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**“Mom, Dad, Look at me”:
The development of the Parental Phubbing Scale**

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Abstract

The widespread diffusion of smartphones has opened new challenges regarding the psychological consequences of their usage on social relationships. The term *phubbing* (a combination of *phone* and *snubbing*) indicates the act of ignoring someone in a social context by paying attention to the smartphone. The few existing studies show that phubbing is widespread, mutually reinforced, and socially accepted, with possible negative consequences for social and individual well-being. Phubbing can occur in every social context, including romantic relationships, workplaces, and family. However, to date, minimal attention has been given to the possible impact that phubbing carried out by parents can have on their children. To start filling this gap, in this paper, we introduced a new scale that measures the perception of being subject to parental phubbing and showed the prevalence of perceived *phubbing* on a stratified sample of 3,289 adolescents. Firstly, the dimensionality, validity, and invariance of the construct were proven. Moreover, our results showed a positive relationship between children's perceived levels of parental phubbing and their feelings of social disconnection with parents, thus suggesting that the more children felt that one or both of their parents were phubbing them, the less the children felt connected with their parents.

Keywords: phubbing; smartphone; parenthood; social connections; scale development.

Introduction

Imagine you are in a café. In a table in front of you, there is a father with his 13-year-old daughter. The child talks excitedly to her father; however, his eyes are glued to the smartphone, and his fingers keep scrolling down some discussion that is occurring online. Occasionally, he nods his head and gives her minimal, inattentive replies at her questions. She raises her voice, touches his arm, but all her attempts to draw his attention back to what she is saying seem worthless. How would this young girl feel? How would her father feel while doing this? And how would you feel observing this scene? This kind of situation should be quite familiar to most people nowadays, as it has become increasingly common in contemporary daily life, to the extent that a neologism, “phubbing,” was coined to refer to it (Macquarie, 2013). *Phubbing* is the combination of *phone* and *snubbing* and can be defined as the act of ignoring someone in a social context by paying attention to the smartphone. In this work, we introduce a new scale that measures the perception of being the subject of parental phubbing.

Some recent studies showed how phubbing is widespread. In a survey conducted by McDaniel and Coyne (2016), 70% of participants reported being phubbed by their partner, especially during leisure time, in which phubbing situations seemed to occur at least once a day for the 62% of the sample. These data are in line with those of Al-Saggaf and MacCulloch (2018), who showed that 62.3% of their participants declared themselves as phubbers, reporting that the most likely target of their phubbing behavior was their partner. However, these studies are limited by their samples that are unbalanced in terms of gender (with a female prevalence), which potentially creates a confounding effect between the prevalence of the phenomenon and gender differences. According to Chotpitayasunondh and Douglas (2016), phubbing has become a sort of new social norm, which was rapidly established through reciprocity, a fundamental process of human interaction (Cialdini, 1993; Falk & Fischbacher, 2006). Indeed, ignoring someone because of the smartphone might be mirrored by the ignored counterpart, intentionally or not. The authors showed

that the relationship between phubbing and being phubbed is strong ($\beta = .60$) and that experiencing phubbing (either actively or passively) increased the perception that this phenomenon is normative. Thus, phubbing seems to be mutually reinforced in social interactions, and, according to the authors, this might have led people to perceive this behavior as acceptable.

The State-of-the-Art of Research on Phubbing

Given the novelty of the phenomenon, little is known about the antecedents and consequences of phubbing. However, the few studies that investigated possible determinants of phubbing agree on one point: phubbing relates positively with “smartphone addiction” (Chotpitayasunondh & Douglas, 2016; Karadağ et al., 2015) or, in other words, with excessive use of smartphones that might lead to adverse effects on user’s daily life (King & Dong, 2017; Lee, Chang, Lin, & Cheng, 2014; Lin et al., 2016). Although there is an ongoing debate about whether smartphones are addictive (Gentile, Coyne, & Bricolo, 2013; Kardefelt-Winther et al., 2017), it is perfectly understandable that individuals who use their smartphone longer and more frequently are more likely to phub others.

However, research on phubbing has been primarily concerned about its consequences on human relationships. The available studies seem to converge on the notion that phubbing causes negative impacts. Indeed, being phubbed by the partner decreases relationship satisfaction that, in turn, has an impact on depression and life satisfaction (Roberts & David, 2016). Similarly, a study on married adults showed that partner phubbing behavior was indirectly associated with depression by negatively impact on relationship satisfaction (Wang, Cie, Wang, Wang, & Lei, 2017). Comparable findings emerged in research that investigated phubbing in a different context, namely the relationship between supervisors and employees. Roberts, Williams, and David (2017) found that being phubbed by their bosses negatively affected employees' engagement by decreasing their trust in them; thus, similar to the romantic context, phubbing occurring in the workplace undermines the quality of the relationships.

