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ORIGINAL RESEARCH

Perceived Overload on Short Video Platforms and Its Influence on Mental Health Among the Elderly: A Moderated Mediation Model

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Background: In the post-epidemic era, the problem of short-video app addiction among older adults has become increasingly prominent, and people have begun to pay attention to the negative emotional and psychological consequences of Perceived Overload of short-video apps. Given the growing mental health concerns of older adults, it is critical to understand the potential relationship between the Perceived Overload of short video apps for older adults and older adults' mental health.

Methods: This study applied the stress-strain-outcome (SSO) framework to explore the relationship between perceived overload of a short-video application and loneliness, mental health, and Confucianism tenets in 1300 Chinese older adults. The relationship between perceived overload and loneliness, mental health, and Confucianism tenet moderated mediation models of perceived overload and mental health were created using SPSS 26.0 and PROCESS 4.1 for SPSS.

Results: The perceived overload of a short video application for older adults directly predicted loneliness and mental health in older adults, and the Confucianism tenet moderated the mediation process between perceived overload and mental health. Perceived overload affects mental health through loneliness in older adults.

Discussion: The results of this study are of practical significance for understanding the current problem of short-video addiction among older adults. Understanding the effects of perceived overload on older adults' loneliness and mental health can help prevent loneliness and mental health problems caused by short-video addiction among older adults on the one hand, and on the other hand, it can also help to develop targeted coping strategies and create psychological intervention programs based on the Confucianism tenet of intervention ethics to improve mental health in a changing technological stress environment.

Keywords: perceived overload, loneliness, mental health, Confucianism tenet

Introduction

China is currently in a stage where population aging and social digitization are developing together, and digital technology represented by short videos is becoming an essential part of older people's lives. According to the report "From Online to Offline: Short Video Use and Offline Social Participation of the Elderly" published by Renmin University of China, Peking University, and Jitterbug, Chinese older adults use smartphones for an average of 3.54 hours per day, with about 90% of them using them for less than 6 hours, and a huge majority of them watch short videos for a total of less than 2 hours, but there are still a few older adults who watch them for a total of more than 3 hours.[1] For older adults, the use of smartphones and short videos has benefits such as improving their social connections, obtaining social support from others, and slowing down neurological decline,[2,4] but overuse and obsession will have a negative impact on their physiological and psychological health and may even cause mental health problems such as anxiety and depression.[5,6] In the post-epidemic era, the problem of short video addiction among Chinese older adults has become increasingly prominent and has attracted widespread attention.[7]

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In recent years, terms such as Information Cocoons, Perceived Overload, and digital addiction have been prominent in the research literature on smartphones and short videos for older adults,[8–10] suggesting that research related to information technology has permeated the field of gerontological research. Specifically, current research on the consequences of information technology use focuses on two aspects: on the one hand, research on information technology and behavioral consequences, such as information media overload and discontinuation of use;[11–13] on the other hand, research on information technology and emotional consequences, such as information media overload and fatigue exhaustion or loneliness.[14,15] Different theories have been used to explain the above phenomena, such as the stress-strain-outcome (SSO) framework,[12] the cognition-affect-conation (CAC) framework,[16] the stimulus- organism-response (SOR) framework,[17] etc.

For example, from the perspective of the SSO framework, studies about using the social media such as short video apps have revealed that, the fear of missing out, excessive use of social media, and overload (strain) are the influences of individuals' moods and attitudes toward social media (stress), which further leads to negative behavioural consequences (outcome) such as decreased individual work and learning effectiveness and discontinuous social media usage;[18,19] from the angle of the CAC framework, the social media user perceived information overload (cognition) causes their fatigue, frustration and dissatisfaction (affect), and information avoidance intention response (conation);[20,21] from the SOR view, both the technical environment of social media and the virtual psychological experience generate environmental incentives users (stimulus), and when an user observes the negative impacts of social media, he/she adopts the discontinuing of the usage (response), which originates from the organic fatigue of the user (organism).[13,22]

Although the above studies have taken an important step towards understanding the consequences of information technology use, especially smartphone addiction and related behaviors, there are still some gaps in exploring the emotional and mental health impacts of short-term smartphone video use among older adults. Firstly, existing studies have mainly explored the factors associated with the positive and negative effects of smartphone use among older adults.[7,23] Therefore, the cognitive factors that constitute the above positive and negative effects are not clear; secondly, existing studies have identified the negative effects of smartphone use on the mental health of older adults despite the fact that it has been identified.[6,24] However, the mechanism of its effect on older adults' mental health is not yet evident; finally, existing studies have demonstrated that smartphone use can enhance older adults' social connections and improve their social support, which in turn improves their loneliness and mental health.[25,26] However, the deeper mechanisms of regulation still need to be explored, such as the influence of beliefs on perceived emotional or psychological regulation, which is still unknown.

In order to fill the above research gap, this study explored the mechanisms by which the perceived factors of older mobile phone short video users influence their mental health wellness as well as the moderating mechanisms of Confucianism tenets. Confucianism tenets, originating from the philosophy of Confucius (孔子, 551–479 B.C), aim to establish a social and moral framework through the following principles: Benevolence (仁/ren): This involves "loving all human beings" and practicing compassion; Righteousness (义/yi): It entails making decisions based on justice, ethics, and altruism; Propriety (礼/li): This refers to behaving in socially proper manners. These tenets collectively shape a harmonious society and ethical values.[27] We drew on the stress-strain-outcome (SSO) framework to establish the research model. Specifically, we hypothesize that the perceived overload of older short video users affects their mood (loneliness), which in turn affects their mental health, and that the Confucianism tenet, which is embraced by the Chinese, has a moderating effect. This study makes three important contributions: first, we extend the applicability of the SSO framework to the mental health of elderly short video users, which is an effective method for studying customers' social media avoidance and interruption behaviors in marketing; second, we extend the system from a more systematic perspective of perceived overload, Information Overload and System Feature Overload, Information Overload and Communication Overload research, providing research experience on older adults; finally, this study provides a useful insight into the role of loneliness and mental health by explaining the Confucianism tenet in the Finally, by explaining the moderating role of Confucianism tenet on loneliness and mental health and the important role of loneliness in the relationship between perceived overload and mental health, this study may contribute to the emergence of new psychological intervention theories and methods for older adults based on unique cultural contexts.

