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RESEARCH ARTICLE

Childhood Trauma, Reflective Functioning, and Problematic Mobile Phone Use Among Male and Female Adolescents

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Abstract:

Background:

The association between traumatic experiences, different forms of emotion dysregulation and problematic technology uses is well established. However, little is known about the role of childhood traumatic experiences and reflective functioning in the onset and maintenance of mobile phone addiction symptoms among adolescents.

Methods:

Self-reported measures on childhood traumatic experiences, reflective functioning, and Problematic Mobile Phone Use (PMPU) were administered to 466 high school students (47.1% females) aged 13-19 years old. Participants also reported the number of hours per day spent on using a mobile phone.

Results:

Hierarchical multiple regression analyses showed that increased time spent on the mobile phone, low reflective functioning scores and high childhood trauma scores predicted PMPU scores in the sample. Moreover, two gender-specific pathways were found. Among males, PMPU was positively related to time spent on mobile phone and childhood traumatic experiences and negatively related to reflective functioning. Among females, PMPU was negatively associated with time spent on mobile phone for video gaming and with reflective functioning.

Conclusion:

These results might have relevant clinical implications in highlighting the importance of planning gender-tailored interventions for adolescents who report mobile phone addiction symptoms.

Keywords: Problematic mobile phone use, Childhood traumatic experiences, Reflective functioning, Gender differences, Adolescence, Internet technology.

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1. INTRODUCTION

Internet technology has changed everyday life and altered the way we communicate and relate to the social environment [1, 2]. Since it is available without any limitation of space and time, the mobile phone has invaded and influenced many fields: health care [3 - 5], education [6], as well as individuals' lives in terms of a variety of different leisure and non-leisure activities (*i.e.*, different communication, work and study-related activities, entertainment, streaming, shopping, gaming

and gambling) [7, 8] with beneficial opportunities. Over the past decade, the number of mobile phone users has increased from 10% in 2011 to 36% in 2018 worldwide, and today it surpasses three billion [9]. Data are even higher among adolescents, since 95% of them own or have access to mobile phones in many countries [10]. The benefits of smartphone use have been reported in the literature in terms of health promotion, education and productivity enhancement [11, 12]. However, nowadays, increased access to the Internet and prompt mobile communication, combined with attractiveness of various applications, can result in the abuse of technology [13, 14], especially among adolescents [15, 16]. The number of internet users simultaneously increases [17] alongside the

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Problematic Mobile Phone use (PMPU), thus the boundary between overuse and necessity can easily overlap [18]. For these reasons, researchers find the concept of mobile phone addiction interesting in this digital natives' age [19] and many studies have been already conducted in this field [19 - 24]. In particular, adolescents' risk factors for developing PMPU are a debated object of investigation in the current literature [25, 26].

PMPU has been defined as problematic online behavior, characterized by the inability to regulate the use of online content and mobile phone features (*i.e.*, messaging, entertainment apps) [27]. Moreover, research has also found similarities with substance use disorders (SUDs) symptoms, such as withdrawal, tolerance, and social impairment [28 - 31]. Indeed, it is demonstrated that, for a minority of individuals, particularly among adolescents [20], PMPU can become uncontrolled and lead to a wide set of negative consequences [32, 33], like sleep impairment [34, 35], musculoskeletal pain [36, 37], road accidents [38, 39], internalization of problems like anxiety and depression severity [40 - 42], boredom proneness [43, 44], dysregulated emotions [45, 46], rumination and negative mobile phone use expectancies [47] and even externalization of problems like neuroticism and impulsivity [48 - 50]. Aside from all the similarities between PMPU and SUDs, research should invest more attention in describing the individual motivations behind PMPU and the consequences of misuse to avoid the risk of over-pathologizing everyday life activities [51].

In this sense, just like the quantity of substance use is a clinically relevant characteristic in SUDs, the amount of time spent on mobile phone showed to be positively associated with PMPU [52]. Nevertheless, no evidence has proven that mobile phone addiction shares similar underlying psychological mechanisms with chemical addictions [32]. Therefore, the recognition of the specific psychological processes associated with mobile phone use has an important role in distinguishing between adolescents' pathological and non-pathological involvement.

