

The Mediating Role of Distress Intolerance in the Bidirectional Relationships Between Loneliness and Short-form Video Addiction

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Acknowledgements

The author(s) disclosed receipt of the following financial support for the research, authorship,
and/or publication of this article: This research was supported by the National Social Science

Fund of China (Grant number: 19ZDA357). The content is solely the responsibility of the authors. We would like to thank all of the school partners and adolescents who participated in this study.

Data Sharing and Declaration

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Funding

This work was supported by the National Social Science Fund of China (Grant number: 19ZDA357).

Conflict of interest

All other authors declare that they have no conflicts of interest.

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Abstract

Previous research has demonstrated a bidirectional relationship between loneliness and technological addictions (i.e., internet addiction and smartphone addiction) among adolescents. However, given the distinct psychological mechanisms and risk factors associated with specific mobile applications, it is essential to explore this relationship in the context of short-form video addiction. Moreover, few studies have explored mechanisms explain the bidirectional relationship between loneliness and short-form video addiction. Therefore, the present study aimed to determine whether (i) distress intolerance mediates the bidirectional relationship between loneliness and short-form video addiction and (ii) family socioeconomic status and gender moderate these associations. At Time 1, a total of 1227 Chinese adolescents aged 14 to 19 years (43.4% boys; $M_{age} = 16.00$ years; $SD = 0.61$) participated in a three-wave longitudinal study with six-month intervals. Results from cross-lagged panel models showed a positive bidirectional relation between loneliness and short-form video addiction, and distress intolerance mediated the bidirectional relationship between loneliness and short-form video addiction. Moreover, the effects of loneliness on short-form video addiction were stronger among adolescents with low family socioeconomic status, while the effects of distress intolerance on short-form video addiction were stronger among adolescents with high family socioeconomic status. The findings highlight the importance of addressing loneliness and fostering distress tolerance to reduce short-form video addiction.

Keywords: Loneliness; Short-form video addiction; Distress intolerance; Adolescents

1. Introduction

Short-form videos refer to videos distributed through digital media platforms, with the duration no longer than five minutes (Kaye et al., 2021). In recent years, short-form videos have gained substantial popularity, particularly among young people, due to their engaging content, ease of interaction, and suitability for fragmented viewing patterns (Yang et al., 2022b). The 5th National Survey on Internet Use among adolescents in China indicated that adolescent short-form video users exceeded 100 million in 2022, accounting for 54.1% of all short-form video users (China Internet Network Information Center, 2023). Considering adolescents' strong desire for social and novel stimuli, along with their limited self-control compared to other age groups, they are more likely to become absorbed in the fresh experiences and social connections facilitated by the personalized algorithms of short-form video platforms (Lu et al., 2022), making them susceptible to short-form video addiction (SFVA). SFVA is a subtype of internet addiction and refers to excessive and uncontrollable watching of short-form videos despite adverse psychological and social outcomes (Zhang et al., 2019), which may impair adolescents' attention, social interaction, and academic performance (Chao et al., 2023). Given the negative consequences of SFVA and adolescents' susceptibility to it, exploring the underlying mechanisms of SFVA among adolescents is essential.

According to the Interaction of Person-Affect-Cognition-Execution (I-PACE; Brand et al., 2016) model, [loneliness is not only a vulnerable social cognition factor for SFVA, but it is also a consequence of individuals' loneliness. Specifically, the I-](#)

PACE model suggests that when adolescents feel lonely or lack social support, they may choose short-form videos as a negative coping mechanism to escape or regulate this discomfort. Furthermore, although short-form videos can temporarily alleviate loneliness, they may cause adolescents to abandon healthier social methods, further exacerbating loneliness and negative consequences in real life. Although some cross-sectional studies reported that loneliness was strongly associated with SFVA (Smith & Short, 2022; Wang et al., 2024), several important gaps remain in this line of research. Firstly, although previous research has established a bidirectional associations between adolescent loneliness and other forms of technology addiction (e.g., Fam & Männikkö, 2025; Roberts et al., 2024), a similar longitudinal relationship for the growing phenomenon of SFVA remains unvalidated. Secondly, the psychological mechanisms underlying different types of technology addiction may vary greatly (Maraz & Demetrovics, 2015), and identifying these mediating factors is crucial to understanding the vicious cycle of loneliness and SFVA. Finally, adolescents' mental health and addiction development may differ by gender or family socioeconomic status (Schnep et al., 2023; Zhang et al., 2024), but these group differences have not been adequately explored in SFVA studies.

To address these research gaps in the extant literature, the present study employed a three-wave longitudinal study to explore whether there is a bidirectional relationship between loneliness and SFVA among adolescents, along with exploring the mediating role of distress intolerance and potential gender and family socioeconomic status differences. This study will expand the application of I-PACE

model to SFVA, an emerging form of technology addiction, and will also help to design more targeted SFVA intervention and prevention strategies for adolescents of different genders and family socioeconomic statuses.

1.1 Loneliness and short-form video addiction

Loneliness is a painful psychological experience arising from unpleasant social relationships or unsatisfied social desire, often accompanied by negative feelings such as emptiness, boredom, and sadness (Asher et al., 1984). Individuals can experience the feeling of loneliness throughout the lifespan, but adolescents and older adults are more vulnerable (Surkalim et al., 2022). Individuals experiencing high levels of loneliness often suffer from persistent emotional emptiness and social frustration, which motivates them to seek external stimulation or escape negative emotions to alleviate their distress (Roberts et al., 2024). Compared to traditional social media, short-form video platforms more effectively fulfill users' entertainment and social needs through fast-paced, low-cost interaction and personalized content recommendation algorithms (Zhang et al., 2023). Therefore, lonely individuals may substitute traditional social activities with short-form video platforms, using fragmented, highly stimulating content and low-cost, one-way social interactions to alleviate negative emotions.

From the perspective of the I-PACE model, loneliness, as a vulnerability factor at the person level, triggers negative emotions and cognitive biases. This leads adolescents to rely on short-form videos for emotional regulation and to fulfill psychological needs (Brand et al., 2016). Under the reinforcing influence of the

reward system, this behavior receives rapid positive feedback and becomes habitual, while executive control functions gradually weaken, making it difficult to inhibit further impulsive use (Su et al., 2021). In turn, SFVA leads to negative consequences in real life, such as social isolation and increased loneliness (Kraut et al., 1998). Moreover, short-form video platforms tend to foster superficial social connections rather than meaningful ones, further diminishing the psychological and social benefits that these interactions provide (Rogier et al., 2021). These outcomes become new stressors and triggers that further drive individuals to immerse themselves in the online world, thereby creating a vicious cycle. Some cross-sectional studies have found a positive correlation between loneliness and SFVA. Specifically, two study of Chinese college students indicated that loneliness was positively associated with an individual's SFVA (Wang et al., 2024; Zhao & Kou, 2024), and these results were also found in another study of *TikTok* or *Facebook* users (Smith & Short, 2022). Furthermore, some longitudinal studies also partially support the inference of a bidirectional relationship between loneliness and SFVA. For example, a nine-year longitudinal study of Dutch adults found a bidirectional positive association between active or passive use of social media and loneliness (Roberts et al., 2024). Another meta-analysis of 26 longitudinal studies also showed that loneliness is associated with problematic media use (Fam & Männikkö, 2025). Recently, a two-wave longitudinal study conducted among Chinese college students found that loneliness could predict subsequent problematic online video viewing, but the reverse was not true (Yan et al., 2025).

