



Understanding the link between social relationships and adolescent Internet addiction: Perspectives from two approaches to well-being

Kaiji Zhou^a, Xiaoqin Zhu^{a,*}, Bin-Bin Chen^b

^a Department of Applied Social Sciences, The Hong Kong Polytechnic University, Hong Kong SAR, PR China

^b Department of Psychology, Fudan University, Shanghai, PR China

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ABSTRACT

This study aimed to investigate the associations of four dyads (mother-child, father-child, teacher-student, and student-student) of social relationships with adolescent Internet addiction (IA) and explore the seldom concurrently examined roles of life satisfaction and life meaning (indicators of hedonic and eudaimonic well-being respectively) as potential mediators and moderators in these associations. Based on data collected from 1,974 adolescents in China, the results showed that 1) father-child relationship (but not other relationships) was negatively associated with IA; 2) the mediation effects of life satisfaction and life meaning were significant on the links between father-child and student-student relationships and IA, and the suppression effect of life satisfaction (but not life meaning) was significant on the association between mother-child relationship and IA, while the mediation effects were not significant regarding teacher-child relationship; 3) life satisfaction and life meaning significantly moderated the association between father-child relationship and IA in opposite directions: life satisfaction reinforced the negative association, while life meaning mitigated the relation. The findings delineate the association between social relationships in different contexts and adolescent IA as well as the unique roles played by life satisfaction and life meaning in underlying the association.

1. Introduction

Internet addiction (IA), alternatively referred to as problematic or pathological Internet use, is defined as excessive, time-consuming engagement with the Internet, leading to adverse outcomes (Davis, 2001; Toth-Kiraly et al., 2021; Young, 1998). With the growing ubiquity and utilization of information and communication technologies in recent years, Adolescent IA is becoming an increasingly prevalent issue. Pew Research Center (2022) showed that 46% of US teens were online “almost constantly,” a significant increase from 24% in 2014–15. Additionally, a survey by EU Kids Online showed that 8%–36% of teenagers across 19 European countries exhibited at least one criterion indicative of problematic Internet use (Smahel et al., 2020). Similar findings on high prevalence rates of adolescent IA have also been documented in scientific literature. For instance, Kawabe et al. (2016) identified 20.7% of Japanese adolescents as possibly addicted, and recent research in China has reported prevalence rates ranging from 15.3% to 32.5% (see Wang et al., 2023). While IA has not yet been considered an official diagnosis (like Gaming Disorder in ICD-11 [WHO, 2018]), its high prevalence among adolescents remains a concern due to

its well-documented negative consequences, such as poor academic performance, physical health problems, mental health issues, and delinquency (Alimoradi et al., 2019; Stavropoulos et al., 2013; Toth-Kiraly et al., 2021; Zhu, Shek, & Chu, 2021).

Social relationships have been identified as playing a vital role in the emergence and development of IA (see Mesch, 2001; Toth-Kiraly et al., 2021). However, despite numerous studies on the relations and mechanisms between social relationships and IA in adolescents, the unique contributions of different social relationship dyads in both family and school contexts have not been well established since most studies have not evaluated them simultaneously. Similarly, although past mechanism research has explored mediators/moderators between social relationships and IA (e.g., Hu et al., 2022), studies investigating the unique mechanisms of different well-being indicators (i.e., life satisfaction versus life meaning) simultaneously are sparse. To address these gaps, a broader analytic framework is needed to include and compare multiple social relationship dyads and different explanatory mechanisms.

* Corresponding author. The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, PR China.

E-mail address: xiaoqin.zhu@polyu.edu.hk (X. Zhu).

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1.1. Social relationships and adolescent IA

Social relationships refer to connections between people who have recurring interactions (August & Rook, 2013), facilitating social integration, fulfilling fundamental human needs, and offering social support (Hulur & Macdonald, 2020). Adolescence is a critical stage of socialization. Positive relationships foster adolescents' development into mature and productive societal members. Conversely, dysfunctional relationships can hinder optimal development, leading to socio-emotional difficulties, behavioral issues, and addictions (see van Harmelen et al., 2017; Viner et al., 2012).

Research has distinguished addictions to specific Internet activities, such as online gaming and social media addiction, from generalized IA (see Pan et al., 2020), which covers all forms of Internet applications (Toth-Kiraly et al., 2021). To capture adolescents' addictive symptoms related to overall Internet use, this research focuses mainly on generalized IA. Besides, due to the ongoing debate surrounding the diagnostic criteria, we considered IA a general condition that varies in severity (Toth-Kiraly et al., 2021; Zhu, Shek, & Chu, 2021). Leading theories of IA (Davis, 2001; Kardefelt-Winther, 2014) have identified dysfunctional social relationships as key risk factors of IA. For example, the Compensatory Internet Use hypothesis (Kardefelt-Winther, 2014) posits that individuals dissatisfied with social relationships might use the Internet to fulfill unmet social needs, increasing the risk of IA (Hu et al., 2022). Adolescents' social relationships are highly rooted in the family and school settings, the two primary socialization contexts according to developmental theories (e.g., Lerner & Castellino, 2002). As such, adolescents' social relationships with parents, teachers, and peers (other students) could be significant antecedents of IA.

Based on Attachment Theory (Bowlby, 1982) and the Compensatory Internet Use hypothesis (Kardefelt-Winther, 2014), adolescents with poor parent-child relationships (e.g., low parental care or high neglect) may develop insecure attachments, which lead to unmet psychological needs and emotional challenges, potentially driving them to the Internet for compensation and escape (Sun et al., 2020; Sung et al., 2020). By contrast, good parent-child relationships are marked by adequate care, trust, communication, and children's satisfaction with parenting, which help children develop secure attachments and foster the internalization of parenting practices into adolescent self-care (Omer et al., 2016) and self-regulation (Deci & Ryan, 2000). This can inhibit adolescents' problematic/addicted Internet use (Shek et al., 2018). Previous empirical studies have suggested that favorable parent-child relationships are negatively associated with IA among adolescents (Shi et al., 2017; Zhang et al., 2019), while poor parent-child relationships are positively related to adolescent IA (Huang et al., 2021; Schimmenti et al., 2014).

Furthermore, studies also demonstrated differential influences of mother-child and father-child relationships. Xu et al. (2014) revealed that mothers have a greater influence on adolescent IA than fathers. Shek et al. (2018) also found that the effect of mother-child relationship is more robust than that of father-child relationship on adolescent IA. Nevertheless, others argue fathers, often taking a leading family role and engaging more in adolescents' activities and guidance, may have stronger impacts (Liu et al., 2013; Su et al., 2018). Given the inconclusive picture, more studies are warranted to differentiate maternal and paternal effects and explore possible mechanisms that may alter the relationship between parent-child relationships and adolescent IA.

With adolescents gradually becoming independent from their parents, their interpersonal networks increasingly expand to broader social contexts (e.g., school). In the school context, teachers' acceptance, support, and care help mitigate the impact of stress and negative emotions (Jia et al., 2017), reducing the risk of maladjustment. Besides, students' connections with teachers serve a social control function (Hirschi, 1977), thus deterring deviant behaviors, including IA. Past studies have associated good teacher-student relationship with a lower risk of IA (Jia et al., 2017; Shi et al., 2022). Peer relationships (student-student relationship) are another vital source of social support and

belongingness, which assist adolescents in coping with psychological distress and stressful events, thereby undermining the risk of IA. Some studies have revealed that good peer relationships are negatively related to IA among children and adolescents (Mesch, 2001; Sun et al., 2020).

To sum up, existing theories and empirical evidence have associated positive social relationships with lower levels of IA among adolescents. Yet, most of the studies focus on either the family or school setting. Empirical studies investigating the social relationships in both the family and school contexts collectively are limited. As suggested by the socio-ecological approach, multiple social contexts and their interdependencies should be taken into consideration in understanding the occurrence and development of problem behaviors (Ennett et al., 2008; Shi et al., 2017). Examining multiple social relationships simultaneously will allow us to compare the effects of different relationship dyads and locate the primary predictor (if there is one). In addition, there is a need to further understand the mechanisms underlying (i.e., mediating or moderating) the association between social relationships and adolescent IA.

1.2. Well-being indicators as mediators and moderators

Well-being refers to individuals' optimal functioning and experience, which has been conceptualized from hedonic and eudaimonic perspectives (Huta & Waterman, 2014; Ryan & Deci, 2001). The hedonic view focuses on pleasure, satisfaction, and emotional and cognitive comfort. One widely used indicator is life satisfaction, which reflects the extent to which one's life meets expectations based on a global assessment of pleasure, comfort, and satisfaction (Diener et al., 1985). In contrast, the eudaimonic perspective focuses on developing the best self, actualizing potential and values, and active contribution (Huta & Waterman, 2014; Ryan & Deci, 2001). One of the indicators of this approach is life meaning (Heintzelman, 2018). Despite several conceptualizations of life meaning (Frankl, 1963; Heintzelman, 2018; Shek et al., 2019), the related elements, such as purpose, transcendence, and spirituality, have been consistently considered important to or even indicators of well-functioning (Krok, 2018).