Literature Review and Research Hypotheses Formulation

Perceived Overload and Mental Health

Overload refers to an individual's subjective evaluation and perception of an object or event that exceeds their processing capacity. Many studies have applied this concept to different research areas, especially with the development of information technology. Some researchers have begun to focus on the phenomenon of technology overload. Specifically, technology overload has three prominent aspects: System Feature Overload, Information Overload, and Communication Overload.[9] In smartphones, internet technologies, or social media-related contexts, System Feature Overload refers to a situation where individuals are exposed to excessive technological features that become burdensome to the user.[28] Too many system features may cause a cognitive burden on the user by increasing their learning load.[29] The continuous enhancement of system features on short videos or other social media platforms may lead to the elderly's inability to adapt to new system features, resulting in System Feature Overload;[8] Information Overload refers to the fact that the large amount of online information received by users during the use of short video platforms or other different types of mobile applications cannot be processed by the brain promptly, thus having a negative impact and leading to adverse outcomes.[30,31] The abundance of short video information may prevent older adults from consuming more information or cause them to excessively focus on negative information, ultimately leading to Information Overload;[32] Communication Overload is replaced by Social Overload, which refers to the overload situation when individuals need to invest excessive effort in maintaining or handling social interactions and relationships in short video apps or other mobile apps due to the high demand for virtual socializing. Older adults' obsession with virtual socializing may impact their everyday lives or physical health, resulting in Social Overload.[11] This study unifies the System Feature Overload, Information Overload, and Social Overload that individuals experience while using short videos and other apps mentioned above as Perceived Overload to emphasize the perceived impact of short video use on individuals.[8,25]

Short video apps have become the primary way for older adults to access the internet, significantly impacting their daily lives and social relationships.[33] The rise of such social apps has changed the situation where elderly people are "digital refugees".[10] These apps have improved cognition, increased social connections, and reduced loneliness to some degree for the elderly.[5] However, smartphone addiction problems related to overusing short video apps are significantly linked to high levels of loneliness.[34] Overuse may trigger mental health issues like depression and anxiety.[6] Research shows that short video apps effectively enhance older adults' quality of life and mental health.[35] However, the perceived overload and negative mental health impacts should also be a concern. The adverse mental health effects of overusing short video apps can be explained in three ways:

First, older adults may not be able to quickly adapt and learn the system features of short video apps, resulting in system feature overload, which may lead to frustration and negative impacts on their mental health;[36] Second, older adults may need more access to diversified information, they can not distinguish harmful and misleading content, and fall into information cocoons. Specifically, short video platforms recommend personalized content based on algorithms, which results in older adults' attention being directed by self-interests,[37] while due to the lack of information grooming, senior people may view and share rumors, emotional or moral misleading contents, and are thus exposed to a disproportionate amount of misinformation and negative social commentary.[38] They may fall into information cocoons and further trigger information overload, increasing their anxiety, depression, and mental health risks;[10,39] Finally, older adults may develop addictive behaviors during the use of short-video apps due to their social features and exhibit the fear of missing out (FoMO) or social media fatigue, leading to social overload and a deterioration in the overall level of mental health in older adults.[29,40] In summary, the phenomenon of Perceived Overload during the use of short video apps by older adults affects their mental health levels, which leads to the proposal that

Hypothesis 1: The Perceived Overload in short video apps among older adults to significantly predict their mental health levels.

The Mediation Role of Loneliness

Loneliness is a subjective negative emotional experience of an individual, including reactions to a lack of intimacy and social needs, and loneliness affects people of all ages but is more prevalent in the elderly population.[41,42] As mentioned

earlier, the use of Perceived Overload by short video apps negatively affects older adults' mental health along with their moods, such as exacerbating their feelings of loneliness. Existing research suggests that older adults' short-video app use Information Overload and Social Overload are important factors that exacerbate their Loneliness:[43–45] on the one hand, older adults have the potential for Information Overload during short-video app use, they are overexposed to upwardly or standardized social comparison information, such as over-accepting information about others' family and friends' company and being unable to deal with it, which in turn exacerbates Loneliness in comparison and thus produces a cumulative adverse effect; on the other hand, older adults may also develop social overload during short-video app use, where older adults are addicted to the virtual social interaction of short-video apps and become disconnected from the reality of their lives. Video apps virtualize socializing and isolate themselves from real society, unable to obtain real social connections, thus aggravating their sense of loneliness. In summary, the phenomenon of Perceived Overload during the use of short video apps by the elderly affects their loneliness level, and thus it is proposed that.

Hypothesis 2: Older adults' loneliness levels were significantly exacerbated by the use of Perceived Overload in short video apps.