Given the negative association between phubbing and quality of interpersonal relationships, scholars have taken the first steps towards a deeper understanding of the phenomenon, investigating it by adopting an experimental methodology. For instance, Abeele, Antheunis, and Schouten (2016) found that people who used a smartphone during a conversation were perceived as less polite and attentive than those who did not use it, especially when their phubbing behavior was self-initiated and not done in response to a notification (i.e., smartphone vibration, sound, and lighting for an incoming message). Even being only a witness of a phubbing scene, as in our first example, might have some negative consequences for the observers' mood, and it increases their stress level (Nuñez et al., 2018).

In a recent study, Chotpitayasunondh and Douglas (2018) manipulated the phubbing experience using a 3D animation of a conversation between two characters in which participants were asked to imagine themselves as one of them. The longer the phubbing experience, the worse the quality of communication and perceived relationship satisfaction. Moreover, phubbing intensity negatively affected the satisfaction of the four fundamental needs as theorized by Williams concerning the experiences of being ignored (2009): (1) belonging, that is the need to engage in positive (or at least, not negative) interactions with other people; (2) self-esteem, which concerns the need to maintain a positive view of ourselves; (3) meaningful existence, that is the necessity to feel recognized by others and being worthy of attention; and (4) control, the need to perceive influence over the surrounding social environment. Specifically, larger exposure to phubbing was associated with a lower sense of belonging, a decrease in self-esteem, the perception of one's own existence as less meaningful, and less perceived control over the social environment. The strongest impact of phubbing was observed for the need to belong, which was also responsible for the indirect effect of phubbing on the quality of communication and relationship satisfaction. In keeping with these findings, another recent study (Hales, Dvir, Wesselmann, Kruger, & Finkenauer, 2018) found that participants, asked to recall a time in which a conversation partner used their cell phone during

an interaction, felt ostracized (i.e., ignored). The authors also found that being phubbed resulted in higher feelings of relational devaluation (i.e., perceiving themselves in the eyes of the partner as not as important, valuable, or close as much as one desire; (Leary, 2001, 2020), which in turn accounted for lower levels of basic needs satisfaction.

The latest research by Chotpitayasunondh and Douglas (2018) and Hales et al. (2018) is particularly important because it emphasizes the link between the recently developed phenomenon of phubbing and the long and fruitful research tradition on being and feeling excluded (for an overview, see: Riva & Eck, 2016). Social exclusion has been broadly defined as the experience of being kept apart from others physically (e.g., social isolation) or emotionally (e.g., being ignored or told one is not wanted; Riva & Eck, 2016). In this perspective, ostracism (i.e., being primarily ignored) and social rejection (i.e., being explicitly told one is not wanted) represent the two core experiences of social exclusion. Since it involves being primarily ignored, phubbing represents an instance of ostracism (Williams, 2007, 2009). Adverse effects of ostracism and rejection are well-known. They include both short-term (e.g., negative emotions, antisocial behaviors, cognitive depletion) and long-term (a series of negative mental and physical outcomes, including depression, poorer immune functioning, and higher rates of substance use) aversive consequences (Bernstein, 2016; Riva, Montali, Wirth, Curioni, & Williams, 2017).

Phubbing and Parenthood

Relational problems between parents and their children could arise from a wide range of factors (e.g., quality of communication, parental warmth, attachment style, adolescents' externalizing, and internalizing problems). Within this variety, technology might represent one of the factors ubiquitously grabbing the parents' attention (e.g., while at playing home, while eating, while walking in the park), thus negatively affecting the parent-child relationship. Indeed, among different technologies (e.g., TV, computer), the ubiquity of smartphones makes this device currently the most likely source of parental distraction and deserves appropriate attention form scholars. The

effects of relational devaluation linked with phubbing might be notably stronger when the relationship at stake is relevant. For children, the most important source of meaning and social support are their parents. Thus, the negative effect of phubbing might be even stronger in parent-child relationships in which communication and parental responsiveness have central roles in children and adolescents development (Baumrind, 1991; Caughlin & Malis, 2004; Davidov & Grusec, 2006; Kochanska & Aksan, 2004; Pinquart, 2016). Indeed, McDaniel and Radesky (2018) have recently shown that mothers' distraction with technological devices (what the authors called "technoference") is associated with problematic externalizing and internalizing behaviors of their young children (5 years old or younger). In line with these findings, Stockdale, Coyne, and Padilla-Walker (2018) showed that parental technoference was related to adolescents' negative psychological (i.e., higher anxiety and depression) and behavioral (i.e., cyberbullying) outcomes. However, the authors also found positive associations with civic engagement (e.g., involvement in political issues, time spent volunteering) and prosocial behaviors (i.e., helping family members and strangers), which were interpreted as means to gain attention from parents who are distracted by technological devices.

