

**The effects of Attachment, Temperament and Self-Esteem on Technology Addiction: A
Mediation Model among Young Adults**

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Abstract

Objective: Excessive use of technology has become a worldwide problem due to its high prevalence, fast growth rate, and undesirable consequences. However, little is known about underlying psychological mechanisms that maintain excessive use of technology. We investigated the mediating role of self-esteem, novelty seeking and persistence on the relationship between attachment dimensions and technology addiction among young adults.

Method: Data were collected from 727 young adults ($N = 478$; 66.3% female), aged 23.44 ± 3.02 years. Participants completed self-report measures of secure and insecure attachment dimensions, personality, and temperament characteristics (i.e., self-esteem, novelty seeking and persistence), technology addiction and frequency of technology use use (i.e., own technology use, perceived use by peers and parents). The mediation model was tested through a path analysis.

Results: The effects of attachment insecurity on technology addiction were partially mediated by the levels of persistence and self-esteem, whereas the effects of attachment security on technology addiction were fully mediated. The effects remained robust even after controlling for the frequency of technology use. The model was gender and age invariant, suggesting that the mediation worked in a similar way for both men and women and across age.

Conclusion: Findings suggest that attachment dimensions exert not only a direct but also an indirect effect on technology addiction through self-esteem and persistence. Such findings may help to develop psychosocial interventions that are sensitive to young adults' dysfunctional attachment, personality, and temperament characteristics.

Keywords: Attachment, Temperament, Personality, Technology Addiction, Frequency of Technology Use

Highlights

- We explored the underlying mechanisms associated with technology addiction.
- Results showed different associations between attachment and technology addiction.
- Self-esteem and perseverance were significant mediators.
- Frequency of technology use was related to a greater technology addiction.
- The mediation model showed similar patterns across male and female young adults.

1. Introduction

To date, 59.5% of the world population use the Internet and 92.6% access cyberspace from mobile devices.¹ Despite being useful and sometimes indispensable tools, excessive use of information technologies² can become problematic and turn into “technology addiction”, a form of behavioural addiction of human-machine interactions characterized by a person’s inability to self-regulate the use of technology (including Internet, Smartphone or Social Media).³

According to the Interactional Theory of Childhood Problematic Media Use (IT-CPU),⁴ both distal and proximal factors contribute to the development of technology addiction. Distal factors are early risk factors for individuals’ technology addiction, such as sociodemographic factors (i.e., gender and age). Proximal factors refer instead to those factors which, in concert with their impacts on distal factors, contribute to the maintenance of technology addiction, such as psychobiological factors (i.e., self-esteem, temperament, attachment dimensions) and internet use factors (i.e., time spent online).⁵

For instance, men seem to focus more on online contents that emphasize their skills, women focus more on aspects of social connection, and technology addiction manifests predominantly during adolescence.⁶ Previous studies found that higher frequency of technology use was associated with higher technology addiction.^{7,8} The empirical evidence also showed that higher frequency of technology use by parents and peers is linked to higher levels of technology addiction among young adults.^{9,10}

Several studies have examined the association between attachment dimensions and technology addiction.^{11,12} Attachment refers to mental representation of self and others that develop from repeated interactions that occur between an infant and caregivers that are internalized.¹³ An attachment bond develops with the caregiver and shapes a set of cognitive-affective schemas or templates for affect regulation and future relationships with friends and

romantic partners.^{14, 15} Securely attached individuals tend to have a greater sense of worthiness and self confidence which in turn lead to greater psychological wellbeing.¹⁶ In contrast, individuals with an insecure attachment tend to be at higher risk of developing internalizing problems, such as low self-esteem, or externalizing problems, such as high impulsivity and technology addiction that lead to lower wellbeing.^{12, 17}

Brennan, Clark and Shaver¹⁸ suggested that insecure attachment is best conceptualised as two distinct dimensions: attachment anxiety and attachment avoidance. Attachment anxiety is characterised by fear of rejection and abandonment and by doubts about self-worth.¹⁹ Attachment avoidance is characterized by emotional distancing as well as a sense of self-sufficiency motivated by discomfort with interpersonal closeness and interdependence.²⁰ Existing literature supports the predictive role of secure and insecure attachment in technology addiction, suggesting that young adults characterised by an insecure attachment are more inclined to use technologies to compensate for their attachment needs in comparison to securely attached individuals.²¹ Eichenberg and colleagues²² further supported this hypothesis, proposing that individuals with insecure attachment exhibit a more prominent tendency for pathological internet use than those with a secure attachment. Conversely, a recent study found that insecure attachment dimensions were not directly associated with technology addiction but instead indirectly related through a range of risk factors, including psychological distress, impulsivity, and alexithymia mediated this relationship.¹²