At the same time, loneliness can also adversely affect the mental health status of older adults.[46] Loneliness not only exacerbates depressive symptoms in older adults,[47] but is also associated with more severe anxiety and somatic symptoms.[48] At the same time, loneliness can also adversely affect the mental health status of older adults.[46] Loneliness not only exacerbates depressive symptoms in older adults but is also associated with severe anxiety and somatic symptoms.[47,48] Loneliness is prevalent among older adults and is characterized by emotional and social isolation, with both their social and physical conditions potentially contributing to loneliness and adverse mental health outcomes.[49] On the one hand, older adults' loneliness is associated with a decrease in social support and weakened family function, which may limit their ability and opportunities to establish new social relationships, resulting in negative psychosocial consequences and worse mental health;[50] on the other hand, older adults' physical health problems such as illnesses of longer duration may also trigger their loneliness, and cause mental health problems such as depression and anxiety.[48] Notably, mental health problems simultaneously increase older adults' loneliness levels and further increase their physical and mental health risks.[47,51] In summary, we propose

Hypothesis 3: The level of loneliness among older adults is positively associated with the level of mental health.

The Perceived Overload of older adults' short video app use is often caused by an inability to adapt to their new features or interfaces, a greater difficulty in dealing with negative messages, and the provision of too much social support.[8,11,12] The above factors may cause older adults to suffer from damaged self-esteem or to fall into Information Cocoons, which can lead to a decrease in contact with the outside world, which in turn enhances their sense of loneliness.[10,52] In this case, older adults lack the necessary social support and social relationships, which often leads to mental health problems such as depression.[53] In summary, the phenomenon of Perceived Overload during the use of short video apps by older adults enhances their loneliness, which in turn adversely affects their mental health. Thus, it is proposed that

Hypothesis 4: Levels of loneliness in older adults mediate their perceived overload with mental health.

The Moderating Role of Confucianism Tenet

The Confucian tradition is considered one of the most important philosophical or religious schools in East Asian societies, including mainland China, and has had a significant impact on East Asian spiritual life and philosophical beliefs.[54] Contemporary counselors or therapists are attempting to use philosophical thinking or concepts to address spiritual and psychological dilemmas in modern societies.[55] The Confucianism tenet, as a new concept of "religious belonging", transcends the traditional religious identities and makes a unique contribution to psychological interventions.[50] Confucianism tenet, as a new concept of "religious belonging", transcends traditional religious identity and plays a unique role in psychological interventions.[50] The Confucianism tenet is based on benevolence, righteousness,

and propriety, aiming to build a social and ethical structure by defining virtues and dealing with interpersonal relationships.[27] The Confucianism tenet focuses on limiting individual needs and desires to satisfy social interests on the one hand and encouraging personal cultivation to promote social harmony on the other.[56] Based on the discussion above, we defined the Confucianism tenet as the degree of internalization of Confucian traditions,[56] ie, the extent to which Chinese older adults identify with and practice the tenet in their daily lives.

The Confucianism tenet has a different understanding of and approach to loneliness, believing that when an individual is in a state of loneliness, it is a time for them to shape and develop themselves.[40] Therefore, this study suggests that the Confucianism tenet will play a unique role in addressing Perceived Overload in the use of short video apps for older adults. First, the Confucian concept of "entertaining into the world" implies that individuals should actively deal with loneliness and enhance their self-improvement through the practice of "benevolence" and "propriety". First, the Confucian concept of "entering into the world" implies that individuals should actively cope with loneliness and improve their self-cultivation through the practice of "benevolence" and "propriety", which in turn prompts older people to detach themselves from the upward social comparisons made by the short-video apps and improves their own understanding and management of loneliness, thus reducing the level of information overload.[40] Secondly, the realism and ritualized relationships emphasized by the Confucianism tenet will be carried through to the cultivation of personal family life and social behaviors, even if older people who are addicted to short-video apps turn to pay attention to the resumes and maintenance of real social relationships, thus reducing the level of social overload.[57] In summary, the concepts of improving self-cultivation and increasing realistic social interaction in the Confucianism tenet are conducive to the reduction of loneliness brought about by the Perceived Overload of short-video apps; Simultaneously, the tenets of Confucianism regarding propriety and etiquette facilitate the formation of interactive networks, providing individuals with community and family support. On one hand, Confucian tenets emphasize personal acquiescence to achieve collective harmony and emotional restraint to avoid interpersonal conflicts, thereby aiding individuals' integration into the community.[58] On the other hand, the family constitutes the core content of Confucian tenets, particularly the emphasized concept of "filial piety" (孝, xiao) which can offer older adults more extensive family support.[59] Through this community and family support, Confucian tenets not only alleviate loneliness but also mitigate psychological health issues such as depression, anxiety, and stress.[60,61] Therefore, the Confucianism tenet is conducive to alleviating mental health problems caused by loneliness brought about by the Perceived Overload of short video use among older adults. From this, it is proposed that

Hypothesis 5: The level of Confucianism tenet moderates the indirect relationship between Perceived Overload and mental health through loneliness.

Psychological interventions combining Religious and spiritual practices have shown initial success.[62] It is noteworthy that the Traditional Confucian concept of mental health has a substantial impact on the mental health of Chinese people,[58] and its effect on mental health improvement has been verified in a meta-analysis.[63] Confucian coping, Confucian responsibility thinking, the Confucian ethic of filial piety, the Confucian ethic of harmony, and the Junzi personality all impact the mental health of the Chinese people.[64–66] For example, Zhongyong thinking (Doctrine of the Mean), a traditional Chinese interpersonal style, can significantly reduce Chinese people's anxiety and depression levels, play an essential role in alleviating their psychological distress and maintaining their subjective well-being, and provide a moderating strategy for Confucianism tenet to promote mental health.[67]

In addition, because mainland China is deeply influenced by the Confucianism tenet, individuals will unconsciously apply the Confucianism tenet as a guideline to deal with or face adversity and stress,[64] implying that when faced with Perceived Overload during the use of short-video apps by older adults, they may adopt the Confucianism tenet as the dominant coping method to reduce the negative psychological impact of Perceived Overload through convenience, self-reflection, etc.[68] Therefore, the Confucianism tenet is conducive to alleviating the mental health problems caused by the Perceived Overload of short video use among older adults. It is therefore proposed that

Hypothesis 6: Level of Confucianism Tenet moderates the direct relationship between Perceived Overload and mental health.