Taken together, these limited evidence indicates a potential vicious cycle between loneliness and SFVA, but this bidirectional association has not yet been tested in longitudinal studies. Moreover, the psychological mechanisms mediating this vicious cycle are unclear, making it difficult to intervene purposefully with adolescents.

1.2 Distress intolerance as a mediator

To offer systematic insight into how SFVA and loneliness interact with each other, it is imperative to examine the underlying mechanisms that may illuminate the prospective reciprocal association between SFVA and loneliness. One possible mediator is distress intolerance, which is defined as the inability to bear psychological suffering and aversive states (Zvolensky et al., 2010). As a cognitive and affective component, distress intolerance contains multifaceted constructs of appraisal, regulation, absorption, and tolerance (Slabbert et al., 2022). More specifically, individuals with distress intolerance tend to be absorbed in negative emotion, perceiving pain as threatening and unbearable. To avoid being overwhelmed, they tend to rely on immediate actions rather than long-term strategies to alleviate distress (Leyro et al., 2010). Consequently, distress intolerance is widely recognized as a key mechanism underlying both substance and behavioral addictions (Leyro et al., 2010).

On the one hand, according to the I-PACE model (Brand et al., 2016), loneliness is an aversive psychological state that arises from unmet social needs and a perceived emptiness in relationships. Individuals who remain in this negative state for an extended period may deplete their psychological resources for stress coping, making it

difficult for them to effectively regulate negative emotions (Cacioppo & S. Cacioppo, 2018). When internal emotional regulation capacity is low, tolerance for distress diminishes, thereby increasing an individual's distress intolerance (Veilleux et al., 2022). This can lead them to adopt maladaptive coping strategies, such as avoidance and self-sabotage, in search of immediate relief regardless of the long-term negative consequences (Karami et al., 2020; Nurmi & Salmela-Aro, 1997). Short-form video platforms, with their fast-paced, low-cost interactions and personalized recommendation algorithms, provide a convenient and immediate avenue for emotional relief and gratification for these individuals with high distress intolerance. Therefore, lonely adolescents, driven by high distress intolerance, turn to short videos as an escape strategy, which increases their risk of SFVA. Several studies have supported that distress intolerance may mediate the pathway from loneliness to SFVA. A qualitative study of college students showed that feelings of loneliness may deplete physical and psychological resources, which in turn impaired individuals' distress tolerance (Veilleux et al., 2022). Another cross-sectional study of college students indicated that loneliness played a predictive role in distress intolerance (Karami et al., 2020). Furthermore, a cross-sectional study of adults and a longitudinal study of adolescents both found that distress intolerance was positively associated with technological addictions (Lin, 2022; Nozaki, 2021). Except for some evidence from the relationship between two variables, the assumption of mediation was also partially supported by previous research. A longitudinal study with Chinese *TikTok* users reported that psychological symptoms (i.e., depression and social anxiety) made a

contribution to SFVA, and was mediated by distress intolerance (Yao et al., 2023). Given the commonalities between loneliness, depression, and social anxiety in the evaluation and regulation of negative emotions (e.g., Dryman & Heimberg, 2018; Patrichi et al., 2024), distress intolerance is likely to serve a similar mediating role in the pathway from loneliness to SFVA.

On the other hand, and according to the I-PACE model, the mediating role of distress intolerance may also underlie the pathway from SFVA to loneliness. More specifically, as a specific internet addiction processes, the gratification experienced by individuals gradually declines, leading to an increased reliance on compensatory behaviors (Brand et al., 2016). In other words, as adolescents' SFVA intensifies, they require greater informational stimuli and more time watching short-form videos to achieve the same level of positive feedback. This overreliance on the instant stimulus of short-form video applications can lead to a lack of internal regulatory resources when adolescents face emotional distress (i.e., increased distress intolerance), which in turn leads to more negative consequences, such as social isolation, loneliness, and a sense of emptiness (Brand et al., 2016). From an empirical perspective, previous research has partially supported the positive effect of SFVA on distress intolerance. For example, one meta-analysis of 25 functional magnetic resonance imaging (fMRI) studies found that addictive behavior may impair reward pathway in brain, which may reduce positive experience from reward and decrease distress tolerance (Luijten et al., 2017). Another fMRI study of college students showed that personalized recommended short videos may enhance immediate pleasure by activating the ventral

tegmental area, increasing an individual's dependence on short-term rewards while reducing their tolerance for long-term discomfort (Su et al., 2021). Reduced social reward perceptions can give rise to disappointed expectations of real life, resulting to elevated distress intolerance (Trafton & Gifford, 2011). However, direct empirical evidence supporting the pathway from distress intolerance to loneliness remains limited. Only one cross-sectional study involving undergraduate students has found that individuals with low distress tolerance are more likely to engage in maladaptive emotion regulation strategies, such as avoidance and suppression (Jeffries et al., 2016). These maladaptive strategies may lead adolescents to regulate their emotions by rejecting or avoiding others in response to potential social exclusion or interpersonal conflicts (Preece et al., 2021), thereby increasing their risk of loneliness.

Combining the theoretical considerations of the I-PACE model (Brand et al., 2016) and empirical findings from previous studies, the bidirectional relationship between loneliness and SFVA may be driven by distress intolerance. However, the potential mediating role of distress intolerance has not been tested in longitudinal research to date. Therefore, the present study employed a cross-lagged panel model to investigate whether distress intolerance mediates the bidirectional relationship between loneliness and SFVA among adolescents.

1.3 Gender and family socioeconomic status as moderators

Prior evidence on gender differences is mixed (Zhang et al., 2024; Tokunaga, 2017), which likely reflects differences in study design (cross-sectional vs. longitudinal) and in the types of Internet applications considered (Dufour et al., 2016). From the

perspectives of adolescents' motivations for using the internet and the adverse consequences of excessive internet use (Kimbrough et al., 2013; Dufour et al., 2016), this study posits that gender may shape the bidirectional relationship between loneliness and SFVA in different ways. Specifically, adolescent boys mainly use the internet for entertainment, whereas girls primarily use it for social interaction (Dufour et al., 2016). Thus, when loneliness motivates compensatory use, the association may be stronger among adolescents whose platform use is more socially oriented (typically girls), because social validation and relatedness needs are salient on short-form video. On the other hand, when entertainment-oriented use leads to short-form video usage occupying a large portion of daily activity time, this association may be stronger among adolescents whose use tends to be entertainment-oriented (typically boys). Thus, this study hypothesizes that the effect of loneliness on SFVA is stronger among girls, while the effect of SFVA on loneliness is stronger among boys.