Adolescence is a critical developmental phase characterized by emotional turmoil [53 - 55]. According to previous research and the theoretical framework outlined by Schimmenti [56 - 59], emotion dysregulation and traumatic experiences may represent important risk factors for developing Internet addiction symptoms. During childhood development, the quality of emotion regulation is internalized by the child within the relationship with caregivers, which acts as a line for future adolescent interactions [60, 61]. If an early traumatic experience occurs, the child erects defense mechanism, such as dissociation, that over time can also lead to pathological manifestations, including behavioral addiction [62 - 64]. Consistently, some studies [65] support the idea that adolescents who have experienced maltreatment adopt maladaptive coping mechanisms that rely on the distraction provided by mobile phone use. Through this dissociative mechanism, they can avoid negative feelings and conflicts that derive from the reactivation of specific painful memories connected to their childhood trauma but at the cost of developing technological addiction [62].

Fonagy [66] introduced the concept of mentalization,

which plays an important role in affect regulation, self-control, and self-monitoring [67]. Mentalization describes a person's imaginative capacity to interpret human behavior in terms of mental states, such as intentions, desires, beliefs, and feelings and it is operationalized by the Reflective Functioning (RF) construct [68]. More specifically, "reflective functioning" refers to an active expression of the psychological processes underlying the capacity to mentalize [66, 68]. According to Fonagy et al. [68], RF must not be confused with introspection, or the ability to report on or define mental states. Rather, RF is better explained as an unconscious, automatic procedure that relates to one's capacity to confer a sense of and regulate behavior. RF capacities provide the mental reflective buffer sustaining the inhibition of impulsive behaviors in emotionally laden contexts [69, 70]. Evidence suggests that addiction behaviors are more likely to occur in instances of impairments in RF [71]. However, although SUDs have been discussed as clinical expressions of impaired mentalizing skills [72], up till now, no study has yet investigated the relationship between RF and PMPU.

Furthermore, gender differences in problematic technology use have been frequently reported [14, 73 - 76], including the literature regarding PMPU [77]. Previous studies showed that males tend to overuse the Internet, in particular for gaming [76 - 79], to feel more confident, and, generally, to achieve a higher self-direction and sense of mastery, whereas females might feel that the Internet, and social networks in particular [80 - 83], could help them stay in touch with their loved ones, or build new relationships [81]. Schimmenti and colleagues [56] described two gender-specific pathways for developing Internet addiction symptoms in a sample of adolescents. In particular, these authors highlighted the pivotal role of traumatic experiences among males, and of emotion dysregulation (*i.e.*, high alexithymia scores) among females in establishing Internet addiction symptoms. Specifically, for some male adolescents, Internet overuse could be an attempt to achieve a higher self-direction and sense of mastery after being exposed to traumatic experiences that impair self-image and self-efficacy. On the contrary, female adolescents that show difficulties in interpreting their own mental states may overuse the Internet to try to manage their dysregulated emotions through online social relationships.

Therefore, both theoretical concerns and empirical evidence support the view that childhood traumatic experiences and lacking RF may have a role in fostering mobile phone addiction symptoms. Accordingly, in the present study, we aim to evaluate the associations between these psychological factors and PMPU among adolescents. To the best of our knowledge, this is the first study that assessed childhood trauma and RF together in relation to PMPU. Hence, we aimed to fill this knowledge gap and further expand the understanding of linkages and specific contributions of these variables in the development of PMPU. In detail, we investigated whether age, gender, hours per day spent on using a mobile phone (*i.e.*, total time, time for social networking, and time for video gaming), reflective functioning and childhood trauma were associated with mobile phone addiction symptoms scores in adolescents. Considering the aforementioned literature, we hypothesized the PMPU to be positively related to hours per day spent on using

mobile phone and childhood trauma, and negatively related to reflective functioning. Basing on a previous study by Schimmenti *et al.* [56], we explored two gender-specific pathways between childhood traumatic experiences, reflective functioning and mobile phone addiction symptoms.