However, no instrument has been developed to date to assess parental phubbing. This is a problematic omission, considering that the absence of a measuring instrument for parental phubbing prevents the generation of basic knowledge about the diffusion of this phenomenon and its effects. Thus, we argue that there is an urgent need for a psychometrically valid instrument to measure adolescents' perception of parental phubbing.

Existing Measures of Phubbing

In the last five years, scholars have proposed various measures of phubbing; each one focused on a specific aspect of this phenomenon. To the best of our knowledge, the first self-report scale on phubbing was developed by Karadağ and colleagues (2015). Based on focus groups, the authors developed a 10-item scale that measured phubbing behavior by respondents towards other

individuals. Specifically, the principal component analysis revealed two factors, both with good internal consistency: five items measured communication disturbance (i.e., how frequently respondents disturb ongoing face-to-face communications by using their smartphone) and the remaining five items measured phone obsession (i.e., how much respondents need their smartphone when they are not interacting with others). While the former factor strictly concerns phubbing, phone obsession is closer to a general dimension of problematic smartphone use (Kwon, Kim, Cho, & Yang, 2013; Pancani, Preti, & Riva, 2020) than a specific dimension of phubbing. Moreover, the sample on which the analyses were conducted mainly consisted of females (71.6%).

Contrarily to the scale above, Roberts and David (2016) developed a measure of perceived phubbing from others and, specifically, from the partner. The authors generated a large pool of items that were reduced through expert evaluation, inter-rater agreement about face validity, and exploratory factor analysis. This procedure led to retain nine items that loaded on a single, highly reliable factor of perceived partner phubbing. The *Partner Phubbing scale (Pphubbing)* was then used in other studies, both in its original form (e.g., Wang et al., 2017) and in a modified version targeting phubbing on work setting (Roberts et al., 2017).

A completely different facet of phubbing has been captured by the measure proposed by Chotpitayasunondh and Douglas (2016). The authors developed a 5-item scale to assess social norms concerning phubbing, focusing both on descriptive (i.e., familiarity and spread of the phenomenon) and injunctive (i.e., appropriateness of the behavior) norms.

Last but not least, two brief scales were conceived in the technofeference literature, targeting different technological devices in addition to the smartphone (e.g., tablet, computer, television). McDaniel & Coyne (2016) developed the Technology Device Interference Scale (TDIS) and the Technology Interference in Life Examples Scale (TILES). Both the scales aimed at measuring the frequency of technology interference in romantic relationships. While the TDIS asked how often each device disturbs or interrupts a dyadic interaction, the TILES asked how often each of five

common situations of technoference (e.g., the partner pulls out the phone during mealtime or is distracted by TV during a conversation) occurs. As evidenced by the items, the two scales were developed to measure a phenomenon wider than phubbing, namely the overall interference of technological devices on dyadic relationships. Moreover, two modified versions of the TILES were developed to measure both adolescents' technoference and perceived technoference from their parents (Stockdale et al., 2018). However, besides internal consistency, no information about the psychometric properties of the two scales was reported.

The Present Study

The present study aimed at developing a brief, psychometrically valid, scale to assess parental phubbing in adolescents, the Parental Phubbing Scale (PPS). Specific aims were to (1) develop items of the PPS and test its dimensionality, (2) investigate its measurement and structural invariance across different subpopulations, (3) testing the PPS concurrent validity through its association with children's feeling of social disconnection, and (4) check differences in parental phubbing levels due to a set of sociodemographic variables.

Several hypotheses were set. The PPS was developed to measure perceived phubbing distinctly and separately from each parent, and we expected that the two dimensions would be correlated and would jointly measure an overall dimension of parental phubbing. This theoretical dimensionality was expected to be invariant across participants' gender, ethnic origin (migrant vs. native), mother, and father education level.

Consistently with the recent literature on phubbing (Chotpitayasunondh & Douglas, 2018; Hales et al., 2018), we hypothesized a good concurrent validity of the PPS. Specifically, we hypothesized that source-specific, perceived phubbing would be positively associated with perceived social disconnection. In other words, we expected to find significant and positive associations between participants' perception of being phubbed by mother (father) and the feelings

of disconnection from their mother (father), along with non-significant or, at least, lower cross associations (i.e., being phubbed by mother and perceived disconnection from father and vice-versa). Similarly, the overall parental phubbing would be significantly and positively associated with the overall perception of social disconnection from parents.