Family socioeconomic status (SES), including income, educational attainment, and occupational prestige, is likewise expected to moderate the association between loneliness and SFVA but via resource-based mechanisms. From the family investment model (Vasilyeva et al., 2018), higher-SES families provide material, cognitive, and social resources (e.g., emotion-regulation scaffolding, extracurricular opportunities, monitoring) that can buffer social stress and reduce reliance on compensatory digital coping. Previous two cross-sectional studies also found that adolescents with low family SES had a higher risk of loneliness and internet addiction (Sarjalioğlu et al., 2022) and social media addiction (Sun et al., 2021). Therefore, the present study

hypothesized that the bidirectional associations between loneliness and SFVA were all stronger among adolescents with low family SES. Due to a lack of sufficient theoretical support and empirical evidence, hypotheses regarding gender and SES differences in other longitudinal associations among the study variables were exploratory rather than confirmatory.

1.4 The present study

The present study longitudinally examined bidirectional associations between loneliness and short-form video addiction (SFVA), as well as the mediating role of distress intolerance and the moderating role of gender and family SES among Chinese adolescents. Three hypotheses were formulated. More specifically, it was hypothesized that (i) there would be bidirectional associations between loneliness and SFVA over time (H_1); (ii) distress intolerance would mediate the relationship between loneliness on SFVA, and vice versa (H_2); (iii) the bidirectional associations among loneliness, distress intolerance, and SFVA would differ by family SES and gender (H_3).

2. Methods

2.1 Participants and procedure

A cohort of 1227 Chinese adolescents (43.4% boys; $M_{age} = 16.00$ years; $SD = 0.61$), aged between 14 and 19 years and enrolled in Grade 11, was recruited through convenience sampling from a high school located in a city in Shandong province, China. With respect to the educational backgrounds of their parents, 17.8% of fathers and 38.9% of mothers had a “primary school or below” education; 53.4% of fathers

and 40.1% of mothers completed “junior high school”; 19.6% of fathers and 14.5% of mothers had a “senior high school or vocational school” education; and 9.2% of fathers and 6.5% of mothers held a “bachelor’s degree or above.” Regarding monthly per capital household income, 11.8% of participants reported an income under 700 yuan, 27.5% reported between 700 and 1500 yuan, 15.1% reported between 1500 and 2000 yuan, 17.7% reported 2000 to 3000 yuan, and 27.9% reported more than 3000 yuan.

Data collection began in August 2023 (Timepoint 1; T1) and proceeded in six-month intervals. [Relative to the 1227 students at T1](#), 1096 (89.3%) students remained at Timepoint 2 (T2; February 2024), and 1077 (87.8%) remained at Timepoint 3 (T3; August 2024). Little’s Missing Completely at Random (MCAR) test produced a value of $\chi^2(df) = 513.326 (410)$, $p < 0.001$, and the present study used Full Information Maximum Likelihood (FIML) to address missing data (Little & Rubin, 2002).

The study was approved by the first author’s Human Research Ethics Committee ([Grant number: HR2-0224-2022](#)) and the relevant school boards, principals, and teachers. Student assent and parents’ informed consent were obtained before data collection. Participants were informed about the general purpose of the study and assured that their responses would remain confidential. Informed consent was obtained from all participants, and parental consent was also secured for those under the age of 18. Additionally, adolescents were free to spend as much time as needed to complete the survey and had the option to discontinue their participation at any point

without consequence.

2.2 Measures

2.2.1 Loneliness

Loneliness was assessed using the Chinese version of the Children's Loneliness Scale (CLS; Dong & Lin, 2011), originally developed by Asher et al. (1984). The CLS is a self-report measure comprising 16 items (e.g., "*I have nobody to talk to.*"). Participants rate each item based on their subjective experiences of loneliness from 1 (*never*) to 5 (*always*). Loneliness scores are calculated by averaging responses across all CLS items, with higher scores indicating greater loneliness. Previous research has confirmed the reliability and validity of the Chinese CLS (Dong & Lin, 2011; Chen et al., 2023). The McDonald's ω coefficients for the CLS were 0.94, 0.94, and 0.94 at T1, T2, and T3 in the present study, respectively.

2.2.2 Distress intolerance

Distress intolerance was assessed using the Chinese version of the Distress Tolerance Scale (DTS; Lin, 2022), originally developed by Simons and Gaher. (2005). The DTS is a self-report measure comprising 18 items (e.g., "*Feeling distressed or upset is unbearable to me.*"). Participants rate each item based on their subjective experiences of distress intolerance from 1 (*strongly disagree*) to 5 (*strongly agree*). Distress intolerance scores are calculated by averaging responses across all DTS items, with higher scores representing higher level of distress intolerance. Previous research has confirmed the reliability and validity of the Chinese DTS (Lin, 2022). In the present study, the McDonald's ω coefficients for the DTS were 0.93 and 0.94 for T1 and T2,

respectively.

2.2.3 Short-form video addiction

Short-form video addiction was assessed using the Chinese version of the Short-form Video Addiction Scale (SVAS; Li et al., 2025), originally developed by the Facebook Intrusion Questionnaire (Elphinston & Noller, 2011). The scale comprises eight items: cognitive salience, behavioral salience, interpersonal conflict, conflict with other activities, euphoria, loss of control, withdrawal, and relapse and reinstatement. A sample item is “*I often use short-form videos application (e.g., Douyin and Kuaishou) for no particular reason.*” Participants rate each item based on their subjective experiences from 1 (*strongly disagree*) to 7 (*strongly agree*). The scores of short-form video addiction were calculated by averaging responses across all items of the SVAS, with higher scores indicating a greater risk of short-form video addiction. Previous research has confirmed the reliability and validity of the Chinese version of SVAS (Li et al., 2025). In the present study, the McDonald’s ω coefficients for the scale in the present study were 0.88, 0.89, 0.90 for T1 to T3, respectively.

2.2.4 Family socioeconomic status

At Time 1 (T1), participants self-reported their gender, age, family income, and parental education levels. Family income and parental education were used as indicators of family socioeconomic status (SES). A composite SES score—referred to as the family economic status score—was calculated using principal component analysis (PCA), following the method proposed by Vyas and Kumaranayake (2006). The SES score was computed as follows: $\text{Family SES} = (0.829 \times \text{father's education}$

level + 0.818 $\times$ mother's education level + 0.592 $\times$ family income) / 1.706, where 0.829, 0.818, and 0.592 represent the factor loadings of the respective variables, and 1.706 is the eigenvalue of the first principal component. Consistent with prior research (Perlstein et al., 2022), participants were categorized into high and low SES groups using a median split..