Both life satisfaction and life meaning may mediate the link between social relationships and adolescent IA. First, social relationships are expected to be positively associated with life satisfaction and life meaning. Regarding life satisfaction, as posited by Tomasello (2014), humans can be characterized as "ultra-social animals" since our lives tend to be excessively socially intertwined (Anderson & Fowers, 2020). Thus, individuals' positive feelings from social relationships may spill over, enhancing overall life satisfaction. Besides, positive social relationships are the conduit of emotional support (Anderson & Fowers, 2020; Kim & Kim, 2013), assisting us in emotional adjustment and fostering comfort and satisfaction. For example, good parent-child relationships contribute to children's attachment security, which promotes a sense of safety and effective emotional regulation, thereby enhancing life satisfaction (Jiang et al., 2013). Empirically, social connectedness has been a widely evidenced source of life satisfaction and happiness (Arslan, 2018; Lee et al., 2008). As for life meaning, close social relationships enable people to be connected to a larger symbolic entity ("something bigger than yourself"), which offers a symbolic promise of lastingness, order, and potential for meaning while transcending personal limitations and allowing individuals to pursue a higher-order collective purpose (Lambert et al., 2013). In this case, close relationships may cultivate a sense of self-transcendence and imbue life with a greater sense of purpose and meaning. Indeed, Lambert et al. (2013) showed that relationships that promote a sense of belonging are a powerful cause of finding life meaningful.

Second, heightened life satisfaction and life meaning may undermine the risk of IA. High life satisfaction leads to a positive outlook on life (Park, 2004), enabling adolescents to cope positively with stressful events and decreasing maladaptive responses like excessive Internet use (Zhu & Shek, 2021). Moreover, individuals content with their lives often

experience positive emotions that broaden their capacity for action, build resources, and enhance resilience (Fredrickson et al., 2008). Empirical studies have shown that life satisfaction is negatively associated with adolescent IA (Kabasakal, 2015; Qiu et al., 2022). Likewise, life meaning can also undermine IA. The humanistic-existential perspective of resilience states that human beings possess a natural inclination to surmount obstacles and setbacks in order to realize their potential and purpose in life (Wong & Wong, 2013). Meaningful life is regarded as beneficial for resilience formation (Wong & Wong, 2013), promoting productive coping and optimal functioning even amid adversity. This can prevent maladjustment and psychopathologies like IA.

Altogether, positive social relationships might contribute to higher levels of life satisfaction and life meaning, which can, in turn, undermine the risk of IA.

In addition to serving as mediators linking social relationships and IA, life satisfaction and life meaning may act as moderators that alter the association between social relationships and IA. As aforementioned, high levels of life satisfaction and life meaning are conducive to the establishment of adaptive coping styles, personal resources, and resilience (Wong & Wong, 2013; Zhu & Shek, 2021), which help adolescents cope with stressors and adversity, interrupting or mitigating the link between risk factors (e.g., poor social relationships) and negative outcomes (e.g., IA).

Furthermore, high life satisfaction and life meaning may further strengthen the protective effects of positive social relationships against IA. According to the Protective-Protective Model, one protective factor can enhance the beneficial effect of another protective factor (Qiu et al., 2022; Zimmerman et al., 2013). First, high life satisfaction enhances an individual's propensity to perceive and appraise life experiences in positive ways (Park, 2004), and positive feelings can broaden individuals' cognitive and behavioral repertoire and build essential resources (Fredrickson et al., 2008), which may enable an individual to better recognize the benefits of positive relationships and utilize social resources related. Second, individuals with higher life meaning often explore and construct meaning by analyzing and evaluating the value of themselves and their actions (Sun et al., 2022). This can lead to the discovery or creation of profound meaning within their social relationships. For example, one with high meaning in life may believe, "My friendships not only bring joy but also inspire me to learn from my friends' virtues and strive to be a better person." Such a meaning-making process enriches a pleasurable relationship with eudaimonic perks. In sum, the heightened tendency towards positivity, better utilization of social resources, as well as meaning-making may enable an individual to optimize the merits of positive social relationships, amplifying their protective effects against IA.

Despite the above theoretical possibilities, limited empirical evidence is available on the mediating and moderating effects of life satisfaction and life meaning on the relationship between social relationships and adolescent IA. A recent study revealed the mediation role of life meaning in the relationship between interpersonal alienation and smartphone addiction (Hu et al., 2022). One study unexpectedly found that life satisfaction did not moderate the link between parent-child relationship and adolescent IA (Qiu et al., 2022). Moreover, to our best knowledge, no studies have explored the mediating or moderating effects of both life satisfaction and life meaning simultaneously. Examining the roles of life satisfaction and life meaning simultaneously allows us to compare the potentially distinct explanatory mechanisms.

From the lifespan perspective, young people show distinctive characteristics regarding striving to deepen their understanding of the world and the significance and purpose of their lives (Krok, 2018). Adolescence has been regarded as a unique stage for the development of spirituality (King & Roeser, 2009). Sagone and De Caroli (2014) found that late adolescents exhibit higher levels of personal growth and purpose in life than their younger counterparts. Steger et al. (2009) found

that emerging adults (late adolescents) have higher levels of searching for meaning than older adults. It seems adolescents experience an increase in the need for meaning-making, peaking in late adolescence before declining in older age. Hence, we are particularly interested in whether life meaning serves as a more prominent mediator or moderator than life satisfaction between social relationships and IA in an older adolescent sample (i.e., senior high school students). Besides, we are also interested in the potential variation in the roles of life satisfaction and life meaning across the different relationship dyads in the family and school contexts (i.e., father-child, mother-child, teacher-student, and student-student).

1.3. The present study

This research aimed to examine three research questions among Chinese senior high school students: 1) whether the four dyads of social relationships (father-child, mother-child, teacher-student, and student-student) are significantly associated with adolescent IA; 2) whether such associations can be mediated by life satisfaction and life meaning; and 3) whether such associations can be moderated by life satisfaction and life meaning.

Based on the theories and empirical evidence reviewed above, we expected that positive father-child (Hypothesis 1a), mother-child (Hypothesis 1b), teacher-student (Hypothesis 1c), and student-student (Hypothesis 1d) relationships are negatively related to adolescent IA. Given the mixed findings on the roles of father-child versus mother-child relationships in adolescent IA, we did not make a specific hypothesis regarding which one is a stronger predictor.

Concerning the mediating effect of the two well-being indicators, we hypothesized that life satisfaction and life meaning significantly mediate the links between the four positive social relationships (father-child [Hypothesis 2a], mother-child [Hypothesis 2b], teacher-student [Hypothesis 2c], and student-student [Hypothesis 2d]) and adolescent IA. More specifically, positive social relationships were expected to be positively associated with life satisfaction and life meaning, which would further negatively predict adolescent IA.

Furthermore, life satisfaction and life meaning were also expected to display significant moderating roles between the four positive social relationships (father-child [Hypothesis 3a], mother-child [Hypothesis 3b], teacher-student [Hypothesis 3c], and student-student [Hypothesis 3d]) and adolescent IA in terms of enhancing the associations.

Figure A1 and A2 in the Appendix present the hypothesized paths in the mediation and moderation models, respectively. Despite the possible unique role of life meaning in adolescence, there is an absence of clear empirical evidence of whether it plays a more salient role than life satisfaction in the link between social relationships and IA. Thus, we leave another open research question of which well-being indicator exerts a stronger mediation or moderation effect.

2. Method

2.1. Participants and procedure

An online survey was conducted across two Chinese high schools. Headteachers shared the survey link with students who were informed about the research purpose, anonymity, and confidentiality. Participation was voluntary, with no penalties for non-participation or discontinuation.

Data quality was ensured by employing strategies outlined by Aust et al. (2013) and Ma et al. (2020). Participants who failed to correctly answer two attention check questions or whose survey completion time was beyond three standard deviations from the average were excluded from the final analysis. After excluding 97 invalid responses, the final working sample consisted of 1,974 adolescents (age range = 14–22 years; mean age = 16.47 ± 0.87 years), including 1,099 (55.7%) adolescent girls and 875 (44.3%) adolescent boys. Most of the

participants ($n = 1,527$, 77.4%) reported that they lived in an intact family (i.e., parents are in the first marriage), and a total of 290 (14.7%) indicated that their family's dependence on governmental welfare.