2. MATERIALS AND METHODS

2.1. Participants

The study involved 466 adolescents (258 males, 52.9%; 230 females 47.1%) aged 13 to 19 years old ($M=16.35$, $SD=1.49$) attending seven public high schools in northern Italy. Regarding family status, 400 (82%) adolescents lived with married parents, 64 (13.1%) with separated or divorced parents, 15 (3.1%) with a single parent, 9 (1.8%) with a widowed parent. With respect to mothers' education, 10 (2%) had primary education, 134 (27.5%) secondary lower education, 246 (50.4%) secondary upper education, 83 (17%) had a bachelor's degree, and 15 (3.1%) a master's degree. With respect to fathers' education, 20 (4.1%) had primary education, 145 (29.7%) secondary lower education, 250 (51.2%) secondary upper education, 65 (13.3%) had a bachelor's degree, and 8 (1.6%) a master's degree. The mean number of hours spent daily on the mobile phone was 5.35 on average ($SD=2.85$, range 1–10).

2.2. Procedure

The participants were recruited from five Italian secondary schools using convenience sampling. The school managers approved the study and allowed the administration of questionnaires to the students. A presentation letter explaining the aims and goals of the study was sent to the families of adolescents. To allow participation, both parents had to sign the informed consent. The administration was conducted during regular class time and in the presence of teachers. The participation rate was excellent, with 100% of adolescents agreeing to take part in the study. All students participated voluntarily in the study. Confidentiality and anonymity were rigorously ensured and respected. The study was designed and carried out according to the Ethical Code of the Italian Association of Psychology (AIP), the European Code of Conduct for Research Integrity (ECCRI), and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

2.3. Measures

Demographic questionnaire – Participants completed a demographic questionnaire collecting information on age, gender, family status, and parents' education level.

Mobile phone usage – Participants completed three ad hoc items that assessed how much time they spend daily on using mobile phone in general (*i.e.*, “On an average day, how many hours do you use a mobile phone?”), for social networking (*i.e.*, “On an average day, how many hours do you use a mobile phone for social networking?”), and for video gaming (*i.e.*, “On an average day, how many hours do you use a mobile phone for video gaming?”).

Problematic Mobile Phone Use – The Dependent use

subscale of the Problematic Mobile Phone Use Questionnaire-Short Version (PMPU-SV) [82] was used to assess the presence of any addictive symptoms of PMPU. Subjects were asked to answer on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 4 (strongly agree). This subscale was composed of 5 items (*e.g.*, “I feel lost without my mobile phone”). Higher scores indicated higher symptoms of PMPU. Cronbach's alpha in this study was .63.

Childhood Trauma Questionnaire – The Childhood Trauma Questionnaire-Short Form (CTQ-SF) [83, 84] was administered to evaluate self-reported childhood traumatic experiences of the sample. The CTQ was composed of 28 items (*e.g.*, “I thought that my parents wished that I had never been born”) and participants were asked to answer on a 5-point Likert-type scale ranging from 1 (never) to 5 (very often). The total CTQ score appraises the severity of multiple forms of abuse and neglect [85]. Cronbach's alpha in this study was .90.

Reflective Functioning Questionnaire – The Reflective Functioning Questionnaire (RFQ) [86, 87] was used to measure participants' ability to link mental states to behavior. Specifically, the RFQu subscale (*e.g.*, “Sometimes I do things without really knowing why”; Cronbach's alpha in this study = .64) assesses the level of uncertainty in relation to their own or someone else's mental states. Whereas, the RFQc (*e.g.*, “I always know what I feel”; Cronbach's alpha in this study = .69) assesses the level of certainty in relation to their own or someone else's mental states and it is associated with better adjustment and mental health [88, 89]. Each of the two subscales are composed of six items that were rated on a 7point Likert scale ranging from 1 (totally disagree) to 5 (totally agree), and they were rescored on a scale from 0 to 3 consistently with the procedure described by the authors [79]. Following a previous study by Badoud *et al.* [90], in the present study, a synthetic score (RF level) obtained by the difference between RFQc scores and RFQu scores was used. In this manner, RF level scores indicated the degree to which adolescents were confident that behaviors depend on intentional, inner mental states.