Temperament characteristics, such as novelty seeking (the tendency to seek out new experiences, thrills, and excitement), and lack of persistence (difficulties in maintaining attention and directing behaviours towards an objective despite frustration and fatigue) seem to increase vulnerability to developing addiction to technology.^{23, 24} Previous studies indicated that the type of attachment has no effect on how temperament develops because temperament is considered an innate construct that remains relatively stable throughout life.²⁵

However, others indicate that the way in which security or insecurity of attachment is expressed, partially reflects aspects of temperament.²⁶ For instance, according to Goldsmith and Campos,²⁷ factors related to social context, such as the type of attachment, control the expression of temperament characteristics.

Self-esteem, an evaluation of self-concept or what individuals think of themselves, is reported to be one the most significant determinant of technology addiction. Self-esteem is also related to attachment dimensions.^{28, 29} For example, a recent meta-analysis by Harris and Orth²⁸ found that securely attached children develop a positive and worthy concept of the self, while children with an insecure attachment are more prone to develop feelings of worthlessness and excessively use technologies to express themselves without fears of being judged.

Despite the growing number of studies on the topic, most of the previous research evaluated the prevalence of technology addiction and its predictors in adolescent samples and only very few studies investigated the mechanisms underlying technology addiction among young adults. Therefore, the present study examined the roles of self-esteem, novelty seeking and persistence to mediate the association between attachment dimensions and technology addiction in a sample of Italian young adults. Since secure and insecure attachment dimensions are related to technology addiction, and given that self-esteem, novelty seeking and persistence are related to both attachment dimensions and technology addiction, we hypothesized that: (1) secure attachment will result in greater levels and insecure attachment dimensions will result in lower levels of technology addiction and that (2) these relationships will be mediated by levels of self-esteem, novelty seeking and persistence. Since young adults' technology addiction not only seem to be related to higher frequency of one's own use of technology, but also to higher frequency of technology use by parents and peers, we hypothesized that (3) higher frequency of technology use by participants, and perceived

frequency of technology use by peers and parents would be positively associated with higher technology addiction. Finally, because age and gender are well-known risk factors in the development of technology addiction, we additionally tested invariance of the structural model for both men vs women and for younger vs older participants.

2. Method

2.1 Participants

A total of 727 young adults (female $N = 478$, 66.3%; mean age 23.44 ± 3.02 years) volunteered for this cross-sectional study. Of the participants, 426 were high-school or university students (42.9%) and 401 had a high-school degree (40.93). Half of the sample was engaged or married ($N = 364$; 50.6%), most were living with their parents ($N = 580$; 79.8%), resided in northern Italy ($N = 514$, 72.4%) and reported a middle-to-high family income ($v = 347$; 47.9%). Inclusion criteria were age between 18 and 30 years and being a native Italian speaker.

2.2 Procedure

Cross-sectional data were collected from November to April 2021. Questionnaires were administered via an anonymous web-based survey through a snowball sampling procedure, starting from friends and relatives of undergraduate students attending University of Bergamo, and via online in-class test administration of students registered at high schools in the city of Rome. Completion time of questionnaires was approximately 40 minutes.

The study was conducted in accordance with ethical standards for the treatment of human experimental volunteers and was approved by the ethics committee of the University of Bergamo. All participants provided informed consent prior to participation.

2.3 Measures

Attachment Dimensions. The Experiences in Close Relationships-12 (ICR-12)^{30, 31} is a 12-item self-report measure of attachment to romantic partners. The ECR-12 measures two

dimensions of attachment to romantic partners, namely attachment avoidance (6 items) and attachment anxiety (6 items). The Short-Form Inventory of Parent and Peer Attachment (S-IPPA)^{32, 33} is a self-report measure of attachment to parents and peers. For the purposes of the present study, we selected the dimension of secure attachment to peers, composed of 12-items.