2.2. Measures

IA. Kimberly Young developed several tools to assess Internet-addicted behaviors, such as a 10-item Internet Addiction Test (IAT) covering ten typical symptoms of IA (Suler, 2004; Young, 1998). This ten-item assessment tool has been translated into Chinese and validated among Chinese samples, including adolescents (Chi et al., 2016; Shek et al., 2018). This ten-item Chinese IAT was utilized in the present study. The participants indicated whether (i.e., "1 = Yes" or "0 = No") they displayed the symptom in the past year on each item (e.g., "Do you feel preoccupied with the Internet or online services and think about it while off-line?"). We treated IAT scores as continuous (Chi et al., 2016; Zhu, Shek, & Chu, 2021). Specifically, adolescents' IA scores were indexed by the total score across the items, which would theoretically range between 0 and 10. A higher score suggests a higher level of IA. Cronbach's $\alpha = 0.76$ and McDonald's $\omega = 0.76$.

Father-child and mother-child relationships. Father-child and mother-child relationships were measured using respective subscales in "Parent-Child Subsystem Quality Scale (PCSQS)," which has been validated and widely adopted among Chinese adolescents (Shek et al., 2018; Zhu et al., 2022). The relationship between the child and each parent was indicated by six items (e.g., "I proactively share my feelings with my father/mother") on a four-point scale ranging from "1" (strongly disagree) to "4" (strongly agree). Higher mean scores across the items for each measure represent better relationships. Cronbach's α s and McDonald's ω s (i.e., 0.90–0.91) of the scales indicated adequate internal consistency of the two scales in the present study.

Teacher-student and student-student relationships. Teacher-student and student-student relationships were measured using subscales derived from the validated Chinese version of "Delaware School Climate Survey-Student" (Teng et al., 2020; Zhu et al., 2022). Each relationship was assessed by four items. Sample items included "teachers care about students" (teacher-student relationship) and "students are friendly with each other" (student-student relationship). A four-point scale (1 = "strongly disagree," 4 = "strongly agree") was used for all items. Higher mean scores across the items represent better relationships. Both scales showed adequate reliability in this study, with Cronbach's α s and McDonald's ω s ranging between 0.92 and 0.95.

Life satisfaction. This study assessed life satisfaction using the five-item Chinese "Satisfaction with Life Scale (SWLS)," which has been frequently employed in assessing Chinese adolescents' life satisfaction (Yu & Xie, 2021; Zhu & Shek, 2020). Sample items included "The conditions of my life are excellent" and "I am satisfied with my life." The participants indicated their agreement with each statement on a six-point scale from "1" (strongly disagree) to "6" (strongly agree). A higher mean score across the items represents a higher level of life satisfaction. Cronbach's α and McDonald's ω were 0.85 and 0.84.

Life meaning. It was measured using the three-item "spirituality" subscale (SP) in the "Chinese Positive Youth Development Scale" (Shek et al., 2007). The SP subscale has previously been used to assess Chinese adolescents' life meaning (Shek & Zhu, 2018). Specifically, the three items assessed to what extent respondents consider their life meaningful and purposeful (e.g., "My life is empty versus full") on a seven-point scale. A higher mean score across the items represents higher life meaning. In this study, Cronbach's $\alpha = 0.88$ and McDonald's $\omega = 0.88$.

Covariates. Control variables included gender (0 = male, 1 = female), age, family intactness, only-child status, family economic status, and parental education, which have been frequently accounted for in previous research (Chi et al., 2016; Zhu & Shek, 2020). Family intactness was indicated by parents' marital status, with first marriage indicating intact families, while other types (e.g., re-married, separated, or divorced) indicated non-intact families. Reliance on governmental

welfare served as an indicator of unfavorable family economic status. Parental education was evaluated on an eight-point scale ranging from "1" (illiterate [cannot read]) to "8" (undergraduate or above), with a higher score indicating a higher level of educational achievement.

Confirmatory factor analyses (CFA) were conducted to test the factor structure of the seven key measures outlined above, with CFI, TLI, and RMSEA selected as fit indices per prior practice (Chen et al., 2014; Zhu, Shek, & Chu, 2021). CFA supported a unidimensional structure of each measure with an acceptable model fit: CFI ranged between 0.94 and 1.00 (0.998), TLI ranged between 0.92 and 0.99, and RMSEA ranged between 0.04 and 0.08 (with the one-factor-three-indicator model for life meaning saturated [see Lee, 2019]), All measures showed adequate factor loadings (0.53–0.93, $ps < 0.001$).

2.3. Item parceling

Parceling items is recommended as a helpful statistical technique to obtain a more reliable model estimation in structural equation model (SEM) analyses when there are more than five indicators (Little et al., 2002). Following this recommendation, the ten items of IAT were randomly grouped into two parcels with five items in each parcel, and the composite scores across the five items in each parcel were used as two observed indicators for the latent IA. Similar item parceling procedures were applied to measures of father-child and mother-child relationships because the two measures included six (i.e., more than five) items. The six items in each measure were randomly grouped into two parcels with three items in each. The latent father-child and mother-child relationships were indicated by the mean scores across the three items in each parcel, resulting in two parceling items in each measure.

The original items in other measures with no more than five items were not parceled but directly used as the observed indicators for the latent variables in SEM analyses.

2.4. Common method bias test

The Harman single-factor model was used to test common method bias. The results showed eight factors with eigenvalues greater than 1. The variance explained by the first factor was 26.5%, which is less than the threshold of 40%, indicating that there was no serious common method bias in this study.

2.5. Data analysis

Reliability and correlational analyses were performed by SPSS 28.0. SEM and the bootstrapping technique (re-sampling = 1,000) were adopted using Mplus 7.0.

3. Results

3.1. Descriptive statistics and correlations among the variables

The results of descriptive statistics and correlations among the variables are shown in Table 1. The key variables were significantly inter-correlated. Besides, given the strong correlation between mother education and father education ($r = 0.54$, $p < 0.001$, $\alpha = 0.69$), we created a composite variable of "parental education" as a covariate by averaging mother and father educational levels for further analyses.

3.2. The mediating effects of life satisfaction and life meaning

Fig. 1 and Table 2 depict the results of SEM analyses on the associations between social relationships and IA and the mediating effects of life satisfaction and life meaning. The latent mediation model fitted data well ($\chi^2/df = 2.70$, CFI = 0.98, TLI = 0.97, RMSEA = 0.03, SRMR = 0.03).

Table 1
Descriptive statistics and correlations among variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Gender ^a	1													
2 Age	-0.06**	1												
3 FMI	-0.05*	0.07**	1											
4 OC	0.11***	0.09***	0.15***	1										
5 FES	0.06*	0.12***	0.01	0.16***	1									
6 Edu_M	-0.04	-0.23***	-0.12***	-0.38***	-0.29***	1								
7 Edu_F	-0.03	-0.12***	-0.05*	-0.35***	-0.23***	0.54***	1							
8 FCR	-0.04	0.01	0.16***	0.01	-0.01	0.07**	0.08***	1						
9 MCR	0.05*	-0.05*	0.08***	-0.03	-0.04	0.07**	0.08***	0.58***	1					
10 TSR	-0.06**	-0.04	0.06**	-0.04	0.01	0.01	0.06**	0.38***	0.39***	1				
11 SSR	-0.07***	-0.05*	0.06*	-0.06*	0.01	0.02	0.08***	0.34***	0.37***	0.70***	1			
12 LS	-0.17***	0.02	0.07**	-0.01	0.01	0.01	0.02	0.33***	0.29***	0.28***	0.29***	1		
13 LM	-0.03	0.02	0.03	0.02	0.02	-0.01	0.02	0.30***	0.26***	0.24***	0.27***	0.45***	1	
14 IA	0.03	-0.06**	0.00	0.02	0.01	-0.02	0.01	-0.20***	-0.10***	-0.14***	-0.12***	-0.23***	-0.22***	1
M		16.47				4.25	4.89	2.97	3.16	3.12	3.16	3.94	5.57	2.26
SD		0.87				1.75	1.46	0.66	0.58	0.54	0.54	1.03	1.21	2.22

Note. ^a 1 = female, 0 = male; FMI, family intactness (1 = intact; 0 = non-intact); OC, only-child status (1 = have sibling[s]; 0 = normal); FES, family economic status (1 = unfavorable; 0 = normal); Edu_M, mother education; Edu_F, father education; FCR, father-child relationship; MCR, mother-child relationship; TSR, teacher-student relationship; SSR, student-student relationship; LS, life satisfaction; LM, life meaning; IA, Internet addiction; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Gender, age, one-child status, family intactness, family economic status, and parental education were covariates in the analyses. The results showed that gender was significantly associated with life satisfaction (Estimate = -0.25, $Z = -5.71$, $p < 0.001$); namely, female students showed lower life satisfaction than male students. Meanwhile, age negatively predicted IA (Estimate = -0.07, $Z = -6.23$, $p < 0.01$), suggesting younger adolescents displayed higher levels of IA. Other covariates were not significant predictors.