Finally, concerning sociodemographic variables, we expected that a higher education level might be related to lower phubbing habits. Indeed, research on the digital divide has found that individuals with higher socioeconomic status show better digital skills and get higher benefits from it (Van Dijk, 2005). Recent research also shows that those with a higher education level can better cope with digital overuse (Gui & Büchi, 2019) and that parents with higher socioeconomic status are more aware of digital overuse and more likely to impose restrictions on their children's use of digital media (Nikken & Opree, 2018). No hypotheses were advanced concerning gender and ethnic origin.

Method

Participants and procedure

Participants were extracted from the second wave of a longitudinal survey, which is part of a wider experimental project named “Digital Well-being - Schools” (Gui, Gerosa, Garavaglia, Petti, & Fasoli, 2019), carried out by the authors. The data collection process was carried out in May 2018 and involved all the students in grade 10 (15-16 years old) enrolled in 18 high schools of two neighboring school districts of the Lombardy region (Northern Italy). Students were surveyed through a CAWI methodology (Computer Assisted Web Interviewing), asking them to fill in an online questionnaire in the computer labs of their school under the supervision of external observers. The questionnaire was finally administered to 3,289 participants located in 171 classes, achieving a total response rate of 90%. A more detailed description of the sample characteristics is offered in Table 1.

[Table 1 near here]

Materials

The original questionnaire provided detailed information on students' sociodemographic characteristics, digital competence, attitudes toward digital technologies, and smartphone daily usage habits (for complete information, see Gui et al., 2019). For the purpose of this study, only the following measures were used.

Item Pool for the PPS

Two subscales of the PPS were developed: the PPS-Mother (PPS-M) and the PPS-Father (PPS-F). The PPS-M and PPS-F were identical (i.e., included the same items) except for the source of phubbing mentioned, mother and father, respectively. The items were adapted from those included in the Pphubbing scale (Roberts & David, 2016). Specifically, the term "cell phone" was replaced by "smartphone," and the term "partner" was replaced by "mother" or "father," according to the subscale. No other changes were made for items 1, 2, 3, 4, and 9 of the Pphubbing scale. Conversely, slight modifications were introduced for items 5 and 6. Indeed, item 5 of the Pphubbing scale (i.e., "My partner glances at his/her cell phone when talking to me") was modified into "My mother/father get distracted when we do something together." This change made the item representative of different activities (i.e., not only talking) shared by adolescents and parents and different ways in which phubbing can be put in place (e.g., glancing at the smartphone, phone calls, playing with online gaming). Item 6 of the Pphubbing scale (i.e., "During leisure time that my partner and I are able to spend together, my partner uses his/her cell phone") was changed into "During leisure time that we spend together, my mother/father pays more attention to her/his smartphone than to me," to detect more extreme situations. The two remaining items of the Pphubbing scale were not included because item 7 was reverse coded, and it could generate confusion, whereas item 8 reports a situation (i.e., going out together) that is more typical of romantic relationships than adolescent-parent ones. Thus, each of the subscales consisted of 7 items.

Regarding response options, a five-point Likert scale was used, ranging from 1 “Never” to 5 “All the time.” The items were then translated into Italian and then back-translated into English by a native English language translator to check their meaning was maintained.

Social Disconnection

We used three items to measure feelings of social disconnection towards parents.

Specifically, for each parent, participants were asked how often they felt (1) lack of companionship from, (2) ignored by, and (3) left out. A five-point Likert scale was used, ranging from 1 “Never” to 5 “All the time.”

Sociodemographic Variables

Participants were asked to indicate their gender, ethnic origin, and the education level of their parents. Students’ gender and ethnic origin were collected as dichotomous variables, distinguishing males from females and natives from the first and second generations of migrants, respectively. The level of education achieved by both parents was recorded in three reference categories identifying low-educated (up to middle school diploma), middle-educated (up to high school diploma), and highly-educated subjects (bachelor’s degree or higher).