Internet Addiction. The Internet Addiction Test (IAT)^{34, 35} is a 20-item self-report questionnaire that examines the degree of preoccupation, compulsive use, behavioural problems, emotional changes, and impact on life related to internet usage.

Problematic Internet Use. The Generalized Problematic Internet Use Scale 2 (GPIUS2)^{36, 37} is a 15-item self-report measure. The GPIUS2 operationalizes problematic internet use by measuring five constructs: preference for online social interaction; mood regulation; cognitive preoccupation; compulsive internet use; and negative outcomes.

Social Media Addiction. The Bergen Social Media Addiction Scale (BSMAS)^{38, 39} is a 6-item self-report measure that assess six core addiction elements (salience, mood modification, tolerance, withdrawal, conflict, and relapse)^{40, 41} related to the experience of using social media over the last year.

Novelty Seeking and Persistence. The Temperament Character Inventory-Revised (TCI-R)^{40, 41} is a measure of temperament and character, which contains 240 items. In the present study, only 26 items, measuring the temperament dimension of novelty seeking and persistence, were used.

Self-Esteem. The Rosenberg Self-Esteem Scale (RSES)^{42, 43} is a 10-item self-report questionnaire that assess the global self-esteem and self-worth, considering the extent to which the subject feels to possess good qualities, to accept one's own characteristics, and to possess a positive evaluation of the self.

Frequency of Technology Use. The own frequency of technology use, and the perceived frequency of use by peers and parents during the previous seven days were assessed through *ad-hoc* Likert-type questions. Each question evaluated frequency of use of different technologies (i.e., smartphones, laptops, tablets, and smartwatches).

2.4 Statistical Analysis

We tested the hypothesized mediation model by using path analyses with both observed and latent (i.e., frequency of technology use and technology addiction) variables. The indicators of the latent variable “frequency of technology use” were the own frequency and the perceived frequency of technology use by peers and parents, while the indicators of the latent variable “technology addiction” were the IAT, GPIUS2 and BSMAS total scores.

Parameter estimates were computed using a maximum likelihood estimation method, while an optimal model fit was evaluated using the following criteria: a root mean square error of approximation (RMSEA) of 0.05 or less, an upper RMSEA’s 90% confidence interval bound of 0.08 or less, a comparative fit index (CFI) and a Tucker-Lewis index (TLI) of 0.95 or more, and a standardized root mean squared residual (SRMR) of 0.05 or less.

We initially tested for the relationship between attachment dimensions and the proposed mediators, then those between attachment dimensions and technology addiction and finally the relationship between personality factors and technology addiction. As a second step we examined the mediating role of novelty seeking, persistence and self-esteem on the association between attachment and technology addiction (see Figure 1 for a graphical depiction of the model). The magnitude of all direct paths was interpreted according to guidelines ($\geq .10$, small; $\geq .30$ medium; $\geq .50$ large).⁴⁴

The standardized indirect (i.e., mediated) effects and their standard errors were computed using a bootstrap procedure, saving parameter estimates drawn from 10,000 bootstrap samples. If the 95% confidence intervals (CI) of these estimates do not include

zero, then the indirect effect is statistically significant at the .05 level.⁴⁵ We reported the proportion mediated (P_M , or the ratio between the standardized indirect effect by the standardized total effect) as a measure of effect size for each indirect effect.⁴⁶

Further, we tested for the age- (with the sample split around the median age of 23 years) and gender-invariance of the model through multi-group path analyses. As suggested by Byrne,⁴⁵ in multi-group path analyses the structural paths are initially allowed to vary freely, and then equality constraints are imposed on the structural paths across the various groups. A small or nonsignificant difference in delta changes of fit indexes or in χ^2 statistics between different models (i.e., unconstrained, and progressively constrained models) is suggestive of an invariant structural model across the groups.

Analyses were performed using Analysis of Moment Structures (AMOS) and Statistical Package for Social Sciences (SPSS) version 26.0. All statistical tests were two-tailed, and a p -value $\leq .05$ was considered statistically significant.

