in the elderly. *Educational Gerontology* 43: 209–24. [\[CrossRef\]](#)
- Glass, Anne P., and Rebecca S. Vander Plaats. 2013. A conceptual model for aging better together intentionally. *Journal of Aging Studies* 27: 428–42. [\[CrossRef\]](#)
- Goh, Dion Hoe-Lian, Ei Pa Pa Pe-Tham, and Chei Sian Lee. 2017. Perceptions of virtual reward systems in crowdsourcing games. *Computers in Human Behavior* 70: 365–74. [\[CrossRef\]](#)
- Hargittai, Eszter, Anne Marie Piper, and Meredith Ringel Morris. 2019. From internet access to internet skills: Digital inequality among older adults. *Universal Access in the Information Society* 18: 881–90. [\[CrossRef\]](#)
- Heissel, Andreas, Anou Pietrek, Michael A. Rapp, Stephan Heinzl, and Geoffrey Williams. 2019. Perceived health care climate of older people attending an exercise program: Validation of the german short version of the health care climate questionnaire. *Journal of Aging and Physical Activity* 28: 276–86. [\[CrossRef\]](#) [\[PubMed\]](#)
- Hektner, Joel M., Jennifer A. Schmidt, and Mihaly Csikszentmihalyi. 2007. *Experience Sampling Method: Measuring the Quality of Everyday Life*. Thousand Oaks: Sage.
- Hutto, Clayton J., Caroline Bell, Sarah Farmer, Cara Fausset, Linda Harley, Julie Nguyen, and Brad Fain. 2015. Social media gerontology: Understanding social media usage among older adults. *Web Intelligence* 13: 69–87. [\[CrossRef\]](#)
- James, Tabitha L., Jie Zhang, Han Li, Jennifer L. Ziegelmayer, and Eduardo D. Villacis-Calderon. 2022. The moderating effect of technology overload on the ability of online learning to meet students’ basic psychological needs. *Information Technology & People* 35: 1364–82. [\[CrossRef\]](#)
- Jung, Eun Hwa, Justin Walden, Ariel Celeste Johnson, and S. Shyam Sundar. 2017. Social networking in the aging context: Why older adults use or avoid Facebook. *Telematics and Informatics* 34: 1071–80. [\[CrossRef\]](#)
- Khosravi, Pouria, Azadeh Rezvani, and Anna Wiewiora. 2016. The impact of technology on older adults’ social isolation. *Computers in Human Behavior* 63: 594–603. [\[CrossRef\]](#)
- Kim, Kyung O. 2012. The Emotional Responses of Older Adults to New Technology. Unpublished Doctoral dissertation, University of Illinois at Urbana-Champaign, Champaign, IL, USA.
- Korlat, Selma, Marlene Kollmayer, Julia Holzer, Marko Lüftenegger, Elisabeth Rosa Pelikan, Barbara Schober, and Christiane Spiel. 2021. Gender Differences in Digital Learning During COVID-19: Competence beliefs, intrinsic value, learning engagement, and perceived teacher support. *Frontiers in Psychology* 12: 637776. [\[CrossRef\]](#)
- Kwak, Minyoung, Berit Ingersoll-Dayton, and Sarah Burgard. 2014. Receipt of care and depressive symptoms in later life: The importance of self-perceptions of aging. *The Journals of Gerontology: Series B* 69: 325–35. [\[CrossRef\]](#)
- Lee, Li Na, and Mi Jeong Kim. 2020. A critical review of smart residential environments for older adults with a focus on pleasurable experience. *Frontiers in Psychology* 10: 3080. [\[CrossRef\]](#)
- Llorente-Barroso, Carmen, Olga Kolotouchkina, and Luis Mañas-Viniegra. 2021. The enabling role of ICT to mitigate the negative effects of emotional and social loneliness of the elderly during COVID-19 pandemic. *International Journal of Environmental Research and Public Health* 18: 3923. [\[CrossRef\]](#)