2.3 Statistical analyses

First, SPSS 22.0 was used to obtain descriptive statistics and bivariate correlations for all study variables.

Second, confirmatory factor analysis (CFA) was conducted to verify longitudinal measurement invariance of the measures. Following Chen (2007), measurement invariance was deemed to hold if the change in Comparative Fit Index (ΔCFI) did not exceed 0.01 and the change in Root Mean Square Error of Approximation ($\Delta RMSEA$) did not surpass 0.015.

Third, Cross-Lagged Panel Models (CLPMs) were used to investigate the reciprocal relationships among loneliness, distress intolerance, and SFVA. The CLPM is commonly used to analyze reciprocal associations among multiple constructs across time points, as it simultaneously estimates prospective, directional effects (cross-lagged paths) between waves while controlling for prior levels (autoregressive paths) and within-time covariances (Orth et al., 2021). This approach is well suited to hypotheses in this study regarding the reciprocal associations among loneliness, distress intolerance, and SFVA, and it enables testing the longitudinal mediating role of distress intolerance. In line with recommendations for prospective effect testing,

constrained and unconstrained models were compared for parsimony and interpretability (Orth et al., 2021), after establishing longitudinal measurement invariance to ensure construct comparability over time (Little, 2013). Following the guidance of Orth et al. (2021), since there is no theoretical basis to expect that the structural coefficients (i.e., autoregressive and cross-lagged paths) in this study will change over time, constraining these coefficients to be equal across different time points is a reasonable and useful method to simplify the research model. Specifically, a series of model comparisons were conducted to simplify the model: In Model 1 (baseline), all parameters were freely estimated; in Model 2, autoregressive paths were constrained to be equal across time; in Model 3, cross-lagged paths were constrained to be equal across time; and in Model 4, both autoregressive and cross-lagged paths were constrained to be equal across time simultaneously. These constrained models (Model 2-4) were compared against Model 1 using the Satorra-Bentler scaled chi-square difference test (Satorra & Bentler, 2001), and when the p -value for the difference in $S-B\chi^2$ was less than 0.05, the models were deemed significantly different. When no significant differences in fit were found, the most parsimonious model was retained. Gender, age, family income, and parental education level measured at T1 were included as covariates in Models 1-4. Each covariate was regressed onto all observed variables at each time point to control for their potential confounding effects.

Fourth, 5000 bootstrapping samples were used to determine the significance of indirect effects, using bias-corrected confidence intervals. An indirect effect was

considered significant at the 0.05 level if its 95% confidence interval did not include zero. Finally, multi-group analysis was employed to examine whether the primary associations differed by gender (girls versus boys) and family SES (high SES versus low SES). Two models were compared separately: (i) an unconstrained model in which all path coefficients were free to vary across gender/family SES, and (ii) a constrained model in which path coefficients were held equal across groups. In line with Satorra and Bentler (2001), if the p -value for the difference in S-B χ^2 fell below 0.05, the models were regarded as significantly different. Significant cross-lagged paths for each group were examined using the Wald test to determine whether any differences in specific pathways reached statistical significance.

All these analyses were conducted in Mplus 8.0 using robust maximum likelihood estimation. Acceptable model fit was evidenced by a Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) approaching or exceeding 0.90, along with a Root Mean Square Error of Approximation (RMSEA) below 0.08 and a Standardized Root Mean Square Residual (SRMR) below 0.10 (Kline, 2010).

3. Results

3.1 Preliminary analyses

As shown in Table 1, the main study variables demonstrated statistically significant positive correlations with one another within and across waves.

INSERT TABLE 1 HERE

3.2 Longitudinal measurement invariance

Table 2 shows the detailed findings from the longitudinal measurement invariance

analyses. In summary, the measures of loneliness, distress intolerance, and SFVA all achieved scalar invariance, thereby confirming the validity of examining cross-time relationships among these variables (Little, 2013).

INSERT TABLE 2 HERE

3.3 Results of cross-lagged panel models

As shown in Table 3, constraining the cross-lagged paths did not produce a significant change in model fit relative to the baseline model. Therefore, for parsimony, the study opted to use the model with cross-lagged paths constrained. The cross-lagged panel models with constrained cross-lagged paths for loneliness, distress intolerance, and SFVA fitted the data well: $\chi^2(df) = 52.416(23)$, CFI = 0.988, TLI = 0.975, RMSEA = 0.032, SRMR = 0.033.

As depicted in Figure 1, significant bidirectional associations emerged between loneliness and SFVA, loneliness and distress intolerance, as well as distress intolerance and SFVA. In addition, as shown in Table 4, the bootstrapping results indicated that: (i) T1 loneliness exerted a significant indirect effect on T3 SFVA through T2 distress intolerance (T1 loneliness $\rightarrow$ T2 distress intolerance $\rightarrow$ T3 SFVA), and (ii) T1 SFVA similarly impacted T3 loneliness via T2 distress intolerance (T1 SFVA $\rightarrow$ T2 distress intolerance $\rightarrow$ T3 loneliness).

INSERT FIGURE 1, AND TABLES 3 AND 4 HERE

3.4 Multiple-group analyses

The multiple-group analysis (see Table 5) revealed significant differences in the longitudinal associations among loneliness, distress intolerance, and short-form video

addiction (SFVA) based on family SES. More specifically, the Walt test statistic showed that the effect of T1 loneliness on T2 SFVA was only significant and stronger among adolescents with low family SES ($\chi^2 = 7.161, p < 0.01$), which was also found in the effect of T2 loneliness on T3 SFVA ($\chi^2 = 6.656, p < 0.01$). The effect of T1 distress intolerance on T2 SFVA was only significant and stronger among adolescents with high family SES ($\chi^2 = 9.974, p < 0.01$), and the effect of T2 distress intolerance on T3 SFVA was stronger among adolescents with high family SES ($\chi^2 = 5.544, p < 0.05$). Moreover, although the effect of T1 loneliness on T2 distress intolerance was only significant among adolescents with low family SES, the result of Walt test was not significant ($\chi^2 = 1.021, p = 0.312$). The effect of T1 SFVA on T2 loneliness was only significant among adolescents with high family SES. However, the result of Walt test was not significant ($\chi^2 = 2.578, p = 0.108$). Results of cross-lagged panel model for loneliness, distress intolerance, and SFVA across different level of SES are shown in Figure 2.

The multiple-group analysis (see Table 5) revealed non-significant differences in the longitudinal associations among loneliness, distress intolerance, and SFVA based on gender. However, given that the effects of loneliness on SFVA and SFVA on loneliness were opposite in different genders in this study, this study still conducted a Walt test to examine whether gender differences in cross-lagged paths were masked. Results of the Walt test showed that none of the cross-lagged paths exhibit sufficient gender differences ($\chi^2 = 0.347 \sim 3.502, p > 0.05$). Thus, this study did not report the results of the cross-lagged panel models for loneliness, distress intolerance, and SFVA

separately by gender.