3. Results

3.1 Preliminary Analyses

The Cronbach's alphas of all measures were good to excellent. Data were screened to test for violations of statistical assumptions. We brought into range 4 univariate outliers in the variable "perceived frequency of technology use by peers" and 1 outlier for the "own frequency of technology use" variable.⁴⁷ Several variables were slightly to strongly skewed (i.e., IAT, GPIUS, BSPAS, RSES, ECR-12 Avoidance, IPPA Peer and own frequency of technology use) and a square-root, a log10 or an inverse transformation corrected the skewness.⁴⁷ Transformed variables were used in all analyses. We evaluated the presence of multivariate outliers and - according to Mahalanobis distance values - we identified a total of 6 cases which were removed from the analyses.⁴⁷

Means and standard deviations, Cronbach's alphas and zero-order correlation coefficients among all variables of interest of are reported in Table 1. The measurement model provided a good fit to the data, $\chi^2(8) = 10.870, p = .209$; RMSEA = 0.022 (90% CI: 0, 0.052); CFI = 0.99; TLI = 0.99; SRMR = 0.021.

3.2 Main Analyses

The mediation model with a modeled covariance between persistence and self-esteem ($r = .32, p < .001$) had a good fit to the data: $\chi^2(37) = 104,820, p < 0.001$; RMSEA = 0.050 (90% CI: 0.039 - 0.062); CFI = 0.96; TLI = 0.93; SRMR = 0.033. As shown in Figure 1 and in partial accordance with our first hypothesis, we found that only insecure attachment dimensions had significant, positive direct associations with technology addiction with trivial to small effects. Attachment Anxiety was significantly associated with novelty seeking, with small effects. All attachment dimensions had significant direct associations on both persistence and self-esteem (i.e., attachment insecurity scales were negatively associated with both variables, while attachment security was positively associated). Effect sizes were trivial to small except for that of Attachment Anxiety on self-esteem, which was medium. Both persistence and self-esteem were significantly associated with lower technology addiction with small effects. Finally, in accordance with our third hypothesis we found that the frequency of technology use was associated with a greater technology addiction with small effects. All other direct paths were not significant. All standardized betas and p -values are reported in Table 2.

Regarding the indirect effects, in partial accordance with our second hypothesis we found that psychological traits and self-esteem were significant mediators of the association between attachment and technology addiction, with trivial to small effects. That is, attachment anxiety was associated with greater technology addiction through a sequence of steps in which attachment anxiety decreased self-esteem and persistence, which in turn

decreased the levels of technology addiction. Interestingly, the effect of attachment security was fully mediated, while those of attachment insecurity were partially mediated. The indirect paths were as follows: Attachment Anxiety standardized indirect effect: .117, $p < .001$, bias corrected CI: .081, .157, $P_M = 41.6\%$; Attachment Avoidance standardized indirect effect: .039, $p = .004$; bias corrected CI: .012, .069, $P_M = 34.5\%$; Attachment Security standardized indirect effect: -.095, $p < .001$, bias corrected CI: -.067, -.130, $P_M = 73.6\%$. The mediation model explained up to 29.1% of the variance in technology addiction.

Further, we tested if our model was age- and gender-invariant through multi-group path analyses. Fits for all models were good, while the differences in CFI and χ^2 statistics between the unconstrained and the progressively constrained models (measurement weights and structural weights) were all small (< 0.001) or non-significant. That is, our proposed mediation model was invariant in respect to age and gender. Descriptive statistics, fit indices, regression weights and indirect paths for all the multi-group models -for age and gender- are reported among the supplementary materials.

4. Discussion

The present study examined the relationship between attachment dimensions and technology addiction with the mediating effects of self-esteem, novelty seeking and persistence among Italian young adults. In accordance with our second hypothesis, the effects of attachment insecurity on technology addiction were partially mediated by the levels of persistence and self-esteem, whereas the effects of attachment security on technology addiction were fully mediated by persistence and self-esteem. Also, in line with our third hypothesis, frequency of technology use was positively associated with technology addiction, suggesting that higher technology use increases the probability of developing an addiction to technology. Of note, the model was gender and age invariant, suggesting that the mediation worked in a similar way for both men and women and across age. These findings extend our

understanding of the roles of attachment, personality, and temperament characteristics to help explain technology addiction. Insecure attachment may lead to difficulties in maintaining attention towards an objective and to lower evaluations of the self which may in turn lead to technology addiction. In contrast, individuals with a secure attachment may develop better capacities to persist despite fatigue or frustration and to have higher evaluations of the self, and these may work as protective factors in the development of technology addiction.