2.4. Analysis Strategy

All analyses in the present study were performed using SPSS statistical software (version 24.00). Descriptive statistics were calculated for all of the variables examined in the current study. Independent *t*-tests were used to assess gender differences, and the magnitude of the differences was evaluated with effect sizes (Cohen's *d*). Partial correlations were examined to look at the associations between the investigated variables, controlling sociodemographic factors (*i.e.*, age, family status, mothers' and fathers' education) except for gender which was dummy coded (0 = females) to allow it to be included in the multiple regression analysis. Subsequently, a hierarchical regression analysis with PMPUQ dependence scores as the dependent variable was performed, including sociodemographic variables (step 1), time spent on mobile phone, time spent on playing video game in mobile, time spent on social networking in mobile (step 2), RF level scores (step 3), CTQ global scores (step 4), and RF level scores x gender and CTQ global scores x gender (step 5) as predictors. All

continuous predictor variables of PMPUQ dependence were mean-centered to minimize collinearity. Finally, two separate hierarchical regression analyses were performed for males and females, with PMPUQ dependence scores as the dependent variable and time spent on mobile phone, time spent on playing video game, time spent on social networking (step 1), RF level scores (step 2), and CTQ global scores (step 3) as predictors. A level of $p < .05$ was set for statistical significance.

3. RESULTS

Descriptive statistics are reported in Table 1 for the full sample differentiated by gender, along with the level of significance for gender differences. Statistically significant differences between males' and females' scores were found. Male adolescents reported a higher amount of time spent on mobile phone for playing video game ($t = 8.99, p < 0.001$), with a large effect size (Cohen's $d = 0.82$). On the contrary, female adolescents showed a higher amount of time spent on mobile phone for social networking ($t = -3.43, p = 0.001$) with a small effect size (Cohen's $d = 0.31$).

Partial correlations among investigated variables were performed, controlling for mother's and father's education (see Table 2). As can be seen in Table 2, PMPUQ dependence scores were positively and significantly associated with time spent on mobile phone, time spent on mobile phone for social networking, and with CTQ total scores and negatively and significantly associated with RF level scores.

A hierarchical regression model was conducted to examine main and interaction effects of predictor variables and gender on PMPUQ-dependence scores. Five steps were entered in the following order. Step 1 was entered with sociodemographic variables (age and gender). Step 2 was entered with total number of hours spent on mobile phone, number of hours spent on mobile phone for social networking, and number of hours spent on mobile phone for video gaming by participants. Step 3 was entered with RF level scores. Step 4 was entered with CTQ global scores. Finally, step 5 was entered with RF level scores \times gender and CTQ global scores \times gender (male coded as 1; female coded as 0 in both cases). The results of the hierarchical regression analysis are reported in Table 3.

The hierarchical regression analysis revealed that age and gender did not predict PMPUQ-dependence scores [$F_{(2, 485)} = 1.79, p = 0.17$]. As expected, time spent on mobile phone was a predictor of PMPUQ-dependence scores [$F_{(5, 482)} = 5.26, p < 0.001$], however the inclusion of this variable among the predictors in step 2 explained only 5% of variance in the PMPUQ-dependence scores. Regarding the psychological factors, as expected, RF level scores negatively predicted PMPUQ-dependence scores at step 3 [$F_{(6, 481)} = 6.01, p < 0.001$] and step 4. CTQ global scores positively predicted PMPUQ-dependence scores at step 4 [$F_{(7, 481)} = 7.52, p < 0.001$] and continued at step 5. No interaction effect was found for gender and predictor variables at step 5 [$F_{(9, 478)} = 6.06, p < 0.001$]. The final model explained only 10% of the variance in PMPUQ-dependence symptoms, therefore the hypothesized model was only partially supported.

Since interaction effects between gender and predictor

variables were not significant, we examined the possibility that PMPUQ-dependence would follow two independent pathways in male and female participants. Therefore, two separate hierarchical analyses were undertaken. As illustrated in Table 4, hierarchical regression analyses revealed that adolescent males' PMPUQ-dependence scores were significantly predicted by hours spent on the mobile phone at each step, negatively predicted by RF level scores at step 3, and positively predicted by CTQ total scores at step 3. Regarding female adolescents, surprisingly, hours spent on the mobile phone for video gaming was the strongest negative predictor of PMPUQ-dependence at each step. RF level scores were significantly and negatively associated with PMPUQ-dependence at step 2, however the addition of CTQ total scores as a predictor at step 3 reduced the association between RF level scores and PMPUQ-dependence below the significance level. CTQ total scores were not significantly associated with PMPUQ-dependence in the female adolescent sample. Models explained a modest amount of PMPUQ-dependence, 14% and 9% for males and females, respectively.