INSERT TABLE 5 AND FIGURE 2 HERE

4. Discussion

The present study used a cross-lagged design to examine the longitudinal relationship between loneliness, distress intolerance, and SFVA among adolescents, as well as the moderating effect of gender and family SES. The results highlighted the bidirectional relationship between loneliness and SFVA, of which distress intolerance served as a mediator. Moreover, the effects of loneliness on SFVA were stronger among adolescents with low family SES, while the effects of distress intolerance on SFVA were stronger among adolescents with high family SES. These findings offer insights into the dynamic interactive development of loneliness and SFVA among adolescents, as well as the potential mechanism of mediation and moderation.

4.1 Bidirectional associations between loneliness and short-form video addiction

As expected, a bidirectional relationship between loneliness and SFVA was observed (supporting H₁). This finding confirmed the I-PACE model (Brand et al., 2016) that loneliness was not only the predisposing factor but also the negative consequence of SFVA. On the one hand, the present result verified that loneliness was a significant predictor of SFVA among adolescents. This finding was consistent with previous cross-sectional studies showing that individuals with higher loneliness are more likely to experience SFVA (e.g., Smith & Short, 2022; Zhao & Kou, 2024). From the perspective of uses and gratifications theory, individuals engage with specific media (such as short-form video applications) to fulfill particular needs or achieve specific

goals (Ruggiero, 2000). Given that short-form video applications can simultaneously satisfy adolescents' interpersonal needs, entertainment desires, trend-following pursuits, and stress relief, lonely adolescents may be more inclined to use short-form videos over other applications to meet these needs (which increases their risk of SFVA) (Dong et al., 2021). Although adolescents may initially engage with short-form videos to fulfill specific needs (e.g., socialization and entertainment), the expansion of online interactions and the continuous optimization of personalized algorithms may lead to increased dependence on short-form videos, making self-regulation increasingly difficult in the face of repeated gratification (Zhang et al., 2019).

On the other hand, SFVA reversely increased the likelihood of loneliness among adolescents. This finding aligns with existing literature regarding adults (Roberts et al., 2023; Wang et al., 2024), which indicates that SFVA exacerbates the feeling of loneliness among adolescents. The social replacement hypothesis (Kraut et al., 1998) provides a possible explanation: because individuals have limited free time, excessive short-form video use may replace adolescents' offline interactions with parents and friends, ultimately leading to interpersonal alienation, declining social skills, and loneliness. Moreover, although most short-form video platforms (such as *TikTok*) claim that their algorithms are designed to promote healthy interpersonal relationships and enhance social connections, these so-called "loneliness algorithms" instead utilize mechanisms such as identity binding and information narrowing to temporarily fulfill users' need for belonging at the expense of deep social interactions (Taylor & Chen,

2024). Consequently, this passive and superficial form of online socialization not only fails to compensate for individuals' interpersonal needs but may also foster unconscious social comparisons and the resulting feelings of envy, further exacerbating their sense of loneliness (Zhang et al., 2022). Overall, the findings of the present study identified a bidirectional relationship between loneliness and SFVA among adolescents, supporting the I-PACE model, which conceptualizes this link as a vicious cycle (Brand et al., 2016).

4.2 The mediating roles of distress intolerance

As regards to mechanisms underlying the links of loneliness and SFVA, the present study found that distress intolerance mediated the bidirectional relationship between loneliness and SFVA (supporting H₂). Firstly, it was expected that loneliness would positively predict SFVA through elevated distress intolerance. This finding supported I-PACE model (Brand et al., 2016) and extended previous research, which showed that depression and social anxiety increased SFVA by enhanced distress intolerance (Yao et al., 2023). Similar to the effects of depression and social anxiety, loneliness can impair emotional processing (e.g., absorption in negative emotions, difficulties in emotion regulation, and reduced use of adaptive strategies), ultimately increasing distress intolerance (Dryman & Heimberg, 2018). Moreover, long-term loneliness made adolescents perceive social exclusion and a lack of emotional support, which in turn contributed to increased distress intolerance (Veilleux et al., 2022). With the increase in distress intolerance, adolescents are inclined to adopt maladaptive coping strategies, seeking immediate gratification, irrespective of long-term negative

consequences (Skues et al., 2016; Veilleux et al., 2022). Therefore, high distress intolerance drives adolescents to engage with short-form video applications to alleviate loneliness, thereby increasing the risk of SFVA. Furthermore, although distress intolerance mediated the longitudinal association between adolescent loneliness and SFVA, loneliness still had a direct bidirectional relationship with SFVA even when this bidirectional mediation was established. This suggests that, in addition to the potential emotional regulation pathway of distress intolerance, there may be other independent and equally important psychological mechanisms at work.

Secondly, it was noteworthy that the effects from SFVA via distress intolerance to loneliness were also significant in the present study. This finding can be understood by integrating the perspectives of the I-PACE model and reward deficiency syndrome theory. According to the I-PACE model (Brand et al., 2019), distress intolerance functions as a core affective-cognitive response: when adolescents increasingly rely on short videos to cope with negative emotions, they gradually form maladaptive expectancies (i.e., “short-form videos are the quickest and most convenient relief”), while their executive control resources are depleted by repeated compensatory use. Over time, this reinforces a cycle in which difficulties tolerating distress make adolescents more likely to depend on short videos, thereby amplifying their addictive tendencies. Complementarily, the reward deficiency syndrome theory (Blum et al., 2000) suggests that frequent reliance on short videos for external rewards diminishes the adaptability of the brain's reward system, gradually reducing the satisfaction adolescents derive from typical social and entertainment experiences (Su et al., 2021).

This impaired reward system further heightens distress intolerance, as adolescents struggle to regulate their emotions in the absence of the instant gratification provided by short videos. Consequently, they are more likely to engage in addictive behaviors at the expense of non-addictive activities (e.g., offline social interactions) (Luijten et al., 2017), thereby increasing their risk of loneliness. Given the high neurobiological plasticity of adolescence, the impact of SFVA on loneliness through distress intolerance is particularly concerning, because the damage SFVA inflicts on adolescents' overall functioning may be difficult to reverse (Cerniglia et al., 2017).

The present study confirmed the bidirectional mediation roles of distress intolerance in the association between loneliness and SFVA among adolescents, which offered an insight into the underlying mechanism of the reciprocal association between loneliness and SFVA. Therefore, distress intolerance may serve as a target for the prevention and intervention of the vicious circle between loneliness and SFVA according to the I-PACE model (Brand et al., 2016). However, this finding is specific to adolescents and SFVA. Because the psychological mechanisms and risk factors underlying different types of internet addiction may vary (Maraz et al., 2015), further research is needed to determine whether the findings of the present study can be generalized to other populations and other types of internet addiction.