In partial accordance with our first hypothesis, we found that higher levels of attachment anxiety or avoidance were significant predictors of technology addiction. People with an anxious attachment are overly preoccupied with relationships whereas those with attachment avoidance prefer social isolation, and both have more tendency toward technology use due to their insecure feelings and lack of trust in others. These findings are in line with previous studies demonstrating that those with greater attachment insecurity use ITs as a way of replacing affection that is missing from family and friendships.⁴⁸ Moreover, the I-PACE model⁴⁹ posits that insecure attachment may represent a biopsychological factor that makes individuals vulnerable to develop Internet-use disorders, especially when they report high preoccupation with relationships.⁵⁰ By contrast, the findings suggested that higher attachment security may not directly lead to technology addiction, but that this association may be influenced by other factors. Previous research was mixed about the relationship between attachment security and technology addiction. Some studies showed a significant direct relationship whereas other studies did not report an association.^{51, 52} Some of these differences may be due to diversity among measurements, which make it difficult to compare findings across studies. Thus, more research is required to determine the exact role of attachment security in predicting technology addiction.

Moreover, higher attachment anxiety was significantly associated with higher novelty seeking, and both higher attachment avoidance and anxiety were related to lower self-esteem

and persistence. On the other hand, higher attachment security was significantly associated with higher self-esteem and persistence. It is not surprising that attachment dimensions act as proxy markers for temperament and personality differences.⁵³ For instance, some studies showed that most securely attached individuals develop distinctly different attachment bonds with each parent and their various caregivers.² This suggests that parents, partners and/or peers can differently modulate individual's temperament by influencing the surrounding environment.⁵⁴ Similarly, feeling of being accepted and trusted by others, in contrast to the tendency to worry about being rejected or dismissing support from others, increases own's self-esteem.⁵⁵

Further, in this study, we found that novelty seeking was not a significant predictor of technology addiction even though previous studies have reported a positive relation between novelty seeking and internet addiction.^{56, 57} People with high levels of technology addiction repeatedly have been characterized as being inhibited instead of being prone to seek out new experiences, thrills, and excitement.⁵⁸⁻⁶⁰ Therefore, it might be worth re-considering previous findings on the role of novelty seeking in the development of technology addiction.

Path analyses also showed that self-esteem and persistence were negatively associated with technology addiction, which was consistent with results from prior studies.^{29, 56} This suggests that individuals with lower self-esteem may overuse technology to better manage and control their self presentation and to satisfy their need to belong. Further, individuals with low persistence may turn to technology to gain more immediate gratification.

Lastly, (perceived) frequency of technology use was significantly associated with increased technology addiction. This finding is supported by the existing literature which suggests that higher frequency of technology use is a significant predictor of technology addiction, and that parental and peer technology use is significantly linked to young adults' use.^{9, 61} However, further research is necessary to disentangle parents and peers influence on

young adults' technology addiction. Some prior research suggested that parents can have a stronger role in mediating their teenagers' online activities than their peers⁶² and that intergenerational emotion regulation can have an influence on young adults' ITs.⁶³

Overall, our findings support the theoretical argument based on IT-CPU that both distal and proximal factors contribute to the development of technology addiction and add to the existing literature by shedding light on some of the specific components of the Interactional Theory.

This study comes with several limitations. First, the use of self-report data may be viewed as a limitation of the study. As we relied solely on self-report scales, our data may be biased, and it would be useful to replicate our findings using multiple informant ratings. Another limitation is about the generalizability of the present findings from the Italian population to other cultural contexts. Further cross-cultural studies are needed to extend our findings. Finally, the cross-sectional nature of our data limits us in drawing conclusions regarding causality. Longitudinal studies are needed to advance this line of work.

Despite these limitations, the results of this study have increased our understanding of the underlying mechanisms of technology addiction. Knowledge regarding attachment styles, personality and temperament characteristics can lead to the development of different therapy or education models to treat technology addiction.⁶⁴ The findings in our study may help to reduce harm caused by technology-related addiction through making sure psychosocial interventions are sensitive to young adults' attachment styles, personality, and temperament characteristics.

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