4. DISCUSSION

The present study aimed to evaluate the relationship between childhood traumatic experiences, reflective functioning, and mobile phone addiction symptoms in a sample of Italian adolescents. In line with previous research and the theoretical framework on dysfunctional technology use among adolescents outlined by Schimmenti [56], a pattern of positive associations was found among mobile phone addiction symptoms, time spent using mobile phone, and childhood traumatic experiences, and a negative association with reflective functioning levels was found. According to our results, the higher the number of hours adolescents spend using the mobile phone, the more they show mobile phone addiction symptoms. On the one hand, these findings seem to accord with Young's [91] conceptual model in which, similarly to what happens with substance abusers, the amount of Internet usage plays a pivotal role in the onset of Internet addiction. However, the correlation and regression analyses revealed that the associations between PMPU and time of phone use were weak. Hence, on the other hand, the present study may support the idea that problematic mobile phone use (PMPU) could be different from longer use of mobile phone: high engagement in mobile phone use may not necessarily mean PMPU [32]. It is therefore possible that mobile phone dependence symptoms are not linearly reflected in increased time spent using the mobile phone but are rather influenced by other factors such as psychological problems related to childhood traumatic experiences or low reflective functioning. Further high-quality longitudinal studies are needed to disentangle and understand these pathways in greater depth.

Regarding the overall time of use of the mobile phone, in our sample of adolescents, we found no significant differences between males and females. Interestingly, gender differences were found for specific mobile phone activities, with male adolescents reporting more hours spent daily using mobile phone for videogaming, and females reporting more hours spent daily using mobile phone for social networking. These findings are in line with the literature on gender differences in

video games [76, 78, 79] and social networking [80] use, and may reflect male tendencies to engage in riskier online behaviors [92, 93]. According to the social norms hypothesis [94], socio-cultural norms may account for gender differences

in exposure to unhealthy behaviors. For example, female adolescents frequently receive more parental control than males, which may help to protect them from high involvement in risky online activities, such as gaming [95].

Table 1. Descriptive statistics and gender differences for all investigated variables

-	Full sample (N = 488)	-	-	Males (n = 258)	Females (n = 230)	$t_{(486)}$	d	95% CI
-	M (SD)	Observed range	Possible range	M (SD)	M (SD)			
Age	16.35 (1.59)	13-19	12-19	16.14 (1.65)	16.59 (1.49)	-3.13**	0.29	[-0.73, -0.17]
Hour per day spent on mobile phone use	5.36 (2.85)	1-10	0-24	5.34 (2.96)	5.36 (2.73)	0.06	0.01	[-0.49, 0.56]
Hour per day spent on mobile social networking	3.22 (2.53)	1-10	0-24	2.56 (2.09)	1.14 (1.24)	8.99***	0.82	[0.34, 1.25]
Hour per day spent on mobile video game playing	1.89 (1.88)	0-8	0-24	2.86 (2.41)	3.64 (2.60)	-3.43**	0.31	[-1.73, -1.14]
PMPUQ dependence	11.22 (3.07)	5-20	5-20	11.00 (3.07)	11.47 (3.05)	-1.68	0.15	[-0.09, 0.98]
RF	2.24 (6.96)	-18-18	-18-18	2.65 (7.24)	1.77(6.62)	-1.40	0.13	[-2.06, 0.30]
CTQ-total score	38.28 (13.65)	27-101	25-125	39.39 (15.08)	37.04 (11.76)	1.90	0.17	[-4.63, 0.13]

Note: PMPUQ dependence: mobile phone use addiction; RF: Reflective Functioning; CTQ-total score: Childhood Trauma Questionnaire.
* $p < .05$; ** $p < .01$; *** $p < .001$

Table 2. Partial correlations between the study variables (controlling family status and mothers' and fathers' education).