Data analysis

All the analyses were carried out using Mplus, version 7 (Muthén & Muthén, 2015). Given the nested nature of our data (i.e., adolescents clustered within classes and classes clustered within schools), all the models were tested adopting a multilevel approach. Specifically, the Mplus’ analysis type “two-level complex” allowed us to estimate the hypothesized associations among variables at the within-subject level by adjusting standard errors and chi-square statistics for both adolescents’ class and school membership. The only exception was measurement invariance, which could not be tested using the “two-level complex” approach with two clustering variables and the grouping variables (i.e., gender, ethnic origin, parents’ educational background) at the within level

(Kim, Kwok, & Yoon, 2012). Thus, we opted for a design-based approach (Kim et al., 2012; “complex” analysis type), which allows for invariance testing, adjusting the chi-square statistic and standard errors (Asparouhov, 2006). Although the design-based approach allows a single clustering variable (adolescents’ class membership was chosen as more meaningful than school membership), it represents a good alternative to multilevel SEM, showing equivalent performance when the between- and within-model structures are assumed as identical, as it was in our case (Wu & Kwok, 2012). Both type “two-level complex” and “complex” were run using the MLR estimator which is robust to data non-normality.

Data were analyzed in four steps. First, the factor structure of the PPS was investigated using multilevel exploratory (EFA) and confirmatory (CFA) factor analysis. Initially, the subscale referring to father (PPS-F) was randomly chosen to explore the factor structure of the scale through a multilevel EFA. Then, the emerging structure was tested on the items referring to mother (PPS-M) through a multilevel CFA. Once the dimensionality of the subscales was confirmed, a multilevel CFA was used to test the hypothesized factor structure of the PPS on all the items by estimating two first-order factors of parent-specific phubbing (regarding mother and father, separately) that loaded on an overall second-order factor of parental phubbing.

Second, the measurement and structural invariance of the PPS was tested on groups of students defined by gender, ethnic origins, and parental education. A series of five hierarchically nested models were run for each of the sociodemographic variables, using multi-group confirmatory factor analysis (MG-CFA). Each model tested a higher level of invariance by adding a set of specific equality constraints across groups (Byrne, 1988; Meredith, 1993; Widaman & Reise, 1997). More technical details on factor validity and measurement and structural invariance are given in the Supplementary Material.

Third, the concurrent validity of the PPS was assessed using multilevel structural equation modeling (SEM). Specifically, we tested the association between parental phubbing and children’s

perception of social disconnection from parents, both from a source-specific (i.e., constructs related to each parent) and general (i.e., overall measures of parental phubbing and parental disconnection) standpoints.

Finally, multiple indicators and multiple causes models (MIMIC; Joreskog & Goldberger, 1975) were run to investigate the relationships between the sociodemographic variables and the source-specific and overall dimensions of parental phubbing.

The goodness of fit of the models was evaluated according to the following indices: (a) the chi-square statistic (χ^2), (b) the comparative fit index (CFI), (c) the Tucker–Lewis index (TLI), (d) the root mean squared error of approximation (RMSEA), and (e) the standardized root mean square residual (SRMR). A model adequately explains the data when the χ^2 probability is lower than .05, the CFI and TLI are higher than .90 (better if higher than .95), the RMSEA is lower than .08 (better if lower than .05), and the SRMR is lower than .08 (Brown, 2015; Kline, 2015).

Competing nested models were generally compared using the chi-square difference test (Kline, 2015): a significant probability ($p < .05$) associated to $\Delta\chi^2$ means that the more restricted model (i.e., less free parameters) fit the data significantly worse than the less restricted model (i.e., more free parameters); thus, the latter one should be preferred. As recommended by Cheung and Rensvold (2002), in addition to the chi-square difference test, two further tests were used to compare models in the measurement and structural invariance analysis: the McDonald's centrality index (Mc) and CFI difference. Values of $\Delta Mc < 0.02$ and $\Delta CFI < 0.01$ are considered sufficient clues of cross-group equivalence in the examined construct.

Results

PPS dimensionality

The dimensionality of the PPS was initially explored using multilevel EFA on the items referring to father (i.e., PPS-F subscale). The first eigenvalue extracted (4.34) was much larger than

the second one (0.71), clearly indicating the presence of a single factor. Loadings were generally high, ranging between .61 (item 2) and .87 (item 5). The subscale unidimensionality was confirmed through a multilevel CFA on the items referring to the mother (i.e., PPS-M subscale). Despite a significant chi-square statistic, easy to reach with such a large sample size (Bentler & Bonnet, 1980), the multilevel CFA on the items referring to mother yielded good fit indices [$\chi^2(35) = 602.30, p < .001$; CFI = .961; TLI = .953; RMSEA = .071; SRMR = .029]. Standardized loadings ranged from .69 to .85, confirming results obtained in the multilevel EFA.