As shown in Fig. 1, father-child, mother-child, and student-student relationships, but not teacher-student relationship, showed significant positive associations with life satisfaction and life meaning, which, in turn, negatively predicted adolescent IA. Father-child and mother-child relationships also showed significant direct links to adolescent IA but in opposite directions. The model explained 24.9%, 16.7%, and 13.9% of the total variance in life satisfaction, life meaning, and adolescent IA, respectively.

Table 2 shows the total effects, direct effects, and indirect effects of our hypothetical paths. The total effect (Estimate = -0.26, $Z = -5.52$, $p < 0.001$) and direct effect (Estimate = -0.18, $Z = -3.98$, $p < 0.001$) of father-child relationship were significant. The mediation roles of life satisfaction (Estimate = -0.05, $Z = -3.54$, $p < 0.001$) and life meaning (Estimate = -0.03, $Z = -2.69$, $p < 0.01$) in the link between father-child relationship and IA were significant, accounting for 19.2% and 11.5% of the total effect, respectively.

The total effect of mother-child relationship on IA was not significant, with a significant suppression effect detected. Specifically, the direct effect of mother-child relationship was positive and significant (Estimate = 0.14, $Z = 2.78$, $p < 0.01$), and the suppression effect of life satisfaction was significant (Estimate = -0.03, $Z = -2.90$, $p < 0.01$), indicating that the increased life satisfaction suppressed the positive direct association between mother-child relationship and IA. In the suppression effect, $|ab/c'| = 0.22$ (22.2% of the positive direct effect was counteracted by the suppression effect). Meanwhile, the mediation role of life meaning in the association between mother-child relationship and IA was not significant.

The results for teacher-student relationship were not significant. In addition, the total effect and direct effect of student-student relationship were not significant, while the mediation roles of life satisfaction (Estimate = -0.03, $Z = -2.38$, $p < 0.05$) and life meaning (Estimate = -0.02, $Z = -2.59$, $p < 0.05$) in the link between student-student relationship and IA were significant. Despite the nonsignificant total effect, the mediation effects can still exist (Shrout & Bolger, 2002).

The results of pairwise contrasts between the mediating effects of life satisfaction versus life meaning across the four dyads of social relationships yielded no significant differences. Additionally, although the association of life satisfaction with IA (Estimate = -0.20, $Z = -4.51$, $p < 0.001$) was slightly larger than that of life meaning (Estimate = -0.13, $Z = -3.23$, $p < 0.01$), the difference between the two coefficients was not significant.

3.3. Moderating effects of life satisfaction and life meaning

We examined the moderating effects of life satisfaction and life meaning on the associations of father-child, mother-child, teacher-student, and student-student relationships with IA, and the nonsignificant results for mother-child, teacher-student, and student-student relationships are not displayed. The results of the latent moderation model analysis for father-child relationship are shown in Table 3 and Figs. 2–4. The working model included four latent variables (father-child relationship, life satisfaction, life meaning, and IA) and covariates.

As the moderation analysis based on the LMS method does not provide the model fit indices generally used in SEM analysis, a log likelihood ratio test was used to compare the moderation model (M1 [with the latent interactions]) and the main effect model (M0 [without the latent interactions]), M0 showed a significant fit loss ($\Delta\chi^2 = 10.47$, $\Delta df = 2$, $p < 0.01$) relative to M1. As M0 already showed a good model fit

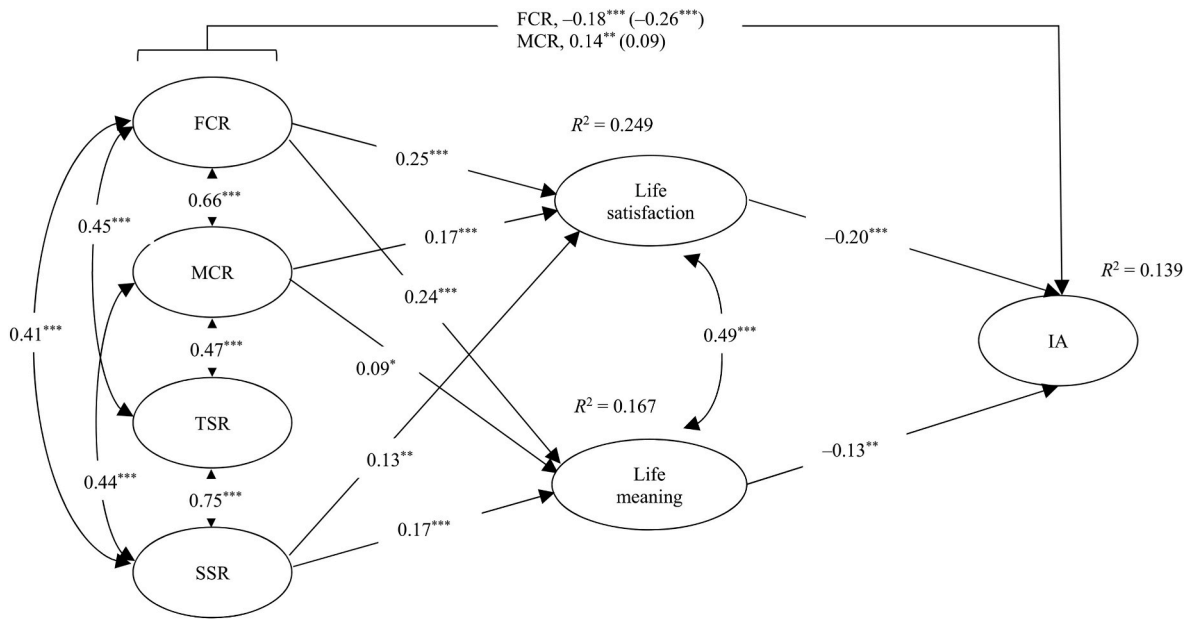


Fig. 1. Simplified representation of the latent mediation model. Controlling for gender, age, one-child status, family intactness, family economic status, and parental education; FCR, father-child relationship; MCR, mother-child relationship; TSR, teacher-student relationship; SSR, student-student relationship; IA, Internet addiction; observed variables, covariates, residual variances, and nonsignificant paths are omitted in the figure to keep it concise (see Figure A3 in the Appendix, for a more detailed diagram); * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 2
Total effects, direct effects, and indirect effects of key predictors.

Path	Standardized estimate	SE	Z	BC Bootstrap 95% CI
<i>Total effects</i>				
FCR → IA	-0.26	0.05	-5.52***	-0.34, -0.28
MCR → IA	0.09	0.05	1.78	0.00, 0.17
TSR → IA	-0.06	0.05	-1.15	-0.14, 0.02
SSR → IA	-0.04	0.05	-0.98	-0.11, 0.03
<i>Direct effects</i>				
FCR → IA	-0.18	0.05	-3.98***	-0.26, -0.11
MCR → IA	0.14	0.05	2.78**	0.06, 0.22
TSR → IA	-0.05	0.05	-1.04	-0.13, 0.03
SSR → IA	0.00	0.05	0.08	-0.07, 0.08
<i>Total indirect effects</i>				
FCR → IA	-0.08	0.02	-4.93***	-0.11, -0.06
MCR → IA	-0.05	0.01	-3.26**	-0.07, -0.02
TSR → IA	-0.01	0.01	-0.43	-0.03, 0.02
SSR → IA	-0.05	0.01	-3.45***	-0.07, -0.03
<i>Specific indirect effects</i>				
FCR → LS → IA	-0.05	0.01	-3.54***	-0.07, -0.03
FCR → LM → IA	-0.03	0.01	-2.69**	-0.06, -0.02
MCR → LS → IA	-0.03	0.01	-2.90**	-0.06, -0.02
MCR → LM → IA	-0.01	0.01	-1.66	-0.03, -0.00
TSR → LS → IA	-0.01	0.01	-0.66	-0.02, 0.01
TSR → LM → IA	0.00	0.01	0.08	-0.01, 0.01
SSR → LS → IA	-0.03	0.01	-2.38*	-0.05, -0.01
SSR → LM → IA	-0.02	0.01	-2.59*	-0.04, -0.01

Note. FCR, father-child relationship; MCR, mother-child relationship; TSR, teacher-student relationship; SSR, student-student relationship; IA, Internet addiction; LS, life satisfaction; LM, life meaning; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

($\chi^2/df = 3.36$, CFI = 0.98, TLI = 0.97, RMSEA = 0.04, SRMR = 0.04), it implies a good model fit of M1 (Maslowsky et al., 2015). The interactions accounted for 1.4% of the variance in IA. The results for the covariates in the latent moderation model showed that age could negatively predict IA (Estimate = -0.09, $Z = -2.65$, $p < 0.01$), while

other covariates were not significant.