4.3 The moderating roles of family SES

The results regarding the moderating role of family SES partially supported H₃ and were consistent with previous studies (e.g., Sarialioğlu et al., 2022; Sun et al., 2021) as well as with the family investment model (Vasilyeva et al., 2018). Firstly, the direct

effect of loneliness on SFVA was only significant and stronger among adolescents with low family SES. The family investment model (Vasilyeva et al., 2018) posits that parents with low SES afford less material, cognitive, and social resources for their children, as well as invest less time and energy in childrearing (Yang et al., 2022a). Consequently, compared to those from high-SES families, adolescents from low-SES families are more likely to turn to short-form videos as a convenient and low-cost way to alleviate unmet emotional and social needs when experiencing loneliness. Moreover, parents with low SES have lower levels of family interaction and communication with their children, which hinders the development of social skills and emotional regulation (Conger & Donnellan, 2007). Therefore, adolescents from low-SES families are more likely to rely on online short-form video platforms rather than offline interactions to fulfill their emotional and social needs when experiencing loneliness.

Secondly, findings indicated that the effect of distress intolerance on SFVA was stronger among adolescents with high family SES. From the perspective of the family investment model (Vasilyeva et al., 2018), although high-SES families provide adolescents with abundant external resources, such as extensive social networks and diverse cultural and entertainment opportunities, this resource abundance may also make adolescents from high-SES families more reliant on external rather than internal psychological resources (such as emotion regulation abilities) to cope with distressing emotions, thereby increasing the risk of SFVA. Moreover, adolescents from high-SES families are believed to have higher peer status online and a stronger pursuit of online

peer status, using social media more frequently, craving popularity, and valuing likes and followers (Nesi & Prinstein, 2019). Consequently, when unable to cope with distressing emotions, such adolescents are more likely to seek emotional comfort and reinforce their social identity through higher digital peer status in short-form video platforms. Taken together, compared with low family SES, high family SES appears to make adolescents with high distress intolerance more vulnerable to SFVA. Moreover, the pathway from loneliness to distress intolerance was only significant for adolescents with low family SES, whereas the pathway from SFVA to loneliness was only significant for adolescents with high family SES. However, the aforementioned paths had no statistically significant difference between adolescents with high and low family SES. Therefore, these paths needed further exploration.

The moderating effect of gender was not observed (not supporting H₃), which was inconsistent with previous research identifying gender as a moderator of the bidirectional relationship between loneliness and SFVA (Zhang et al., 2024) but consistent with another meta-analysis (Tokunaga, 2017). On one hand, although early studies pointed out differences in the motivations of adolescents of different genders when using the Internet (Dufour et al., 2016), recent studies have shown that gender differences in the motivations and behaviors associated with the use of short video platforms are narrowing (Gu et al., 2022; Zhang et al., 2024). Therefore, this result suggests that the motivations for using short video platforms among male and female high school students may be highly similar (e.g., leisure, escaping boredom, and seeking social/informational fulfillment). Thus, the mechanisms by which loneliness

drives their use of short video platforms and how excessive use, in turn, exacerbates loneliness are likely to be the same for both boys and girls. On the other hand, the algorithms and content ecosystems of *Douyin* and *TikTok* immerse each user in a personalized entertainment space, blurring traditional gender-specific preferences (Schellewald, 2023). The neutralization of technology and the diversification of content have led to increasingly convergent behavioral patterns among male and female users, resulting in consistent patterns of association between loneliness and SFVA. To summarize, although the absence of significant gender differences in the longitudinal associations between loneliness, distress intolerance, and SFVA in the present study appears reasonable, future research is needed to further confirm this conclusion.

4.4 Contributions and limitations

As far as the authors are aware, the present study is the first to explore the dynamic interactive relationship between loneliness, distress intolerance, and SFVA. Existing findings regarding bidirectional associations between loneliness and internet addiction were extended to SFVA. Moreover, the present study extends the application of the Interaction of Person-Affect-Cognition-Execution (I-PACE) model by highlighting distress intolerance as a key mechanism linking the bidirectional relationship between loneliness and SFVA. Moreover, the study detected the moderating effect of family SES, which provided information on the protective and risky factors that modulated the vicious cycle. Overall, the study's findings offer targets for prevention and intervention of loneliness and SFVA by indentifying the underlying mechanisms of

mediation and moderation.

Despite these contributions, the study has some limitations. First, all the data were self-report by adolescents, which may introduce social desirability bias. Although self-reports are regarded as an “individual-focused” measure, future research should employ multiple measurements, such as results from third-party reports from parents, peers, and teachers, or objective behavioral data such as actual short video usage time. Second, the samples were all drawn from one high school in eastern China, and the specificity of the sample may limit the generalizability of the findings to other cultural or educational settings. Future studies could explore the longitudinal association between loneliness and SFVA among adolescents in different cultural contexts to ensure that these findings have broader applicability. Third, the study only followed the sample for a one-year period. Future studies should verify the findings over longer time spans.

4.5 Implications

The present study has important implications for the prevention and intervention of loneliness and SFVA. First, the results showed that loneliness increased the likelihood of SFVA, and (in turn) SFVA elevated feelings of loneliness. The result suggest that alleviating loneliness may reduce the occurrence of SFVA among adolescents. Moreover, prevention and intervention of SFVA would likely mitigate loneliness problems among adolescents. Therefore, parents should limit the use time of short video applications for adolescents and help them develop supportive social networks to ease loneliness.

Second, loneliness had an impact on SFVA among adolescents through distress intolerance, and vice versa. Therefore, distress intolerance serves as a potential target for prevention and intervention efforts aimed at disrupting the cycle of loneliness and SFVA. Mindfulness training has been identified as an effective way to foster distress tolerance (Carpenter et al., 2019). Mindfulness can make adolescents focus on in-the-moment feelings without judgement, which can improve the acceptance of distressing experiences (Carpenter et al., 2019). Higher distress tolerance can ease the urge to release negative feelings through maladaptive strategies, which may buffer the development and maintenance of loneliness and SFVA. Additionally, empirical evidence has shown that social support contributes to overcoming distress intolerance (e.g., Karami et al., 2020; Veilleux et al., 2022), therefore it is important for adolescents to develop supportive social networks.

Third, the results showed that the impact of loneliness on SFVA was stronger among adolescents with low family SES, while the pathway from distress intolerance to SFVA was more robust among adolescents with high family SES. For adolescents with low family SES, more attention should focus on bolstering their social connections, as well as offering more opportunities and resources for them to deal with loneliness feelings in alternative ways. For adolescents with high family SES, improvement in distress tolerance should be highlighted. Mindfulness training and other skills to enhance emotion regulation may be conducive to buffer SFVA.

5. Conclusion

The present study comprised a three-wave cross-lagged design to examine the

dynamic interaction between loneliness and SFVA among adolescents, as well as the underlying mechanisms of mediation and moderation. The findings confirmed that loneliness was not only the predisposing factor but also the negative consequence of SFVA among adolescents. Moreover, distress intolerance bidirectionally mediated the associations between loneliness and SFVA. Moreover, the effects of loneliness on SFVA were stronger among adolescents with low family SES, whereas the effects of distress intolerance on SFVA were stronger among adolescents with high family SES.