Finally, the theoretical dimensionality of the PPS was tested using a further multilevel CFA on all the items. Specifically, items of the two subscales were loaded on two first-order latent factors, namely PPS-M and PPS-F, which represented the adolescents' perception of being phubbed by their mother and father, respectively. Moreover, an overall dimension of parental phubbing was included in the model by estimating a second-order latent factor (i.e., PPS) on which the two first-order factors were loaded. In addition, we estimated error covariances between item pairs that were identical except for the source of phubbing.

Though the chi-square statistic was significant, the model, reported in Figure 1, yielded excellent fit indices [$\chi^2(160) = 1397.19, p < .001$; CFI = .957; TLI = .951; RMSEA = .049; SRMR = .032]. Standardized loadings on first-order factors ranged from .62 to .87 and the loadings of PPS-M and PPS-F on the PPS general factor were both equal to .58. Error correlations were all significant at $p < .001$ level and ranged from .15 to .30, except for the correlation between the pair of items number 5, which was slightly lower but still significant, $r = .08, p = .006$.

[Figure 1 near here]

A further model was tested without the error correlations, but it yielded worse fit indices compared to the above model [$\chi^2(167) = 2452.14, p < .001$; CFI = .921; TLI = .914; RMSEA = .065; SRMR = .040]. Moreover, the MLR-corrected chi-square difference test indicated that the

model with error covariances fitted the data significantly better than the one without error covariances ($\Delta\chi^2 = 736.21$, $\Delta df = 7$, $p < .001$).

The internal consistency of the three latent factors was computed using Cronbach's alpha. Results indicated high reliability for all of them, with the coefficient of PPS-M ($\alpha = .91$) slightly higher than those of PPS-F and PPS ($\alpha = .89$ for both).

Measurement and structural invariance

Instead of focusing on the overall PPS construct, measurement and structural invariance tests have been conducted on the first-order model in which PPS-M and PPS-F were left free to covary. Even though the two models can be considered substantively equivalent from a statistical point of view, the first-order solution has the advantage of being immune to the risk of under-identification in the multi-group analytical framework, simplifying the entire estimation process.

To check whether the factor structure of our model specification was consistent among different sub-population of participants, a preliminary analysis of baseline models was conducted on groups of students distinguished by gender (females and males), ethnic origins (natives and non-natives), father and mother education level (low, middle, and highly educated). We found general inflation on the χ^2 values, but RMSEA, CFI, and TLI alternative fit indices reached at least acceptable values for all the groups of students we considered in the analysis (Table 2), indicating that data was suitable to proceed with the measurement and structural invariance tests.

We then estimated a total of five hierarchically nested models for each of the grouping variables. The first four models deal with measurement issues related to observable items, testing configural, weak (or metric), strong (or scalar), and common residual covariance invariance, respectively (Byrne, 1988; Meredith, 1993; Widaman & Reise, 1997).

Configural invariance represents the prerequisite condition for assessing the equivalence of all the other parameters in the model and can only be satisfied if the construct at stake has the same

number of factors and the same patterns of free and fixed factor loadings across groups (J. Wang & Wang, 2012). This is the case of our model specification that showed to be at least acceptable in all the cross-group comparisons according to the values of CFI, RMSEA, and TLI reported in Table 2.

We, therefore, proceeded with the analysis of weak measurement invariance, which has to do with the equivalence of slope coefficients obtained regressing observed items on their underlying latent factor (factor loadings). The models fitted the data well, and their values of ΔCFI and ΔMc remained widely below the .01 and .02 cut-off thresholds suggested by Cheung and Rensvold (2002), highlighting the tightness of the invariance hypothesis for all the sub-populations under study.

Similar results can also be inferred from the analyses of strong and common residual covariance invariance. Strong measurement invariance was evaluated constraining items intercepts to be equivalent across groups, to check whether latent mean differences accounted for all the mean differences in the shared variance of the observable items (Putnick & Bornstein, 2016). On the other hand, invariance testing of residual covariances enabled us to assess whether the covariances between residuals operate equally across different groups. Watching at the variations registered in the CFI and Mc alternative fit indices, we can confirm the existence of full measurement invariance between all the groups considered in the analysis.

[Table 2 near here]

In addition to the items related measurement invariance testing procedure, we finally conducted a set of multi-group comparisons focused on PPS-M and PPS-F factor variances and covariances, reflecting the structural equivalence of the derived latent constructs themselves (Vandenberg & Lance, 2000). Also, in this case, the invariance hypothesis held for each of the sub-population under study, both in terms of goodness of fit to the data and variations of the CFI and Mc alternative fit indices with respect to the configural model.