As shown in Fig. 2, father-child relationship was significantly and negatively associated with IA (Estimate = -0.13, $Z = -3.54$, $p < 0.001$). Moderating effects of life satisfaction and life meaning on the link between father-child relationship and IA were significant while in opposite directions. Although both life satisfaction (Estimate = -0.19, $Z = -4.38$, $p < 0.001$) and life meaning (Estimate = -0.11, $Z = -2.91$, $p < 0.01$) were negatively associated with IA, life satisfaction could enhance the negative link between father-child relationship and IA, whereas life meaning mitigates the relation. The results of simple slope analyses are shown in Table 3 and Figs. 3 and 4. Cohen's d for each simple slope was estimated (Gaudreau et al., 2016). Father-child relationship was significantly and negatively associated with IA when life satisfaction was high (+1 SD) (Estimate = -0.29, $Z = -4.15$, $p < 0.001$, $d = -0.395$), whereas the link was not significant when life satisfaction was low (-1 SD) (Estimate = -0.00, $Z = -0.05$, $p > 0.05$, $d = -0.004$). Meanwhile, father-child relationship was significantly and negatively related to IA among the participants with low (-1 SD) life meaning (Estimate = -0.29, $Z = -3.48$, $p < 0.001$, $d = -0.398$) but not among those who had high (+1 SD) life meaning (Estimate = -0.00, $Z = -0.01$, $p > 0.05$, $d = -0.001$).

4. Discussion

4.1. Total and direct effects

Father-child relationship was found to be the most prominent protective social relationship against IA among the four social relationships in the present study, and the total effects of other social relationships (mother-child, father-child, teacher-student, and student-student relationships) were nonsignificant. Such a finding supports our Hypothesis 1a but does not support Hypothesis 1b to 1d.

The more important role of father-child relationship than mother-child relationship in adolescent IA is inconsistent with some previous studies, which reported that mothers exert a greater influence on adolescent IA than fathers (e.g., Xu et al., 2014). The present finding also seems to contradict Attachment Theory, which emphasizes mothers' unique role in offspring's development (see Dagan & Sagi-Schwartz,

Table 3
Simple slope analyses.

Moderator	Level	Simple slope				Contrast (High – Low)			
		Standardized estimate	SE	Z	95%CI	Standardized estimate	SE	Z	95%CI
Life satisfaction	Low	-0.00	0.06	-0.05	-0.10, 0.09	-0.28	0.10	-2.96**	-0.44, -0.13
	High	-0.29	0.07	-4.15***	-0.40, -0.17				
Life meaning	Low	-0.29	0.08	-3.48***	-0.42, -0.15	0.29	0.12	2.46*	0.10, 0.48
	High	-0.00	0.07	-0.01	-0.10, 0.10				

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

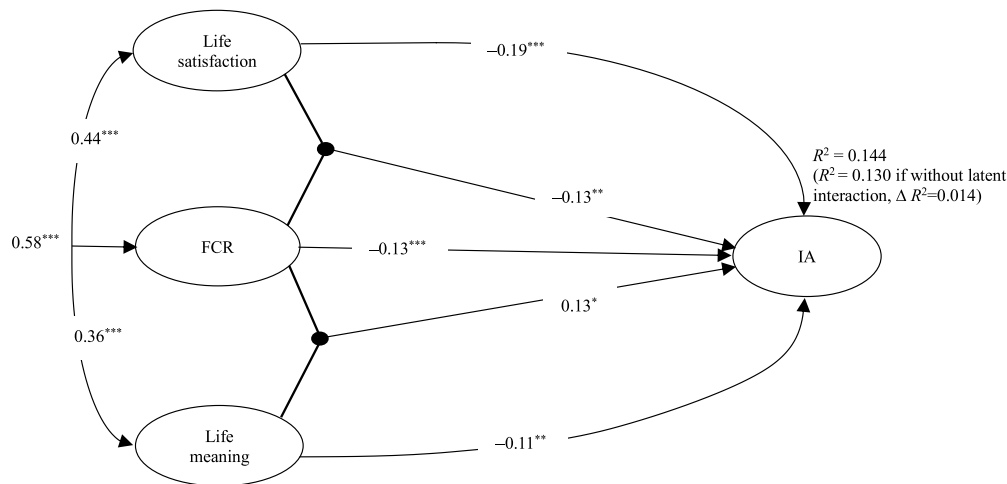


Fig. 2. Simplified representation of the latent moderation model. $-2 \log$ likelihood = 60517.02; the black circles “●” represent the latent interactive terms of father-child relationship \times life satisfaction and father-child relationship \times life meaning, respectively; controlling for gender, age, one-child status, family intactness, family economic status, and parental education; FCR, father-child relationship; IA, Internet addiction; observed variables, covariates, and residual variances are omitted in the figure (see Figure A4 in the Appendix, for a more detailed diagram); * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

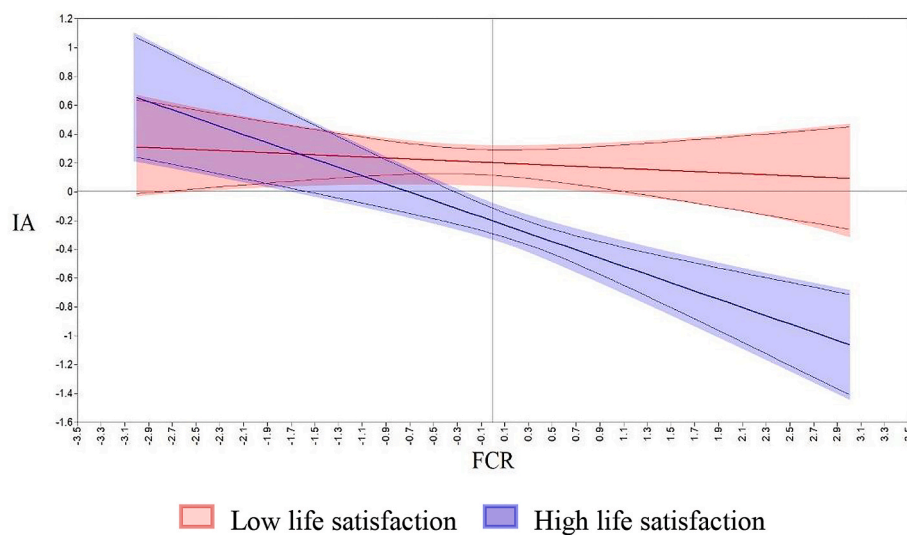


Fig. 3. Interaction between FCR and life satisfaction predicting IA. FCR, father-child relationship, IA, Internet addiction.

2018). However, such a finding is compatible with Su et al. (2018), in which father-child relationship played a more important role than mother-child relationship in the association between parental monitoring and Internet gaming disorder. Our finding can also mesh with some previous studies suggesting that paternal parenting plays a more salient role in adolescent externalizing problems than maternal parenting (Fosco et al., 2012; Hoeve et al., 2009). One possible explanation is that although mothers are generally involved more in rearing

the child, including education, communication, and caregiving, fathers might engage more actively in children’s leisure activities, guidance, and giving advice (Su et al., 2018; Videon, 2005). Positive relationships with fathers may help adolescents internalize their fathers’ guidance and advice and lead adolescents to more meaningful activities, thus undermining the risk of IA. This explanation is also supported by our mediation analyses (which will be discussed later).

Although the total effect of mother-child relationship was not

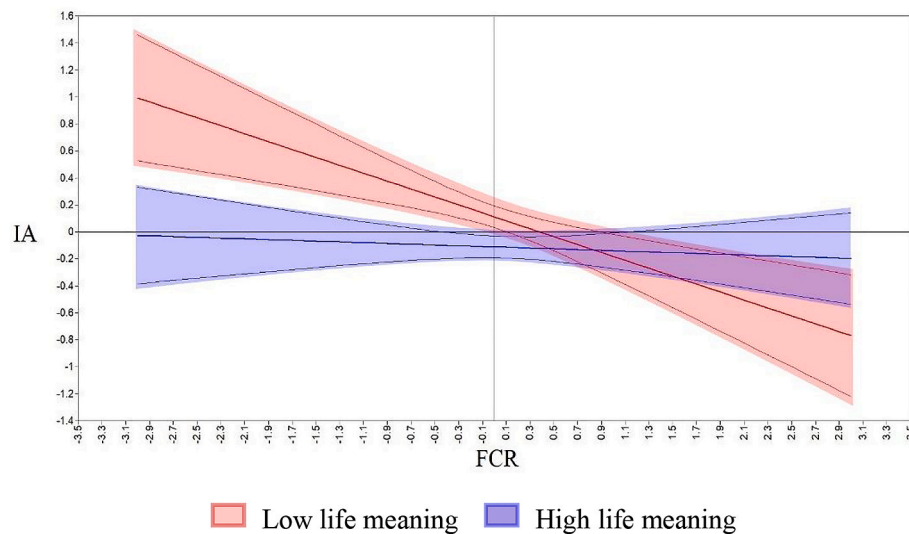


Fig. 4. Interaction between FCR and life meaning predicting IA. FCR, father-child relationship, IA, Internet addiction.