- Lüders, Marika, and Edith Roth Gjevjon. 2017. Being old in an always-on culture: Older people’s perceptions and experiences of online communication. *The Information Society* 33: 64–75. [\[CrossRef\]](#)
- Masi, Christopher M., Hsi-Yuan Chen, Louise C. Hawkey, and John T. Cacioppo. 2011. A meta-analysis of interventions to reduce loneliness. *Personality and Social Psychology Review* 15: 219–66. [\[CrossRef\]](#) [\[PubMed\]](#)
- Morris, Meg E., Brooke Adair, Elizabeth Ozanne, William Kurowski, Kimberly J. Miller, Alan J. Pearce, Nick Santamaria, Maureen Long, Cameron Ventura, and Catherine M. Said. 2014. Smart technologies to enhance social connectedness in older people who live at home. *Australasian Journal on Ageing* 33: 142–52. [\[CrossRef\]](#) [\[PubMed\]](#)
- Mulasso, Anna, Paolo Riccardo Brustio, Alberto Rainoldi, Gianluca Zia, Luca Feletti, Aurèle N’dja, Susanna Del Signore, Eleonora Poggiogalle, Federica Luisi, and Lorenzo Maria Donini. 2019. A comparison between an ICT tool and a traditional physical measure for frailty evaluation in older adults. *BMC Geriatrics* 19: 88. [\[CrossRef\]](#)
- Myin-Germeys, Inez, Zuzana Kasanova, Thomas Vaessen, Hugo Vachon, Olivia Kirtley, Wolfgang Viechtbauer, and Ulrich Reininghaus. 2018. Experience sampling methodology in mental health research: New insights and technical developments. *World Psychiatry* 17: 123–32. [\[CrossRef\]](#)
- Partala, Timo, and Alekski Kallinen. 2012. Understanding the most satisfying and unsatisfying user experiences: Emotions, psychological needs, and context. *Interacting with Computers* 24: 25–34. [\[CrossRef\]](#)

- Pettersson, Beatrice, Rebecka Janols, Maria Wiklund, Lillemor Lundin-Olsson, and Marlene Sandlund. 2021. Older adults' experiences of behavior change support in a digital fall prevention exercise program: Qualitative study framed by the self-determination theory. *Journal of Medical Internet Research* 23: e26235. [\[CrossRef\]](#)
- Pihlainen, Kaisa, Kristiina Korjonen-Kuusipuro, and Eija Kärnä. 2021. Perceived benefits from non-formal digital training sessions in later life: Views of older adult learners, peer tutors, and teachers. *International Journal of Lifelong Education* 40: 155–69. [\[CrossRef\]](#)
- Plass, Jan L., Bruce D. Homer, and Charles K. Kinzer. 2015. Foundations of game-based learning. *Educational Psychologist* 50: 258–83. [\[CrossRef\]](#)
- Prentice, Mike, Eranda Jayawickreme, and William Fleeson. 2020. An experience sampling study of the momentary dynamics of moral, autonomous, competent, and related need satisfactions, moral enactments, and psychological thriving. *Motivation and Emotion* 44: 244–56. [\[CrossRef\]](#)
- Przybylski, Andrew K., Netta Weinstein, Richard M. Ryan, and C. Scott Rigby. 2009. Having to versus wanting to play: Background and consequences of harmonious versus obsessive engagement in video games. *Cyberpsychology and Behavior* 12: 485–92. [\[CrossRef\]](#)
- Raudenbush, Stephen W., and Anthony S. Bryk. 2002. *Hierarchical Linear Models: Applications and Data Analysis Methods*. Thousand Oaks: Sage, vol. 1.