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Loneliness, distress intolerance, and short-form video addiction

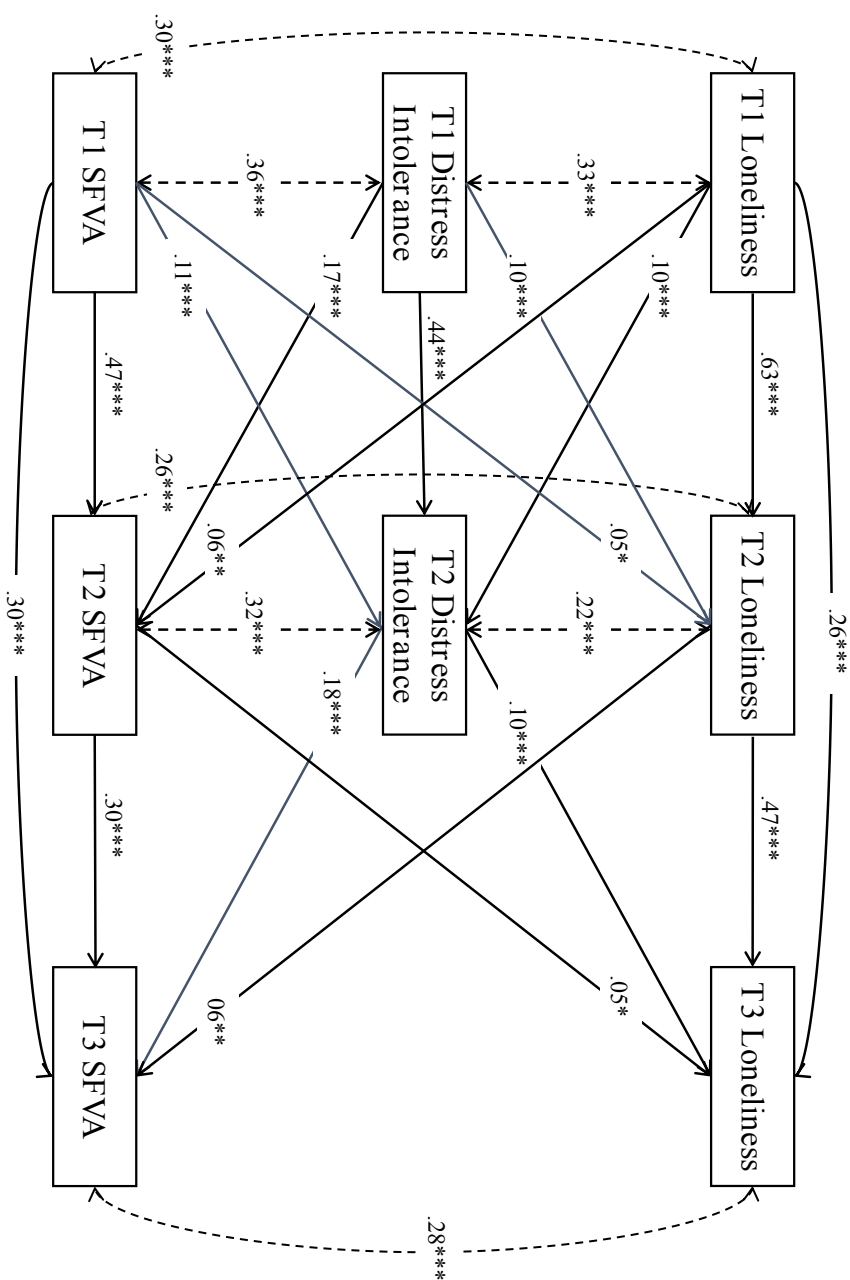


Figure 1. Standardized path coefficients of the final cross-lagged panel model for loneliness, distress intolerance, and short-form video addiction. SFVA = Short-Form Video Addiction. T1 = Timepoint 1; T2 = Timepoint 2; T3 = Timepoint 3. Only significant paths are displayed in the model. For simplicity, the covariates (gender, age, parental education level, and family income) are not pictured.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Loneliness, distress intolerance, and short-form video addiction

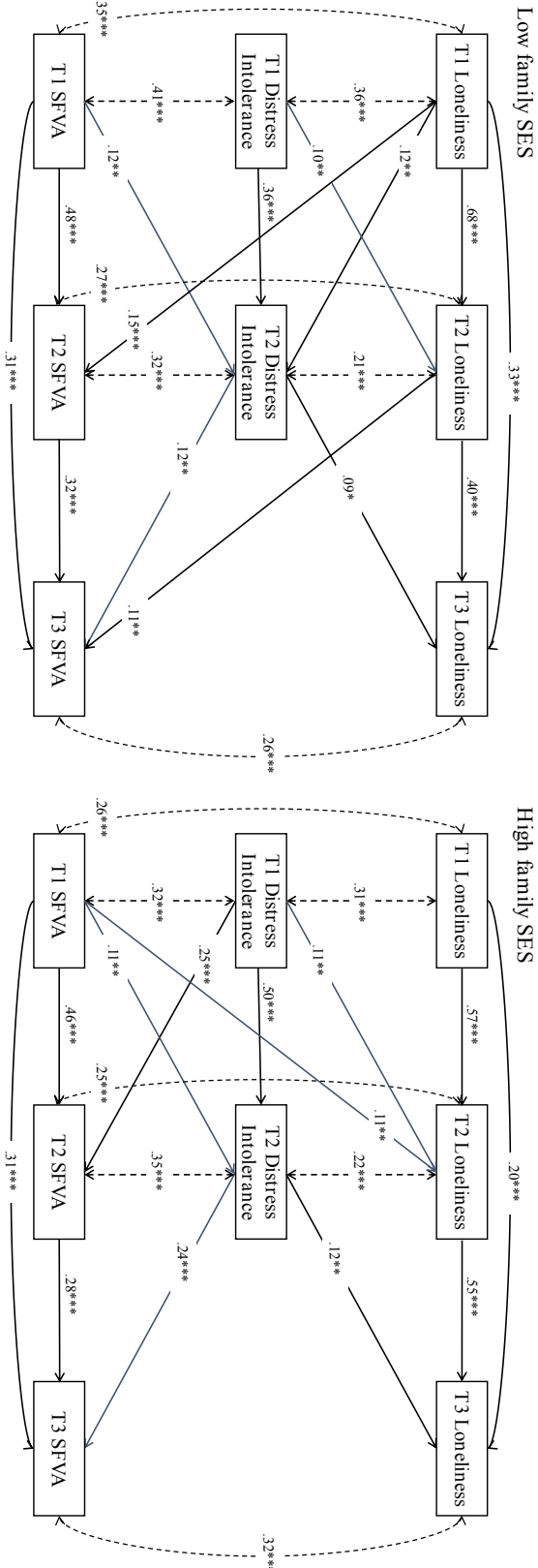


Figure 2. Cross-lagged panel model for loneliness, distress intolerance, and short-form video addiction across different level of family SES. SFVA = Short-Form Video Addiction, SES = Socioeconomic status. T1 = Timepoint 1; T2 = Timepoint 2; T3 = Timepoint 3. Only significant paths are displayed in the model. For simplicity, the covariates (gender and age) are not pictured.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Loneliness, distress intolerance, and short-form video addiction

Table 1
Descriptive statistics and correlations for the observed variables.