significant, the positive and significant direct effect of mother-child relationship on IA found in this research indicates that adolescents' good relationships with mothers are related to higher levels of IA. This seems contradictory to our prediction based on existent theories, especially Attachment Theory. A good mother-child relationship, often linked with the child's secure attachment, is generally beneficial for child development. However, a nuanced understanding drawing on the notion of "enmeshment" in family systems theories posits that overly close and undifferentiated relationships in the family are likely to cause identity issues and maladjustment among children (see Leung et al., 2021). Specifically, a close mother-child relationship may become enmeshed in some cases, as mothers can be more overly protective and involved than fathers (Holmbeck et al., 2002). This over-involvement may lead to adolescents' lack of autonomy and overdependence (see van Petegem et al., 2020), possibly driving them to use Internet to compensate for repressed individuality (e.g., resorting to a virtual identity on social media). This may be particularly the case for the present Chinese adolescent sample, given Confucian culture's emphasis on family connectedness, which may foster enmeshment. Further, a "good" relationship with the mother might relate to a higher risk of indulgence in some contexts, as mothers, expected to be more emotionally available, may meet children's needs more than fathers do, including indulgence (Clarke et al., 2014; Cui et al., 2019). So, a mother's provision of more Internet access, aimed at keeping the relationship "good," could heighten the risk of excessive Internet use in adolescents. Certainly, these explanations still need further examination.

The nonsignificant findings for teacher-student and student-student relationships contrast our predictions based on social control and support from teachers and peers. They are also inconsistent with some prior findings (Shi et al., 2022; Sun et al., 2020). This might be because stronger ties (e.g., father-child relationship) may provide more noticeable support and control, overshadowing adolescents' more transient relationships with teachers and peers. However, these prior studies did not examine multiple social relationships, perhaps allowing weaker ties' effects to be less overshadowed. Furthermore, peer influences could be complex. While positive student-student relationships generally fulfill socio-emotional needs, close ties with problematic peers (e.g., Internet-addicted peers) might offset these benefits (Li et al., 2016).

4.2. Mediation and suppression effects of life satisfaction and life meaning

Both life satisfaction and life meaning significantly mediated the association between father-child relationship and IA. That is, a good

father-child relationship predicted higher levels of life satisfaction and life meaning, which further undermined IA. This finding supports Hypothesis 2a based on our theoretical analyses of the twofold roles of positive social relationships in promoting well-being and the joint protective role of the two aspects of well-being against IA (as previously discussed in Section 1.2 in the Introduction). Besides, the nonsignificant difference between the mediation roles of the two constructs implies that the two well-being indicators serve as equally important mediation mechanisms between father-child relationship and IA.

In contrast, mother-child relationship was indirectly related to IA through the suppression effect of life satisfaction (but not life meaning), partially consistent with our Hypothesis 2b and supporting the prediction of Attachment Theory. Specifically, having a good relationship with the primary caregiver facilitates child attachment security, thereby fostering child life satisfaction. Meanwhile, enhanced life satisfaction, in turn, inhibits IA, counteracting the potentially adverse direct effect of mother-child relationship on IA. The mutual offset of suppression and direct effects resulted in the null total effect. However, mother-child relationship might not contribute to adolescent life meaning as did father-child relationship. This result supports the aforementioned conjecture explaining the more significant role of father-child relationship than mother-child relationship in adolescent IA— fathers may be more likely to lead adolescents to meaningful activities because they engage more actively in adolescents' leisure activities, guidance, and giving advice, compared with mothers who engage more in caregiving and emotional support (Su et al., 2018; Videon, 2005).

Neither life satisfaction nor life meaning mediated the link between teacher-student relationship and IA, contrary to Hypothesis 2c. This may be because teachers primarily focus on students' academic development, especially in Chinese senior high schools where "gaokao" (university entrance examination) is the top priority (Ye et al., 2019); teachers may overlook students' psychological needs, thus becoming less influential on adolescent life satisfaction and life meaning.

Regarding student-student relationship, although the total effect was nonsignificant, it was significantly linked to both higher life satisfaction and life meaning, which, in turn, correlated with lower IA. This finding supports Hypothesis 2d. As mediation effects can occur even without significant total effects (Hayes, 2009; Shrout & Bolger, 2002), we believe the mediating mechanisms are still meaningful. That is, positive peer relationships fulfill the relatedness need and provide social support, enhancing life satisfaction. Meanwhile, belonging to peer groups may allow individuals to gain a sense of transcending self and collective purposes (Lambert et al., 2013), facilitating meaning in life. Both subsequently reduce IA risk. On the other hand, the potentially adverse

influences of deviant peers could offset the protective effects of life satisfaction and life meaning derived from positive peer relationships, leading to a nonsignificant total effect.

4.3. Moderation effects of life satisfaction and life meaning

The link between father-child relationship and IA could be moderated by both life satisfaction and life meaning but in opposite directions, partially supporting Hypothesis 3a. However, neither of them could significantly moderate other links, unresponsive of Hypothesis 3b to 3d. What should be acknowledged is that despite the significant results, there was only a small proportion of variance (1.4%) in IA explained by the interaction terms. Hence, the findings should be interpreted with caution. Nevertheless, small moderation effects are not uncommon in social/behavioral sciences (e.g., Ma et al., 2021; Xie et al., 2018; Xu & Chan, 2016). In addition, simple slope analyses in the present study revealed distinct associations between the father-child relationship and IA with different levels (high vs. low) of life meaning or life satisfaction. Thus, we consider the finding meaningful and put forward possible explanations for the significant results before discussing the reason for the weak effects.

First, life satisfaction enhanced the strength of the negative link between father-child relationship and IA, suggesting positive father-child relationship's protective effect against IA is more potent when life satisfaction is high. This finding aligns with our prediction based on the Stress and Coping Theory, Broaden-and-Build Theory, and Protective-Protective Model (in Section 1.3). However, our result diverges from a previous study (Qiu et al., 2022), where the direct link between parent-child relationships and IA was not moderated by life satisfaction. This may be because Qiu et al. (2022) examined parent-child relationships as a singular variable without differentiating father-child and mother-child relationships, which might perturb their result since the moderating effect might be only significant for father-child relationship as found in this study. This highlights the importance of examining father-child and mother-child relationships separately in future research.

Second, life meaning weakened the negative link between father-child relationship and IA; namely, compared with adolescents who feel meaningful in their lives, the IA levels of those who feel meaningless depend more on their relationships with fathers. Such a result is quite unexpected based on the logic of the Protective-Protective Model, while it implies that the moderation mechanism of life meaning, as the eudaimonic aspect of well-being, might be profoundly different from life satisfaction, a hedonic well-being indicator. Specifically, unlike "feeling good," which serves to add an "extra layer" of positive impact over a positive father-child relationship, "feeling meaningful" makes adolescents independent from the impacts of their relationships with fathers. This might be explained by an existential concept, "authenticity," that refers to living in accordance with one's authentic self, values, and purposes, rather than conforming to social expectations or external pressures (Jacobsen, 2007; Macquarrie, 1972). Existential theories posit authenticity as a crucial component of a meaningful life (see Schlegel et al., 2009). Therefore, one explanation of our finding is that children usually make sense of themselves and the world depending on their parents, as their "authenticity" has not been well-established, whereas when they have constructed their own life meanings, values, and purposes and act with greater agency, they will make sense of themselves and the world more independently. As a result, parents (e.g., fathers) become less influential in their lives.

However, given the small moderation effects, more empirical evidence is needed to validate the above explanations. One possible reason for the small moderation effects is that the link between father-child relationship and IA is relatively salient across conditions, which makes it difficult to be altered to a large extent by the moderators. Besides, life satisfaction and life meaning may serve as protective factors mainly in terms of directly reducing the risk of IA but not in the form of buffering

the negative impact of the unfavorable father-child relationship on IA. Nevertheless, more studies are warranted to further test these possibilities.

5. Implications, limitations, and future research

This research provides a broader perspective for understating the link between social relationships and IA in both family and school contexts. The differential roles of the four dyads of social relationships highlight the importance of examining multiple social relationships simultaneously. By comparing the effects of social relationships in family and school contexts, our findings support the viewpoint that adolescents' decreased dependence on parents does not mean a less important role of parents (than someone else) in adolescent development, and parents continue to be influential on adolescent outcomes (which even extends into young adulthood) (Laible et al., 2004). Furthermore, our findings highlight the prominent role of father-child relationship. Nevertheless, parenting studies focus more on mothers or parents in general rather than fathers specifically (Cabrera et al., 2018). Evidence increasingly highlights the essential role of fathers in child development (Lansford et al., 2014; Li & Lamb, 2015; Liu et al., 2013; Su et al., 2018). Thus, there is a call for extensive exploration of the paternal role in adolescent development, especially in the development of adolescent behavior issues regarding Internet use. Future parenting and family theories can pay more attention to the importance of fathers.