Stressor-Strain-Outcome Framework

The stressor-strain-outcome (SSO) framework was originally applied in psychological research to elucidate the effects of stressors on strain and outcome.[69] In general, stressor refers to the environmental factors of stress formation, strain refers to the emotional consequences caused by the stressor, and outcome refers to the behavioral consequences of the stress.[70] The SSO framework has been widely used in the field of technological stress research, particularly describing the different forms of social media contexts in which OVERLOAD factors become STRESSORs affecting individuals' emotions and attitudes (eg, exhaustion, regret, etc)., which in turn lead to various behavioral consequences (eg, interruption of usage behaviors, etc).[13,19,71,72]

In the related social media research fields, the SSO framework.[18,19] Within the framework, system features, information, and social overload from technological stress are often considered stressors.[11] Multiple types of overload lead to adverse emotions on social media (eg, fatigue, dissatisfaction, etc)., which can be a strain.[12,73] Meanwhile, different emotional responses cause changes in the users' attitudes and behaviors (continued attitudes versus interrupted behaviors), which are outcomes of social media use overload.[8,74]

Based on previous studies, the SSO framework was selected as the basic theoretical framework in this paper to explore the mental health outcomes of perceived overload of short video apps among elder adults. As shown in the literature, although the SSO framework has been widely used to study the overload phenomenon of various applications, especially social media applications, the studies have focused on the behavioral consequences and lacked studies on the individual mental health outcome. Therefore, this study explored the mental health outcome of Perceived Overload in short video apps for older adults based on the SSO framework. Based on the SSO framework and the existing literature, this study designed a moderated mediation model as shown in Figure 1. Specifically, Perceived Overload is considered an important stressors, including System Feature Overload, information overload, and social overload, which leads to negative emotional consequences;[11] loneliness has been set as a "strain" as it is an antecedent of Perceived Overload that triggers mental health outcomes.[12] It has been shown that an individual's gender and age may have an impact on an individual's mental health outcome,[16] so gender and age were included as control variables in this moderated mediation model.

Methods

Participants and Procedure

The data for this study were collected between January and June 2023 using a whole group sampling method from Gansu Province, China, by selecting older adults who were over 60 years old, cognitively alert, without language barriers, and without any diagnosed mental disorder. The survey was conducted using a paper-based questionnaire. Before the survey began, the investigator would first issue a consent form to ensure that the subjects were informed of the purpose of the survey and participated voluntarily. For some subjects who were unable to recognize or understand the content of the questionnaire, the investigator would repeat and explain the content of the questionnaire to ensure that they fully understood the questions and gave truthful answers. After the questionnaire was completed, incomplete answers,

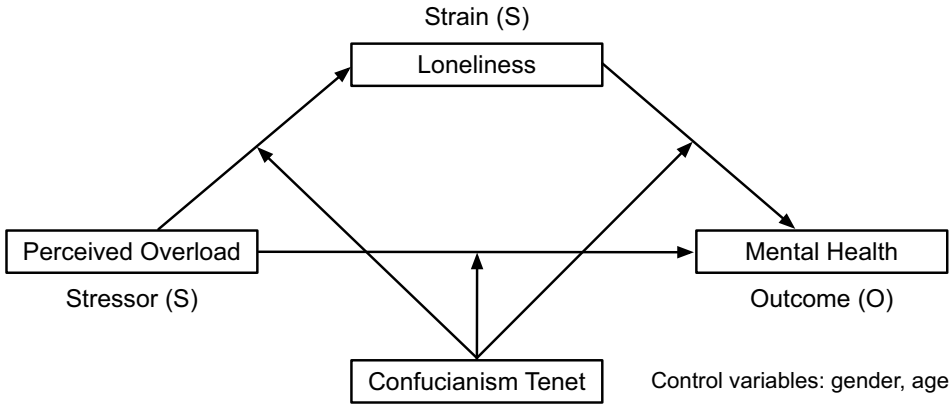

Figure 1 The conceptual framework of the moderated mediation model.

a large number of questions with consistent choices, and logical incoherence were excluded. A total of 1300 questionnaires were distributed, and 1209 valid questionnaires were returned with a recovery rate of 93.0%. Of these, 596 (49.3%) were male older adults and 613 (50.7%) were female older adults surveyed, with an average age of 70.65 years and a standard deviation of 6.40. Other socio-demographic characteristics information can be found in Table 1.

Measures

Social Media Overload Scale

To measure the Perceived Overload level of short video use among older adults, the Social Media Overload Scale was used, which consists of three *System Feature Overload*, information overload, and Communication Overload dimensions, which correspond to three salient dimensions of technology overload and reflect the perceived level of users when using information technology.[9,12,75] In this study, the Perceived Overload Scale was adapted by using the same seven-point Likert scale ranging from 1-no/never happened to 7-yes/always as the original scale, and the total scores were weighted and averaged, with a higher mean score indicating a higher level of Perceived Overload (eg, "I found a lot of good features in short videos and very few useless features"). In a study of Qzone users in mainland China, the reliability of the Social Media Overload Scale was Cronbach's $\alpha = 0.862$.[8] In the present study, Cronbach's alpha for the scale was 0.893.