- Reis, Harry T., Kennon M. Sheldon, Shelly L. Gable, Joseph Roscoe, and Richard M. Ryan. 2000. Daily well-being: The role of autonomy, competence, and relatedness. *Personality and Social Psychology Bulletin* 26: 419–35. [\[CrossRef\]](#)
- Ryan, Richard M., and Edward L. Deci. 2000. Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology* 25: 54–67. [\[CrossRef\]](#) [\[PubMed\]](#)
- Seifert, Alexander. 2020. The digital exclusion of older adults during the COVID-19 pandemic. *Journal of Gerontological Social Work* 63: 674–76. [\[CrossRef\]](#) [\[PubMed\]](#)
- Soong, Andrea, Julia Cen Chen, and Dina L. G. Borzekowski. 2015. Using ecological momentary assessment to study tobacco behavior in urban india: There's an App for that. *JMIR Research Protocols* 4: e76. [\[CrossRef\]](#)
- Spence, Jeffrey R., Douglas J. Brown, Lisa M. Keeping, and Huiwen Lian. 2014. Helpful today, but not tomorrow? feeling grateful as a predictor of daily organizational citizenship behaviors. *Personnel Psychology* 67: 705–38. [\[CrossRef\]](#)
- Stockwell, Stephanie, Brendon Stubbs, Sarah E. Jackson, Abi Fisher, Lin Yang, and Lee Smith. 2021. Internet use, social isolation and loneliness in older adults. *Ageing and Society* 41: 2723–46. [\[CrossRef\]](#)
- Strom, Robert D., and Paris S. Strom. 2015. Assessment of intergenerational communication and relationships. *Educational Gerontology* 41: 41–52. [\[CrossRef\]](#)
- Strutt, Paul A., Carly J. Johnco, Jessamine Chen, Courtney Muir, Olivia Maurice, Piers Dawes, Joyce Siette, Cintia Botelho Dias, Heidi Hillebrandt, and Viviana M. Wuthrich. 2022. Stress and coping in older australians during COVID-19: Health, service utilization, grandparenting, and technology use. *Clinical Gerontologist* 45: 106–19. [\[CrossRef\]](#)
- Terp, Rikke, Lars Kayser, and Tove Lindhardt. 2021. Older patients' competence, preferences, and attitudes toward digital technology use: Explorative study. *JMIR Human Factors* 8: e27005. [\[CrossRef\]](#)
- Tkatch, Rifky, Lizi Wu, Stephanie MacLeod, Rachel Ungar, Laurie Albright, Daniel Russell, James Murphy, James Schaeffer, and Charlotte S. Yeh. 2021. Reducing loneliness and improving well-being among older adults with animatronic pets. *Ageing & Mental Health* 25: 1239–45. [\[CrossRef\]](#)
- Touvier, Mathilde, Caroline Méjean, Emmanuelle Kesse-Guyot, Clothilde Pollet, Aurélie Malon, Katia Castetbon, and Serge Hercberg. 2010. Comparison between web-based and paper versions of a self-administered anthropometric questionnaire. *European Journal of Epidemiology* 25: 287–96. [\[CrossRef\]](#) [\[PubMed\]](#)
- Vanhove-Meriaux, Charlotte, Guillaume Martinent, and Claude Ferrand. 2020. Adaptation and validation of the french psychological need frustration scale for older adults. *Ageing International* 45: 99–117. [\[CrossRef\]](#)
- Vroman, Kerryellen G., Sajay Arthanat, and Catherine Lysack. 2015. "Who over 65 is online?" Older adults' dispositions toward information communication technology. *Computers in Human Behavior* 43: 156–66. [\[CrossRef\]](#)
- Wiwatkunupakarn, Nutchar, Chanapat Pateekhum, Chanchanok Aramrat, Wichuda Jirapornchaoren, Kanokporn Pinyopornpanish, and Chaisiri Angkurawaranon. 2022. Social networking site usage: A systematic review of its relationship with social isolation, loneliness, and depression among older adults. *Ageing & Mental Health* 26: 1318–26. [\[CrossRef\]](#)
- Yu, Rebecca Ping. 2020. Use of messaging apps and social network sites among older adults: A mixed-method study. *International Journal of Communication* 14: 4453–73.
- Zhang, Yao, Zhenping Lin, Xiaoming Li, Tu Xiaoming, Yeqin Zhou, and Xinping Zhang. 2019. Factors Affecting ICT Use in Health Communication among the Older Population in Jiangsu, China. *International Journal of Libraries and Information Studies* 69: 41–53. [\[CrossRef\]](#)
- Zhong, Hua, and Li Huang. 2016. The Empirical Research on the Consumers' Willingness to Participate in E-waste Recycling with a Points Reward System. *Energy Procedia* 104: 475–80. [\[CrossRef\]](#)

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