Introducing two concepts, namely "compensatory priority" and "suitability," to the Compensatory Internet Use hypothesis may also help understand the differential importance of the four social relationships in predicting IA. Compensatory priority denotes the extent to which a relationship is prioritized to be compensated, while compensatory suitability reflects how suitable a relationship is for compensation via the Internet. Father-child and mother-child relationships might be high in compensatory priority due to their importance, while they may differ in compensatory suitability. The paternal role, often associated with leisure activities and guidance (Su et al., 2018), seems more compensable via the Internet, which offers similar services (e.g., streaming media, search engines). In contrast, the role of mothers who often serve as the primary caregivers, engage more deeply in fulfilling attachment needs, emotional support, and care (Videon, 2005), may be less suitably compensated by the Internet. Therefore, a dysfunctional father-child relationship may show a stronger link to IA due to its potentially higher compensatory suitability. Meanwhile, teacher-student and student-student relationships might be relatively low in compensatory priority. Thus, a weaker link to IA does not necessarily mean a relationship is unimportant, yet the suitability for compensation via the Internet should be considered. This analytical framework can also be applied to understanding other risk and protective factors of IA, which certainly needs further validation in future research.

In addition, the findings regarding the direct effect and suppression effect for mother-child relationship might be attributable to the notions of enmeshment and attachment, respectively (see Section 4.1), implying a theoretical possibility of integrating enmeshment into Attachment Theory. Future parenting or family research can further explore this direction. For example, future research on IA can investigate the role of enmeshment directly while investigating predictors of IA based on Attachment Theory.

Our findings regarding life meaning and life satisfaction support the current consensual opinion that both hedonic and eudaimonic well-being are indispensable in individuals' lives (Huta, 2016). Besides, we attribute the discrepant mediating effects of the two constructs for mother-child relationship to the role of mothers in a family (as discussed in Section 4.2). However, it is important to be aware that this phenomenon may be culturally constructed. That is, the role of mothers might be influenced by societal expectations regarding women in the family context (Ciaccio et al., 2021). Thus, the observed patterns of mediation mechanisms in the link between mother-child relationship

and IA may vary across different cultural settings, which can be examined in cross-cultural studies in the future.

The opposite directions of the moderating effects for father-child relationship support the idea that hedonic and eudaimonic approaches to well-being are based on distinct psychological processes even though they are highly inter-correlated (Huta, 2016). Our finding extends this idea by showing that the two “distinct psychological processes” might also function differently. Our finding also supplements the Protective-Protective Model by showing that one protective factor does not necessarily enhance the effect of another protective factor. We suggest that an alternative “Protective-Competitive Model,” positing that one protective factor may overshadow the effect of another, can be explored in the future. Replications of the current novel finding are also needed in the future, especially concerning that it is still unclear why the moderating effects exclusively operated on father-child relationship (but not on other social relationships). Future research can further examine the moderating effects of both life satisfaction and life meaning, as well as other indicators of well-being, on the links between other social relationships and IA, providing possible explanations for this phenomenon.

Our findings suggest that practitioners should consider the crucial role of fathers in preventing or intervening in adolescent IA. This is particularly important since the focus might have traditionally been on mothers due to their well-established significance in child development. Furthermore, the unique moderating role of life meaning indicates that interventions fostering a sense of meaning in life, such as existential therapies, may be beneficial in treating IA among adolescents, particularly among those with poor father-child relationships. This approach may help mitigate the impact of poor father-child relationship while directly addressing IA itself.

The present study has several limitations. First, it only focused on generalized IA. Some studies emphasized the importance of differentiating different forms of IA based on specific activity types on the Internet (see Pan et al., 2020), such as Internet gaming and social media addiction. Future research should examine these specific forms to validate our findings. Second, although Young’s IAT is a commonly used measure for generalized IA, there is a lack of consensual diagnostic criteria based on this measure. Thus, we considered IA as a general condition and only investigated it among general adolescents (as did some previous studies, e.g., Toth-Kiraly et al., 2021), limiting the applicability of our findings in developing treatment strategies among clinical samples. Future studies can adopt validated clinical diagnoses and include clinical samples. Third, it involved only senior high school students, limiting the generalizability to different age groups. For example, the prominent role of fathers (versus mothers) may be stage-specific, as the maternal role in child-rearing is likely diminishing during adolescence compared to earlier stages. Similarly, the significance of out-family relationships might increase if we investigate older individuals who engage more in

college or workplace relationships. Future research can explore these dynamics across different age groups. Fourth, we generally assessed adolescents’ social relationships without delving into specific aspects of these relationships, such as attachment and overprotection. Consequently, our explanations for some novel findings were based on assumptions and previous studies. Future research can consider a more specific examination of interpersonal relationships to substantiate our explanations. Fifth, we used life satisfaction and life meaning to represent the two aspects of well-being. However, there have been multiple conceptualizations for these constructs (e.g., balance of positive and negative emotions for hedonic well-being). Future studies can employ multiple assessments for these constructs. Sixth, the relatively large sample size may inflate the significance of some findings. Future studies should aim to replicate these effects for more definitive conclusions. Last, the cross-sectional design of our study limits causal inferences and prevents the identification of developmental trajectories. Future research can utilize longitudinal design to explore causal relationships among and developmental patterns of the variables.

Author contribution statement

KZ: Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing. XZ: Conceptualization, Methodology, Writing - review & editing, Supervision, Funding acquisition. BC: Writing - review & editing. All authors read and approved the final manuscript.

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Ethical statement

This study received approval from the Institutional Review Board (IRB) at the corresponding author’s university (HSEARS20210526004), and written consent was obtained from the schools, student participants, and their parents.

Declaration of competing interest

The authors declare no competing interests with respect to the research, authorship, and/or publication of this article.

Data availability

Data will be made available on request.

Appendix

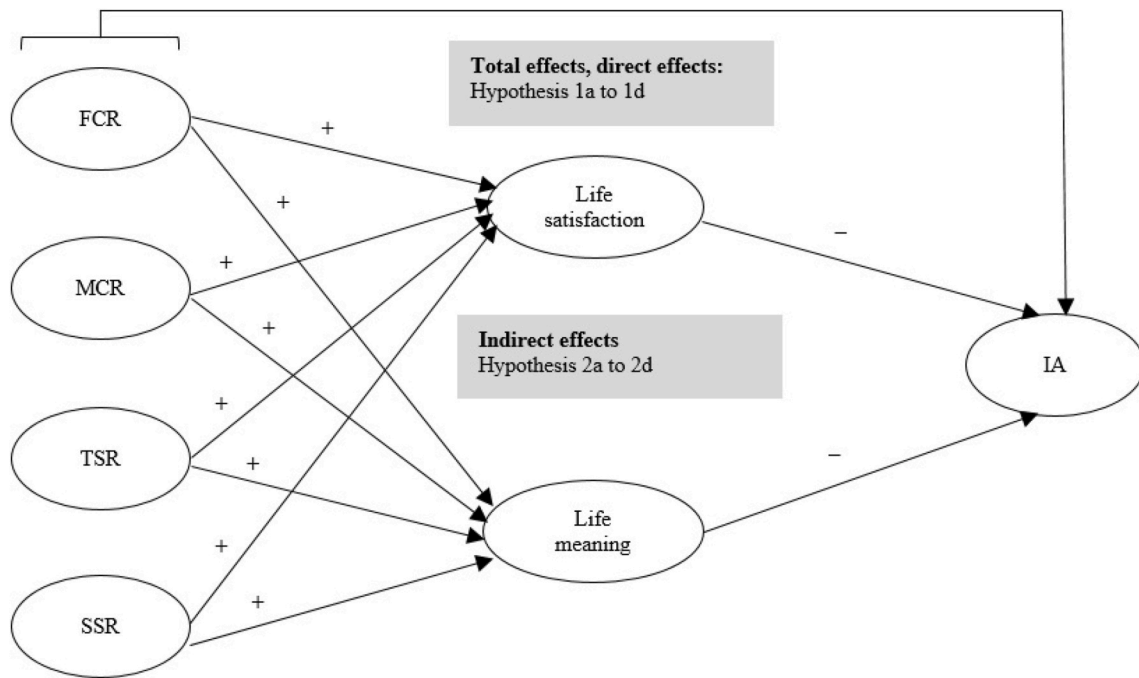


Fig. A1. Hypothesized paths in the mediation model. FCR, father-child relationship; MCR, mother-child relationship; TSR, teacher-student relationship; SSR, student-student relationship; IA, Internet addiction.