6-item De Jong Gierveld Loneliness Scale (DJGLS-6): The De Jong Gierveld Loneliness Scale (DJGLS) is an 11-item self-reported questionnaire, originally developed in Dutch by De Jong Gierveld et al, divided into two dimensions of social and emotional loneliness, designed to measure loneliness with the understanding that one's perceived loneliness is a primary indicator of one's social well-being.[76] The 6-item De Jong Gierveld Loneliness Scale (DJGLS-6) was developed as a shortened version of its 11-item counterpart, which was developed to facilitate large-scale survey projects. A 3-point Likert scale is used for scoring; each item scores 1–3 points, corresponding to answers of "No", "Neutral" and "Yes".[77] In a recent study of older adults in Shanghai, the Chinese version of DJGLS-6 was used with a seven-point Likert scale ranging

Table 1 Socio-Demographic Characteristics

Socio-Demographic Characteristics	Mean ± SD / n (%)
Age	70.65 ± 6.40
Gender (female)	
Male	596 (49.3%)
Female	613 (50.7%)
Marital Status	
Single	26 (2.2%)
Married	1031 (85.3%)
Divorced	48 (4.0%)
Widowed	104 (8.6%)
Income level	
No salary	345 (28.5%)
0–2000 CN ¥	397 (32.8%)
2001–3000 CN ¥	238 (19.7%)
3001–5000 CN ¥	123 (10.2%)
More than 5000 CN ¥	106 (8.8%)
Education level	
Illiterate	180 (14.9%)
Primary education	385 (31.8%)
Secondary education	458 (37.9%)
Higher education	186 (15.4%)
Occupation	
Retired	258 (21.3%)
Self-employed	329 (27.2%)
Unemployed	307 (25.4%)
Other	315 (26.1%)

from strongly disagree (1) to strongly agree (7), and the total scores were weighted and averaged, with higher mean scores indicating lower levels of loneliness, and the reliability of the Chinese version scale was Cronbach's α = 0.700.[78] In the present study, Cronbach's alpha for the scale was 0.835.

Warwick-Edinburgh Mental Well-being Scale (WEM-WBS): The Warwick-Edinburgh Mental Well-being Scale (WEM-WBS) is a 14-item self-reported questionnaire with total positive psychological function, emotion, and interpersonal relationship satisfaction dimensions to measure positive mental health status.[79] In the present study, the Chinese version of the WEM-WBS was adopted, using a seven-point Likert scale ranging from strongly disagree (1) to strongly agree (7), and the total scores were weighted and averaged, with higher mean scores indicating higher levels of mental health, and the reliability of the scale was Cronbach's α = 0.930.[80] In the present study, Cronbach's alpha for the scale was 0.809.

Confucianism Tenet Scale

To assess the level of Confucian tenets among older adults, we employed the Restrictive and Empowering Confucianism scales from the Three Teachings of East Asia Inventory (TTEA). These scales consist of 11 and 12 items, respectively. The Restrictive Confucianism section encompasses four dimensions: priority pressure, intrinsic propriety, interpersonal harmony, and adherence to social norms, all related to self-regulation. Conversely, the Empowering Confucianism section comprises three dimensions of self-cultivation: leading by example and human-heartedness, both associated with self-development. The combined score of these two subscales reflects the overall level of Confucian tenets. In this study, the Confucianism Tenet Scale (eg, Feel ashamed when I do not uphold proper social etiquette in public) was formed by selecting entries from each dimension using a seven-point Likert scale ranging from strongly disagree (1) to strongly agree (7), and the total scores were weighted and averaged, with higher mean scores indicating higher levels of Confucianism tenet, and the reliability of the scale was Cronbach's α = 0.850.[43] In the present study, Cronbach's alpha for the scale was 0.781.

Statistical Analysis

IBM SPSS Statistics 26 was used for data analysis. The study calculated the mean and standard errors for continuous variables and the frequencies and percentages for categorical variables. The correlations of study variables (perceived overload, loneliness, mental health, Confucianism tenet) were analyzed by Pearson correlation analyses. The mediation model (Model 4) and the moderated mediation model (Model 59) were tested using PROCESS 4.1 for SPSS (Hayes, 2013, 2022).[81] The bias-corrected 95% confidence interval (CI) was calculated with 5000 bootstrapping re-samples. First, testing whether loneliness played a mediation role between Perceived Overload and mental health in model 4. Secondly, Model 59 was used to examine the moderated mediation effect to determine if the Confucianism tenet moderated the direct effect of Perceived Overload on mental health and the indirect effect of Perceived Overload on mental health, including the effect of Perceived Overload on loneliness and the effect of loneliness on mental health (Figure 1). When a 95% bootstrapping CI did not include 0, the moderated mediation effect was considered statistically significant. In addition, statistical significance was defined as a two- tailed p-value < 0.05.