-	2	3	4	5	6	7	8
1. PMPUQ dependence	0.05	0.08	0.21***	0.16**	0.01	-0.16***	0.18***
2. Age	-	0.14*	0.15*	0.11*	-0.07	-0.05	-0.06
3. Gender	-	-	0.00	-0.15**	0.38***	-0.06	-0.09
4. Hour per day spent on mobile phone use	-	-	-	0.58***	0.25***	-0.12**	0.03
5. Hour per day spent on mobile social networking	-	-	-	-	0.13**	-0.16***	-0.01
6. Hour per day spent on mobile video game playing	-	-	-	-	-	-0.11**	0.05
7. RF	-	-	-	-	-	-	-0.05
8. CTQ-total score	-	-	-	-	-	-	-

Note: PMPUQ dependence: mobile phone use addiction; RF: Reflective Functioning; CTQ-total score: Childhood Trauma Questionnaire.
* $p < .05$; ** $p < .01$; *** $p < .001$

Table 3. Hierarchical regression model for mobile phone use addiction (PMPUQ dependence) scores

-	R^2	ΔR^2	B	Lower bound	Upper bound	β
Step 1	0.01	0.01	-	-	-	-
Age	-	-	0.08	-0.10	0.25	0.04
Gender	-	-	-0.43	-0.98	0.12	-0.70
Step 2	0.05	0.04	-	-	-	-
Age	-	-	0.01	0.16	0.18	0.01
Gender	-	-	-0.38	-0.97	0.22	-0.06
Hours per day spent on MP	-	-	0.20**	0.08	0.32	0.18
Hours per day spent on MP-SN	-	-	0.06	-0.07	0.19	0.05
Hours per day spent on MP-VG	-	-	-0.02	-0.18	0.13	-0.01
Step 3	0.07	0.02	-	-	-	-
Age	-	-	0.00	-0.17	0.17	0.00
Gender	-	-	-0.30	-0.89	0.29	0.05
Hours per day spent on MP	-	-	0.20**	0.08	0.31	0.18
Hours per day spent on MP-SN	-	-	0.04	-0.09	0.17	0.03
Hours per day spent on MP-VG	-	-	-0.05	-0.21	0.11	-0.03
RF	-	-	-0.06**	-0.10	-0.02	-0.14

(Table 3) cont.....

Step 4	0.10	0.03	-	-	-	-
Age	-	-	0.02	-0.15	0.19	0.01
Gender	-	-	-0.38	0.07	0.30	-0.06
Hours per day spent on MP	-	-	0.19**	0.07	0.30	0.17
Hours per day spent on MP-SN	-	-	0.05	-0.08	0.18	0.04
Hours per day spent on MP-VG	-	-	-0.05	-0.21	0.10	-0.03
RF	-	-	-0.06**	-0.09	-0.02	-0.13
CTQ-total score	-	-	0.04***	0.02	0.06	0.17
Step 5	0.10	0.00	-	-	-	-
Age	-	-	0.02	-0.15	0.18	0.01
Gender	-	-	-0.36	-0.95	0.22	-0.06
Hours per day spent on MP	-	-	0.18**	0.06	0.30	0.17
Hours per day spent on MP-SN	-	-	0.05	-0.08	0.18	0.04
Hours per day spent on MP-VG	-	-	-0.06	-0.21	0.10	-0.03
RF	-	-	-0.08	-0.20	0.04	-0.18
CTQ-total score	-	-	0.08*	0.02	0.13	0.34
RF x gender	-	-	0.01	-0.06	0.09	0.04
CTQ-total score x gender	-	-	-0.03	-0.07	0.01	-0.17

Note: Hours per day spent on MP: Hours per day spent on mobile phone; Hours per day spent on MP-SN: Hours per day spent on mobile phone for social networking purposes; Hours per day spent on MP-VG: Hours per day spent on mobile phone for video gaming purposes; PMPUQ dependence: mobile phone use addiction; RF: Reflective Functioning; CTQ-total score: Childhood Trauma Questionnaire.