Association between phubbing and feelings of social disconnection

As a preliminary step, a second-order, multilevel CFA was run on the social disconnection scale (SDS), confirming the hypothesized dimensionality with excellent fit indices [$\chi^2(20) = 59.44$, $p < .001$; CFI = .995; TLI = .993; RMSEA = .025; SRMR = .023]. As for the PPS, we estimated two first-order factors, one referring to mother (i.e., SD-M; $\alpha = .69$) and one to father (i.e., SD-F; $\alpha = .70$), and a second-order factor (i.e., overall social disconnection, SD; $\alpha = .78$).

Two multilevel structural equation models (SEMs) were tested to investigate whether phubbing was associated with social disconnection. The first model investigated whether the relationship between phubbing and perceived disconnection was source-specific by running a SEM in which only the first-order factors of both the constructs were included. Specifically, in addition to the measurement models of phubbing and social disconnection, SD-M and SD-F were regressed on both PPS-M and PPS-F. The model yielded good fit indices [$\chi^2(344) = 1909.25$, $p < .001$; CFI = .962; TLI = .958; RMSEA = .037; SRMR = .031]. As displayed in Figure 2, all the regression coefficients were positive and significant at $p < .001$, except for SD-M on PPS-F that had a probability of $p = .014$. Although phubbing from both mother and father was associated with the perception of disconnection from both parents, the source-specificity of these relationships was confirmed by testing a series of model constraints. The influence of PPS-M on SD-M was significantly stronger than that of PPS-F on SD-M ($\Delta b = .15$, $p < .001$), as well as the influence of PPS-F on SD-F compared to the one of PPS-M on SD-F ($\Delta b = .08$, $p < .001$). Consistently, the influence of PPS-M on SD-M was stronger than the influence of PPS-M on SD-F ($\Delta b = .12$, $p < .001$) as well as the influence of PPS-F on SD-F compared to the one of PPS-F on SD-M ($\Delta b = .11$, $p < .001$). The percentage of explained variance was 16% for SD-M and 15% for SD-F.

[Figure 2 near here]

The second model tested whether parental phubbing was associated to the overall parental disconnection, along with source-specific (i.e., mother and father) associations between phubbing

and social disconnection. Results, graphically depicted in Figure 3, indicated a good model fit [$\chi^2(345) = 1915.42, p < .001$; CFI = .962; TLI = .958; RMSEA = .037; SRMR = .032]. The highest standardized regression coefficient was observed for the association between the two second-order factors, $\beta = .29, p < .001$, followed by the association between PPS-M and SD-M, $\beta = .28, p < .001$, and PPS-F and SD-F, $\beta = .26, p < .001$. However, model constraints between all possible pairs of regression coefficients yielded non-significant results (SD on PPS vs. SD-M on PPS-M: $\Delta b = 0.01, p = .80$; SD on PPS vs. SD-F on PPS-F: $\Delta b = 0.04, p = .33$; SD-M on PPS-M vs. SD-F on PPS-F: $\Delta b = 0.03, p = .14$), showing equal magnitude. The highest R^2 was observed for SD-F (.65), followed by SD-M (.51) and SD (.09).

[Figure 3 near here]

Group differences in perceived parental phubbing

Two multilevel distinct MIMIC models have been estimated: one for the two sub-dimension of PPS-M and PPS-F (M1) and another one focused on the overall PPS latent construct (M2). Both models specifications resulted in values of alternative fit indices indicating close fit to the data [M1: $\chi^2(236) = 1475.9, p < .001$; CFI = .949; TLI = .943; RMSEA = .042; SRMR = .027. M2: $\chi^2(212) = 1496.8, p < .001$; CFI = .949; TLI = .943; RMSEA = .044; SRMR = .029]. As for regression coefficients, we found that males perceived to be less phubbed by parents than females and, at the same time, first and second generation of migrants declared to be more exposed to this phenomenon than natives (Table 3). These results were observed for both PPS-M and PPS-F. Although at a first glance the influence of gender and ethnic origin seemed to be stronger for PPS-M than for PPS-F, a direct comparison of the regression parameters yielded non-significant results, demonstrating that gender ($\Delta b = 0.02, p = .61$) and ethnic origin ($\Delta b = -0.04, p = .41$) had the same effect on perceived phubbing from both parents. Conversely, no significant differences in perceived phubbing were found for the education level of parents.

[Table 3 near here]

The analysis conducted on the overall construct of PPS (M2) confirmed that girls and migrant students perceived to be more phubbed by parents than males and natives, while parental education level does not appear to be a relevant predictor of phubbing at the family level.