Results

Test for Common Method Bias

The use of self-report Measures may have produced common method bias. Therefore, Harman's one-factor test was applied to test for common method bias, examine the factor analysis of the data, and select the extraction method with an eigenvalue greater than 1. Four factors with eigenvalues greater than one were extracted, which explained 69.69% of the total variance; the first of these factors explained 30.60% of the variance, which is not more than half of the total variance explained; therefore, this study does not have a serious problem of common method bias.[82]

Descriptive Statistics and Correlation Analysis

The Results of the correlation analysis are shown in Table 2. The results show that every two variables were significantly correlated. There was a significant positive correlation between Perceived Overload and loneliness (p < 0.001), which

Table 2 Means (M), Standard Deviations (SD), and Results of Correlation Analysis

Variable	Mean ± SD	PO	LONE	MH	CFT	Skewness	Kurtosis
Perceived Overload	5.58 ± 1.65	1				−0.500	−0.371
Loneliness	5.96 ± 1.03	0.249***	1			−0.544	−0.411
Mental Health	6.03 ± 1.01	0.152***	0.379***	1		0.206	−0.814
Confucianism Tenet	5.09 ± 1.24	0.480***	0.169***	0.084**	1	0.710	−0.572

Notes: N = 1209, ***p<0.001, **p<0.01.
Abbreviations: PO, Perceived Overload; LONE, Loneliness; MH, Mental Health; CFT, Confucianism Tenet.

were positively and significantly correlated with mental health ($p < 0.001$); and the Confucianism tenet was positively and significantly correlated with perceived overload ($p < 0.001$), loneliness ($p < 0.001$), and mental health ($p < 0.01$). In addition, correlations are small between the variables except for Confucianism tenet and Perceived Overload where there is a medium correlation.

The normality of the distribution was tested with the Kolmogorov–Smirnov test, skewness, and kurtosis value. Despite statistically significant ($p < 0.001$) values of the Kolmogorov–Smirnov test, the skewness and kurtosis values were in a relatively low range of ±1. Therefore, it was found that the variables of perceived overload, loneliness, mental health and Confucianism tenet were close to the normal distribution.

Testing for Mediation

In this study, Model 4 of SPSS PROCESS 4.1 was used to test the mediating effect of loneliness on the relationship between Perceived Overload and mental health. The results in Table 3 show that the 95% confidence interval of the direct effect of Perceived Overload on mental health was [0.01, 0.07], and the 95% confidence interval of the mediation effect of loneliness was [0.04, 0.07]. Both the direct effect and the indirect effect were significant, and the indirect effect accounted for 44.4%.

Testing for Moderation Mediation

In this study, Model 59 of SPSS PROCESS 4.1 was used to test the moderation mediation effect of the Confucianism tenet on the relationship between Perceived Overload and mental health. As shown in Table 4, for the dependent variable

Table 3 The Mediating Role of Loneliness in the Relationship Between Perceived Overload and Mental Health

	B	Boot SE	Boot LLCI	Boot ULCI	Relative Effect
Total effect	0.09	0.02	0.06	0.12	100%
Direct effect	0.04	0.02	0.01	0.07	44.4%
Indirect effect	0.05	0.01	0.04	0.07	55.6%

Table 4 Results for the Moderating Effect of Level of Confucianism Tenet on Perceived Overload and Mental Health

Predictors	Model 1 (On loneliness)					Model 2 (On Mental Health)				
	B	SE	t	LLCI	ULCI	B	SE	t	LLCI	ULCI
Perceived overload	0.16	0.02	7.32	0.12	0.20	0.07	0.02	3.30	0.03	0.11
Loneliness						0.36	0.03	13.33	0.31	0.41
Confucianism tenet	0.05	0.03	1.92	−0.01	0.10	−0.02	0.02	−0.70	−0.07	0.03
Interaction 1	0.04	0.01	2.53	0.01	0.07	0.04	0.01	2.69	0.01	0.07
Interaction 2						0.06	0.02	2.85	0.02	0.11
R^2	0.07					0.16				
F	30.27***					46.41***				

Notes: ***p<0.001, Interaction 1, Perceived overload * Confucianism tenet; Interaction 2, Loneliness * Confucianism tenet.

of loneliness, Perceived Overload had a positive predictive effect on loneliness (B = 0.16; SE = 0.02; LLCI = 0.12; ULCI = 0.20), and the interaction between Perceived Overload and Confucianism tenet had a significant impact on loneliness (B = 0.04; SE = 0.01; LLCI = 0.01; ULCI = 0.07), indicating that Confucianism tenet moderated the effect of Perceived Overload on loneliness. However, the Confucianism tenet did not have a significant effect on loneliness (B = 0.05, SE = 0.03, LLCI = −0.01, ULCI = 0.10).

For the dependent variable of mental health, the Confucianism tenet also did not have a significant effect (B = −0.02; SE = 0.02; LLCI = −0.07; ULCI = 0.03). But Perceived Overload and loneliness had a positive predictive effect on mental health (B = 0.07; SE = 0.02; LLCI = 0.03; ULCI = 0.11; B = 0.36; SE = 0.03; LLCI = 0.31; ULCI = 0.41). The interaction between loneliness and the Confucianism tenet had a significant impact on mental health (B = 0.06; SE = 0.02; LLCI = 0.02; ULCI = 0.11), and the Confucianism tenet also moderated the effect of loneliness on mental health. In sum, Confucianism tenet moderated the first and second halves of the mediation model, and the validated mediation model was moderated. Meanwhile, the interaction between Perceived Overload and the Confucianism tenet had a significant impact on mental health (see Table 1) (B = 0.04; SE = 0.01; LLCI = 0.01; ULCI = 0.07), indicating that the Confucianism tenet moderated the direct effect of Perceived Overload on mental health.

In addition, we examined the trend of moderating through a simple slope analysis, divided Confucianism tenets into a high group (M + 1SD) and a low group (M1SD), and made a simple slope test chart between perceived overload, Confucianism tenet, and mental health among the elderly. In the first half of the model, Confucianism tenet modeling was found to be the most effective way of modeling. In half of the model, the Confucianism tenet moderated the effect of Perceived Overload on loneliness (Figure 2 and Table 5). Specifically, when the level of Perceived Overload was low, the Confucianism tenet played a weak role, while when the level of Perceived Overload was high, the moderating role of the Confucianism tenet was not significant. The moderating role of Confucianism tenet became more pronounced in the second half of the model; in the second half of the model, Confucianism tenet moderated the effect of loneliness on mental health (Figure 3 and Table 6). Specifically, when the level of Confucianism tenet was low, it exerted a more protective effect on the influence of loneliness on mental health, but when the level of Confucianism tenet was high, it played a less protective role in the influence of loneliness on mental health.