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

Table 4. Hierarchical regression model for mobile phone use addiction (PMPUQ dependence) scores

-	R^2	ΔR^2	B	Lower bound	Upper bound	β
Males (N = 258)	-	-	-	-	-	-
Step 1	0.07	0.07	-	-	-	-
Age	-	-	0.0	-0.22	0.23	0.00
Hours per day spent on MP	-	-	0.21***	0.06	0.36	0.21
Hours per day spent on MP-SN	-	-	0.05	-0.13	0.22	0.04
Hours per day spent on MP-VG	-	-	0.11	0.08	0.30	0.08
Step 2	0.08	0.01	-	-	-	-
Age	-	-	0.00	-0.23	0.22	0.00
Hours per day spent on MP	-	-	0.20**	0.05	0.35	0.19
Hours per day spent on MP-SN	-	-	0.03	-0.14	0.21	0.03
Hours per day spent on MP-VG	-	-	0.08	-0.11	0.28	0.06
RF	-	-	-0.05	-0.10	0.00	-0.12
Step 3	0.14	0.06	-	-	-	-
Age	-	-	0.01	-0.21	-0.23	0.00
Hours per day spent on MP	-	-	0.17*	0.03	0.32	0.17
Hours per day spent on MP-SN	-	-	0.05	-0.13	0.24	0.04
Hours per day spent on MP-VG	-	-	0.08	-0.10	0.27	0.06
RF	-	-	-0.06*	-0.11	-0.01	-0.14
CTQ-total score	-	-	0.05***	0.02	0.07	0.24
Females (N = 230)	-	-	-	-	-	-
Step 1	0.06	0.06	-	-	-	-
Age	-	-	0.13	-0.22	-0.30	0.19
Hours per day spent on MP	-	-	0.16	-0.03	-0.04	0.36
Hours per day spent on MP-SN	-	-	0.08	-0.14	0.29	0.07
Hours per day spent on MP-VG	-	-	-0.46***	-0.80	-0.14	-0.19
Step 2	0.08	0.02	-	-	-	-
Age	-	-	0.03	-0.23	0.29	0.02
Hours per day spent on MP	-	-	0.18	-0.02	0.38	0.16
Hours per day spent on MP-SN	-	-	0.05	-0.16	0.26	0.04
Hours per day spent on MP-VG	-	-	-0.47**	-0.78	-0.15	-0.19

(Table 4) cont.....

-	R ²	ΔR ²	B	Lower bound	Upper bound	β
RF	-	-	-0.06*	-0.12	-0.05	-0.14
Step 3	0.09	0.01	-	-	-	-
Age	-	-	0.05	-0.21	0.31	0.02
Hours per day spent on MP	-	-	0.18	- 0.02	0.34	0.16
Hours per day spent on MP-SN	-	-	0.05	-0.16	0.26	0.04
Hours per day spent on MP-VG	-	-	-0.48**	-0.79	-0.16	-0.19
RF	-	-	-0.05	-0.11	-0.01	-0.12
CTQ-total score	-	-	0.02	-0.01	0.06	0.09

Note: Hours per day spent on MP: Hours per day spent on mobile phone; Hours per day spent on MP-SN: Hours per day spent on mobile phone for social networking purposes; Hours per day spent on MP-VG: Hours per day spent on mobile phone for video gaming purposes; PMPUQ dependence: mobile phone use addiction; RF: Reflective Functioning; CTQ-total score: Childhood Trauma Questionnaire.

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

In line with the literature on adolescents' PMPU [96], males and females did not significantly differ as for the level of mobile phone addiction symptoms. However, in line with our expectations, the results in the present study revealed two gender-specific pathways between childhood traumatic experiences, reflective functioning and mobile phone addiction symptoms. Childhood trauma scores were predictive of mobile phone addiction symptoms in males, whereas reflective functioning scores negatively predicted mobile phone addiction symptoms among females, but less in males. This means that a higher level of childhood traumatic experiences among males and lower levels of reflective functioning among females fostered the mobile phone addiction symptoms in our sample of adolescents. These findings are in line with theoretical and empirical arguments by Schimmenti and colleagues [62, 97], who stated that problematic internet related activities may serve as a dysfunctional behavior to avert painful memories of childhood traumatic experiences, especially for male adolescents [56]. In this aspect, it was also suggested that male adolescents' internet excessive use may reflect their desire to escape into cyberspace as a self-medication for internalized depressed mood [98], *i.e.* through a disordered video game use [99]. On the contrary, some female adolescents who have trouble understanding their mental states, such as loneliness, depression, isolation and boredom, could be more prone to overuse mobile phone as an attempt to regulate their affective mental states and to fulfill their unmet social needs [100]. Other possible interpretations of these data are possible. For example, previous research found that female adolescents, who unreflectively stick to sociocultural unrealistic ideals conveyed by the media, are more at risk of maladjustment, *i.e.* low body esteem [101]. Hence, female adolescents with PMPU could be more subjected to media influences (*e.g.*, ideal female body represented in the social networks) and less oriented to adopt an adequate reflective attitude toward themselves.