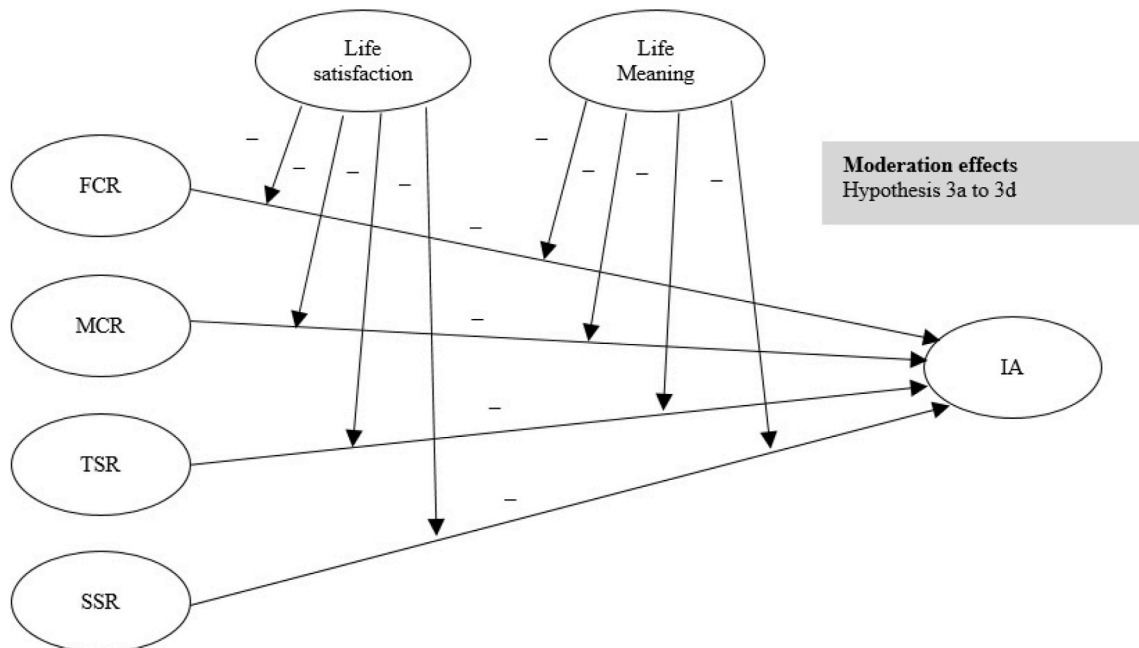


Fig. A2. Hypothesized paths in the mediation model. FCR, father-child relationship; MCR, mother-child relationship; TSR, teacher-student relationship; SSR, student-student relationship; IA, Internet addiction.

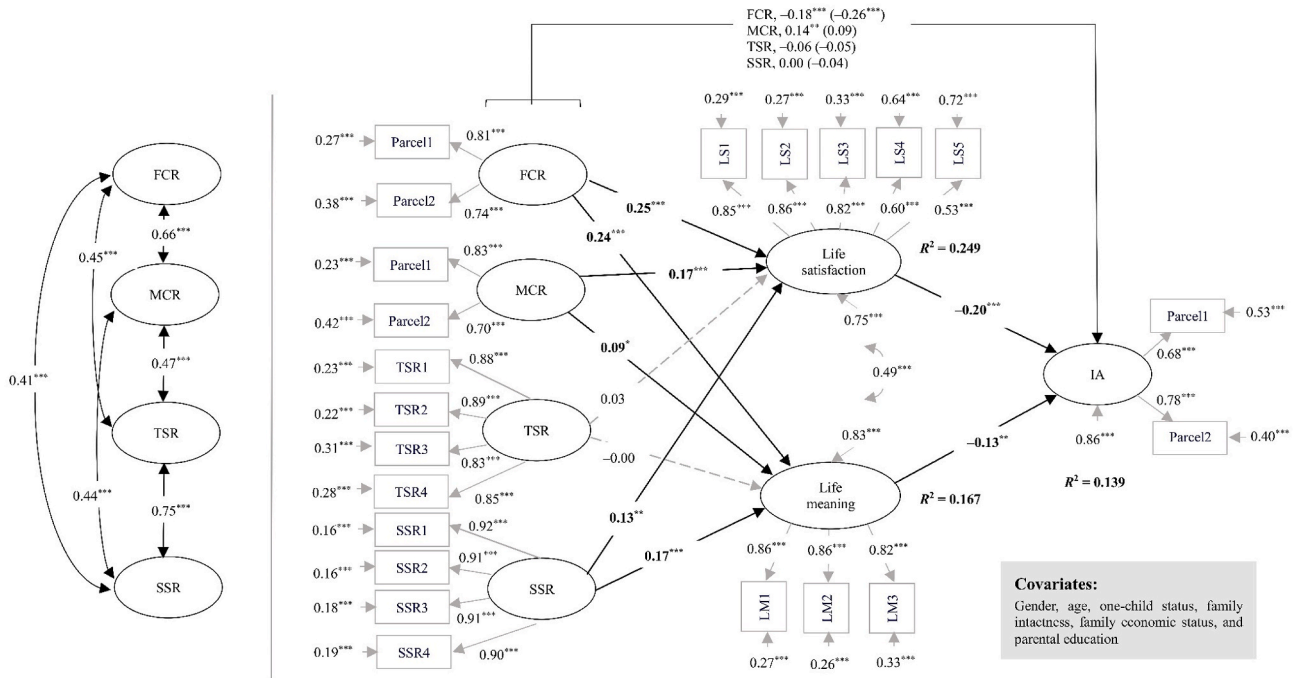


Fig. A3. Detailed representation of the latent mediation model. Controlling for gender, age, one-child status, family intactness, family economic status, and parental education; FCR, father-child relationship; MCR, mother-child relationship; TSR, teacher-student relationship; SSR, student-student relationship; IA, Internet addiction; TSR1 to TSR4, items for teacher-student relationship; SSR1 to SSR4, items for student-student relationship; LS1 to LS5, items for life satisfaction; LM1 to LM3, items for life meaning; the paths from covariates are omitted in the figure; corrections among the four social relationships are displayed separately in the left of the figure; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

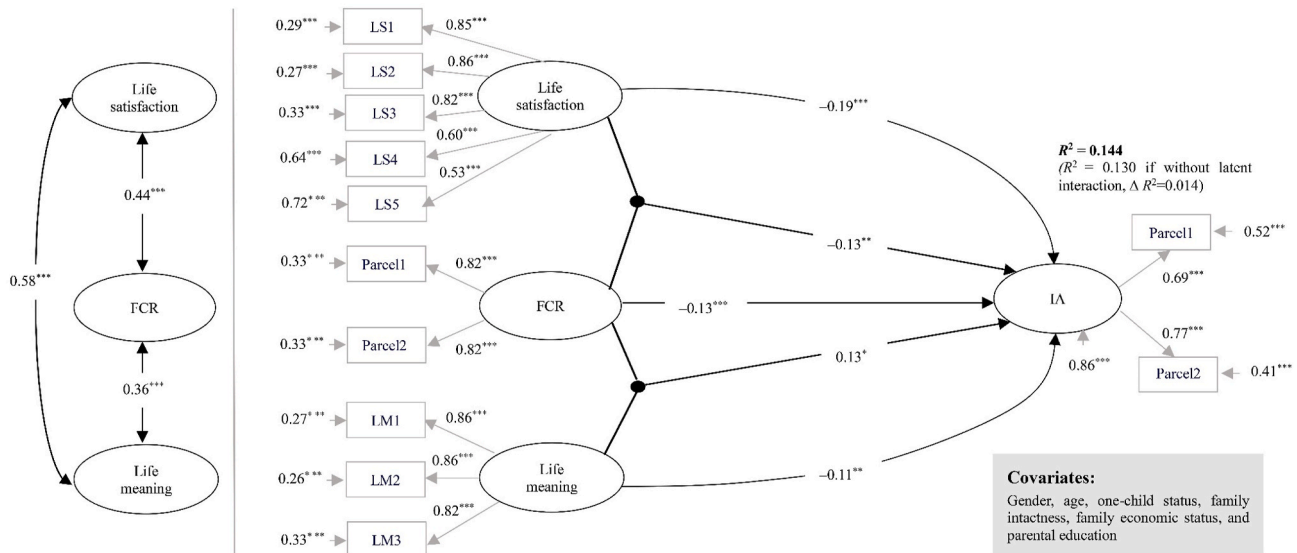


Fig. A4. Detailed representation of the latent mediation model. The black circles “●” represent the latent interactive terms of father-child relationship \times life satisfaction and father-child relationship \times life meaning, respectively; latent moderation model based on LMS does not generate observed indicators for latent interactive terms; controlling for gender, age, one-child status, family intactness, family economic status, and parental education; FCR, father-child relationship; IA, Internet addiction; LS1 to LS5, items for life satisfaction; LM1 to LM3, items for life meaning; paths from covariates are omitted in the figure; corrections among father-child relationship and the moderators are displayed separately in the left of the figure * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

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