Finally, testing the data at three levels of Confucianism tenet (Table 7), indicated that conditional indirect effects were found to be significant between Perceived Overload and mental health via loneliness at the three levels of Confucianism tenet (in both cases, 95% bootstrapped CI did not include 0%).

Discussion

There are several important findings in this study. First, the Perceived Overload of short video apps for older adults had a significant negative impact on their loneliness and mental health, and these results confirmed that System Feature Overload, information overload, and social overload factors are linked to their negative emotions such as fatigue and

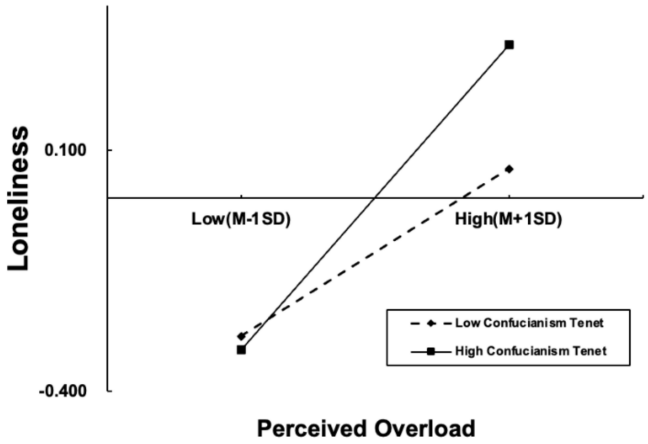

Figure 2 The Moderating Effect of Confucianism Tenet on Perceived Overload and Loneliness.

Table 5 The Moderating Effect of Confucianism Tenet Between Perceived Overload and Loneliness

Confucianism Tenet	B	Boot SE	Boot LLCI	Boot ULCI
M-1SD	0.11	0.02	0.07	0.16
M	0.16	0.02	0.12	0.20
M+1SD	0.21	0.03	0.14	0.27

frustration and also validated previous findings of the adverse effects of Perceived Overload factors on mental health.[6,8,29,47,83] In addition, the loneliness that occurs during the use of short video apps among older adults also exacerbates their mental health problems, thus elucidating the relationship between loneliness and mental health in terms of technological stress.[36,38]

Second, the analysis of the mediation results in this study showed that the use of Perceived Overload by older adults' short video apps had an indirect effect on their mental health through loneliness, and loneliness partially mediated the relationship between Perceived Overload and mental health, indicating that loneliness is a key factor in the unfavorable effects of older adults' short video app use of Perceived Overload on their mental health. In particular, in the case of perceived overload among older adults, negative emotions such as loneliness not only influence or control individual social media activities and use behaviors,[16,17] but also exacerbate individual mental health problems. Specifically, older adults are prone to fall into Information Cocoons during the use of short-video apps and experience Perceived Overload after being exposed to a large number of system feature changes, misleading information, and virtual social demands, making it difficult for them to obtain stable social support and emotional connections,[8,10] which leads to mental health deterioration consequences such as depression in older adults while exacerbating their loneliness negative emotions.[84]

Finally, the moderating mediator results of this study suggest that older adults' Confucianism tenet levels have a moderating effect on their short-video app use Perceived Overload through the indirect relationship of loneliness on mental health. Specifically, when older adults' short-video app use Perceived Overload levels were higher, their Perceived Overload levels played a greater role in alleviating their loneliness, whereas when their Confucianism tenet levels were higher, Confucianism tenet had a moderating effect on older adults' loneliness and played a less protective role in the effects of loneliness on mental health. On the one hand, when older adults' Perceived Overload of short video use is low, their Confucianism tenet is more likely to improve older adults' cognition and judgement through self-reflection and other forms and enhance their ability to deal with negative short video information.[40] At the same time, it is also easier to motivate older adults to participate more in real-life social activities, develop and maintain stable social relationships and emotional ties, and alleviate the dependence on virtual socialization in short videos,[52] which in turn

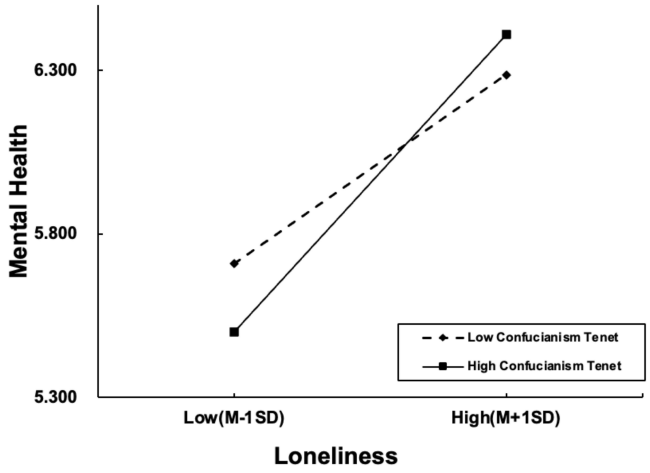

Figure 3 The Moderating Effect of Confucianism on Loneliness and Mental Health.