Finally, surprisingly, in the females' subsample, not only time spent using mobile phone was not associated with PMPU but also time spent using mobile phone for video gaming negatively predicted mobile phone addiction symptoms. This, to some extent controversial, finding could be linked to the fundamental difference between high involvement and pathological involvement in video games [102]. Literature evidence revealed that while pathological gaming is linked with negative outcomes, occasional or passionate use of video games could be non-problematic [99] and indeed associated

with psychosocial adjustment [103, 104]. Furthermore, a thematic analysis of female gaming experience conducted by McLean and Griffiths [105] highlighted that females tend to use highly social interactive gaming environments to create strong emotional relationships. Thus, online social interactions could provide them emotional mirroring opportunities that can facilitate reflecting functioning [106] and in turn discourage PMPU.

As with all research, the present study comes with a number of limitations. Primarily, our sample was not overly large and included solely high school students from the normal population, therefore, our findings are not immediately generalizable to all adolescents. Studies with clinical or high-risk subjects are greatly needed to compare and extend our findings, providing more significant clinical implications for public health. In the second place, it is acknowledged that clinical self-report measures may be affected by bias problems [107], thus the accuracy of individual reports cannot be guaranteed. Furthermore, although the measures used in the present study have demonstrated good psychometric properties in worldwide research, in the present study, quite low, but acceptable (according to Hair [108]), Cronbach's alpha values were observed. Probably, a multimethod assessment of childhood traumatic experiences, reflective functioning, and mobile phone addiction symptoms would have led to more valid and reliable findings. In addition, our data showed an overlap of time spent using mobile phone for social networking and time spent using mobile phone for video gaming, because we did not consider social network games as a separate domain of investigation. Future assessment of mobile phone addiction symptoms could also include a detailed assessment of mobile phone behaviors, functions and patterns of usage, such as motives for using specific mobile phone activities. Third, the cross-sectional nature of the study made it impossible to conclude a cause-effect relationship between the predictors and PMPU among adolescents. Longitudinal studies with large sample size are greatly needed to advance this line of work. Moreover, our findings may have been affected by other variables not explored here (*e.g.*, impulsivity, alexithymia, insecure attachment). Finally, we do not have specific data about the specific moment when our participants overuse Internet. Since sleep is important during development [109], it is crucial in every prevention program to inform adolescents about the risks that Internet addiction has before bedtime, in particular in developing sleep problems (*i.e.*, circadian

preference or delayed sleep phase pattern).

However, despite these limitations, this initial study provided new evidence about the differential role that gender may play in the complex relationship between childhood trauma, reflective functioning, and mobile phone addiction symptoms, which could inform any treatment plan aimed to help late adolescents who display problematic mobile phone use.

CONCLUSION

This study has likely opened new perspectives on how the amount of time spent using mobile phone, childhood traumatic experiences and lack of reflective functioning could induce mobile phone addiction symptoms among adolescents. We found that childhood trauma predicted mobile phone addiction symptoms among males, and that reflective functioning negatively predicted mobile phone addiction symptoms among females, and less among males. Moreover, the amount of time spent using mobile phone for video gaming negatively predicted mobile phone addiction symptoms only among females. This might have relevant implications to inform prevention of problematic mobile phone use among youth, and treatment of adolescents who are already overinvolved with the mobile phone. For example, treatment plans aimed to address trauma memories could help some male adolescents to develop an adequate self-image and reduce escapism motives related with mobile phone overuse. Whereas, some female adolescents with PMPU may be helped by treatments focused on developing better abilities to understand their mental states.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

Informed consent was taken from the parents before the participants were enrolled in the study.

AVAILABILITY OF DATA AND MATERIALS

The data shall be shared on request by the corresponding author [C.F.] upon reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The author reports no conflicts of interest in this work.

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