	1	2	3	4	5	6	7	8	9	10	11	12	
1.T1 Loneliness	1												
2.T2 Loneliness	.67***	1											
3.T3 Loneliness	.62***	.70***	1										
4.T1 DI	.33***	.34***	.31***	1									
5.T2 DI	.28***	.38***	.37***	.51***	1								
6.T1 SFVA	.30***	.29***	.29***	.36***	.30***	1							
7.T2 SFVA	.27***	.40***	.33***	.36***	.47***	.55***	1						
8.T3 SFVA	.27***	.33***	.44***	.40***	.43***	.54***	.57***	1					
9.Gender (0 = girls, 1 = boys)	.02	.01	.02	.01	.01	-.06	-.00	.06	1				
10.Age	.03	.02	.06*	-.02	.08**	-.03	.02	.02	.08**	1			
11.Family income	-.09**	-.07*	-.09**	-.00	.01	-.03	.02	-.01	.19**	.01	1		
12.Father's educational level	-.08**	-.03	-.05	-.01	.01	-.09**	-.04	-.07*	.08**	-.03	.26***	1	
13.Mother's educational level	-.10**	-.07*	-.08**	-.04	-.04	-.09**	-.04	-.07*	.04	-.10***	.24***	.52***	1
<i>M</i>	2.31	2.36	2.40	2.85	2.89	3.21	3.39	3.55	0.43	16.00	3.22	2.21	1.89
<i>SD</i>	0.67	0.68	0.66	0.66	0.69	1.22	1.19	1.14	0.50	0.61	1.41	0.85	0.89

Note. DI = Distress Intolerance, SFVA = Short-Form Video Addiction. T1 = Timepoint 1; T2 = Timepoint 2; T3 = Timepoint 3; M = Mean; SD = Standard Deviation.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 2

Model fit statistics for longitudinal measurement invariance

Variables	Model Tested	χ^2/df	CFI	TLI	RMSEA	ΔCFI	$\Delta RMSEA$
Loneliness	Configural Invariance	1.465	0.999	0.998	0.019		
	Metric Invariance	1.438	0.999	0.998	0.019	0.000	0.000
	Scalar Invariance	2.009	0.997	0.995	0.028	-0.002	0.009
Distress intolerance	Configural Invariance	4.850	0.991	0.984	0.056		
	Metric Invariance	4.279	0.991	0.986	0.052	0.000	-0.004
	Scalar Invariance	3.859	0.990	0.988	0.048	-0.001	-0.004
Short-form video addiction	Configural Invariance	2.139	0.997	0.992	0.030		
	Metric Invariance	2.553	0.994	0.989	0.036	-0.003	0.006
	Scalar Invariance	3.268	0.990	0.984	0.043	-0.004	0.007

Note. Bold type indicates established model of measurement invariance.

Table3

Model fit and comparison of all alternative cross-lagged panel models.

Models	Model Fit				Model Comparison		
	S-B χ^2 (<i>df</i>)	CFI	RMSEA [90% CI]	SRMR	Δ S-B χ^2	Δ <i>df</i>	<i>p</i>
Model 1: Baseline model (unconstrained model)	50.970 (19)	0.987	.037 [.025, .049]	0.033			
Model 2: Model with auto-regressive paths fixed to be time-invariant	86.668 (21)	0.974	.050 [.040, .062]	0.040	29.068	2	<0.001
Model 3: Model with cross-lagged paths fixed to be time-invariant	52.416 (23)	0.988	.032 [.021, .044]	0.033	2.811	4	0.590
Model 4: Model with auto-regressive and cross-lagged paths fixed to be time-invariant	93.517 (25)	0.973	.047 [.037, .058]	0.047	38.705	6	<0.001

Note. S-B χ^2 = Satorra-Bentler scaled chi-square; *df* = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; 90% CI = 90% confidence interval; SRMR = standardized root mean squared residual; Δ S-B χ^2 = difference testing with Satorra-Bentler scaling correction. Bold type indicates the final selected model.

Table 4

Indirect paths between loneliness, distress intolerance, and short-form video addiction for the CLPMs (standardized coefficients).

Indirect Effects	β	SE	Bootstrapped	
			95% CI	
			Lower	Upper
Total sample				
T1 Loneliness → T2 Distress intolerance → T3 SFVA	0.019	0.007	0.007	0.033
T1 SFVA → T2 Distress intolerance → T3 Loneliness	0.012	0.005	0.004	0.022
Low family SES				
T1 Loneliness → T2 Distress intolerance → T3 SFVA	0.015	0.008	0.002	0.033
T1 SFVA → T2 Distress intolerance → T3 Loneliness	0.010	0.006	0.001	0.025
High family SES				
T1 Loneliness → T2 Distress intolerance → T3 SFVA	0.020	0.011	-0.001	0.044
T1 SFVA → T2 Distress intolerance → T3 Loneliness	0.014	0.008	0.002	0.031

Note. SFVA = Short-Form Video Addiction. 95% CI = 95% confidence interval; T1 = Timepoint 1; T2 = Timepoint 2; T3 = Timepoint 3. Bold type means that the indirect paths are statistically significant.

Tables

Model fit and comparison for multi-group analysis.

Models	Model Fit			Model Comparison		
	S-B χ^2 (<i>df</i>)	CFI	RMSEA [90% CI]	SRMR	Δ S-B χ^2	Δ <i>df</i> <i>p</i>
Model A1: Unconstrained model with all path coefficients allowed to be unequal across gender	55.036 (32)	0.991	.034 [.018, .049]	0.037		
Model A2: Constrained model with all path coefficients constrained to be equal across gender	68.717 (49)	0.992	.026 [.008, .039]	0.044	15.157	17 0.584
Model B1: Unconstrained model with all path coefficients allowed to be unequal across family SES	31.006 (20)	0.995	.030 [.000, .050]	0.017		
Model B2: Constrained model with all path coefficients constrained to be equal across family SES	66.484 (37)	0.987	.036 [.022, .050]	0.031	34.814	17 0.007

Note. S-B χ^2 = Satorra-Bentler scaled chi-square; *df* = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; 90% CI = 90% confidence interval; SRMR = standardized root mean squared residual; Δ S-B χ^2 = difference testing with Satorra-Bentler scaling correction.

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