Table 6 The Moderating Effect of Confucianism Tenet Between Perceived Overload and Mental Health

Confucianism Tenet	B	Boot SE	Boot LLCI	Boot ULCI
M-1SD	0.28	0.04	0.21	0.35
M	0.36	0.03	0.31	0.41
M+1SD	0.44	0.04	0.36	0.52

Table 7 The Conditional Process Analysis Shows the Indirect Effects at Three Levels of Confucianism Tenet

Different Levels of the Moderator	B	Boot SE	Boot LLCI	Boot ULCI
Low Confucianism Tenet	0.03	0.01	0.01	0.05
Moderate Confucianism Tenet	0.06	0.01	0.04	0.08
High Confucianism Tenet	0.09	0.02	0.05	0.14

reduces the loneliness of older adults; whereas, when the Perceived Overload level is higher, the cognitive limitations of older adults limit their acceptance of ideas, including the Confucianism tenet, which limits the development of social connections and social support, thus increasing their loneliness.[85] On the other hand, in terms of the Confucianism tenet for the elderly, the good effect of the Confucianism tenet as a psychological intervention ethic has been verified,[86] so when the level of the Confucianism tenet is high, through the pro-social behaviors of the Confucianism tenet, the old people may be able to increase their loneliness through the pro-social behaviors of the Confucianism tenet conceptual guidance, the old people may increase the real social interaction and social connection construction activities and improve their own psychological resilience in the process of obtaining social and family emotional support, so as to reduce their mental health risks such as anxiety, depression, etc.[45,87]

This study has several important theoretical implications. First, although studies have applied the SSO framework to examine the emotional and behavioral consequences of System Feature Overload, information overload, and social overload in the context of technological stress, they emphasize interruptions and switching behaviors as Perceived Overload coping strategies.[12,59] However, no study has been conducted to explain the mental health outcome of perceived overload, yet the negative psychological consequences of digital addiction to mobile phones are evident.[19] The empirical results of this study illustrate our point and reveal the relationship between Perceived Overload on negative emotions and negative mental health outcomes, providing the possibility of further exploring mental health outcomes and coping behavioral strategies; secondly, in terms of affective perspectives, the present study validates the relationship between negative emotions in the context of the use of short video apps with Perceived Overload context has a negative impact on mental health, which is consistent with the findings of other studies on the relationship between emotions and mental health effects.[38] Our findings suggest that the negative emotions of loneliness generated by the Perceived Overload of short-form video app use can adversely affect mental health, arguably enriching the antecedent pathways of behavioral consequences of SSO frameworks. These findings are informative for future research, which can extend this model to identify its subsequent multiple types of behavioral impacts; third, and most importantly, our study validated the effect of Confucianism tenet in mainland China on the relationship between loneliness negative emotions and mental health outcomes, which validates the good effect of philosophical thinking or concepts to address psychological and emotional dilemmas in modern society,[41] and especially illustrates the potential of Confucianism tenet to be an intervention ethic and principle in clinical psychological interventions, providing further Confucian cognitive interventions for the elderly population therapies, providing empirical evidence.[69]

This study has some limitations. First, in terms of sample selection, our study sample mainly consists of elderly people, although they are representative of the use of short video apps. We still need to be cautious when interpreting the results, and future research should be extended to other populations, such as college students. Second, this study only examines the current situation of Perceived Overload of short video apps, and short videos are more media attributes, which may highlight the

Information Overload characteristics of perceived overload. Second, this study only examines the current situation of Perceived Overload in short-video apps, and short-video apps have more media attributes, which may emphasize the Information Overload feature of perceived overload, while Wechat, QQ, etc. may emphasize the social media attribute more. Therefore, the Perceived Overload of different platforms may highlight different features, and the above differences may lead to different psychological and behavioral consequences for different user groups.Future research may explore the applicability of this research framework to other platforms; again, this study combines the three elements of System Feature Overload, information overload, and social overload into one stressor factor (perceived overload) and put it into the SSO framework model, its separate effects on loneliness and mental health have not been specifically studied, which may reduce the explanatory effect of the study. Therefore, future research should attempt to examine the effects of the individual factors of Perceived Overload on the variables in our model; finally, this study only discussed the mediating role of loneliness and the moderating role of the Confucianism tenet in the effects of Perceived Overload on mental health. Other mediators and moderating pathways still deserve further exploration. Therefore, future studies should adopt a mixed-Methods research design and validate it in different cultural contexts to enrich the research in this area.

Conclusion

This study explored the effect of Perceived Overload of short video apps on mental health in older adults through moderated mediation modeling. The findings indicated that the Perceived Overload of short video apps directly predicted the mental health status in older adults. In addition, loneliness and Confucianism tenets play a key role in mediating the relationship between Perceived Overload and mental health. Specifically, in the first half of the moderated mediation process, Confucianism tenet plays a greater role in lowering the level of loneliness in older adults when their Perceived Overload level of short-video app use is low and gradually increases as the level of Perceived Overload increases; in the second half of the regulatory mediation process, higher levels of Confucianism tenet have a less protective role in the effects of loneliness on mental health, while lower levels of Confucianism tenet have a greater protective role. In addition, this study has some practical implications for understanding and preventing the elders' use of video apps: 1. Senior users should be aware of perceived overload as a risk factor for their loneliness and mental health; they can exercise strict control over using video apps and reduce the frequency of their social system, information, and communication. 2. The Confucianism tenet can be a coping strategy for preventing loneliness and mental health problems, such as strengthening community ties and family communication in reality. 3. In terms of welfare policies, the government should formulate relevant policies to address the current situation of the perceived overload of the elderly, stipulate that short-video application service providers offer optional services and functions for senior people, provide user guides and training to reduce the burden of the elderly using the short-video apps.

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Disclosure

The authors report no conflicts of interest in this work.

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