General Discussion

Human beings have a fundamental need to belong (Baumeister & Leary, 1995); therefore, they are constantly motivated to seek social connections with other individuals to satisfy such need. Digital technologies, smartphones, in particular, offer several attractive ways to fulfill this basic need, providing easy channels to create and maintain connections with people irrespectively of space and time. Indeed, international surveys show how widespread is the use of such technologies worldwide. In 2019, 66.6% of the world population owned a smartphone (+2.0% from 2018) and spent more than 3 hours a day (+4.3% from 2018) using it (We Are Social, 2019).

Within this context, the present study was conceived to investigate phubbing within the parent-child relationship. If being phubbed leads to feelings of relational devaluation, the threat to fundamental psychological needs, and even depression (Chotpitayasunondh & Douglas, 2018; Hales et al., 2018; Roberts & David, 2016; Wang et al., 2017), these effects could be stronger and potentially more detrimental in the long-term when adolescents are phubbed by their parents. This is because communication and parental responsiveness have central roles in children and adolescents' development (Baumrind, 1991; Caughlin & Malis, 2004; Davidov & Grusec, 2006; Kochanska & Aksan, 2004; Pinquart, 2016). However, the adverse consequences of parental phubbing cannot be examined without the proper measurement of the phenomenon. That measure is still lacking; thus, our study aimed at filling in this gap by developing a brief scale of parental phubbing as a preliminary and necessary step in the investigation of this phenomenon.

The results showed that the Parental Phubbing Scale (PPS) is a psychometrically valid measure of adolescents' perception of parental phubbing. The PPS consisted of two highly reliable

sub-dimensions of phubbing (i.e., phubbing of mother and father) that identify an overall dimension of parental phubbing. The PPS demonstrated full measurement and structural invariance for a set of adolescents' and parents' characteristics, indicating that perceived parental phubbing is reliably measured irrespectively of adolescents' gender, ethnic origins, and mother's and father's education level.

The PPS also demonstrated a good concurrent validity. Generally speaking, the perception of phubbing was significantly and positively associated with the feeling of social disconnection from parents. This association held for both the overall measure of parental phubbing and its source-specific components (i.e., phubbing of mother and father). Digging into these associations yielded some insights about how parental phubbing is structured. Phubbing is a construct that primarily emerges in one-to-one interactions; thus its consequences (i.e., an increase of social disconnection) should be observed in a specific relationship between two persons (e.g., the adolescent and one specific parent). This is consistent with our results that showed that the association between phubbing and social disconnection was significantly higher when both the constructs were referred to the same parent than when perceived phubbing was referred to one parent and the feeling of disconnection to the other one. However, the two relationships considered (i.e., adolescent-mother and adolescent-father) are elements of the same meaningful social context, namely the family unit. Thus, the relational dynamics of the two dyads are likely to be influenced by one another, and the dyadic nature of the constructs at stake might be extended to the larger context of the family, making it possible to estimate the overall constructs of parental phubbing and parental social disconnection. Nevertheless, along with the possibility to estimate global parental dimensions, the two constructs primarily concern one-to-one relationships, and this clearly emerged in our analyses. Indeed, the parent-specific associations between phubbing and social disconnection came out as fundamental paths to properly describe the link between adolescents' perception of

being ignored by their parents because of the smartphone and their perceived social distance from their mother and father.

Generally speaking, the positive association between parental phubbing and social disconnection is in line with studies that shed light on phubbing as an instance of social exclusion (Chotpitayasunondh & Douglas, 2018; Hales et al., 2018). However, the present study is the first showing this link in the parent-child relationship. Although the literature on technofeference has paved the way to the investigation of the adverse effects of parents distracted with technological devices (McDaniel & Radesky, 2018; Stockdale et al., 2018), no studies have focused yet on whether phubbed children would feel socially excluded by their parents. Given the importance of the quality of the parent-child relationship, knowing that children being phubbed by their parents feel excluded by them is extremely important. Indeed, feeling disconnected from others is one of the biggest problems in our society (de Jong Gierveld, Van Tilburg, & Dykstra, 2006) and it is related to a wide array of adverse consequences for physical health, cognitive functioning, and emotional sphere (for an overview, see Riva and Eck, 2016). Concerning the parent-child relationship, it is well-known how parenting style affects infants and adolescents' development. For instance, two recent meta-analyses conducted on more than 1,000 studies each (Pinquart, 2016, 2017) found out that low parental responsiveness and neglectful parenting style were associated with children's externalizing problems and worse academic performance. These dimensions of parenting cover a broad spectrum of cognitive, affective, social, and behavioral characteristics. Accordingly, we argue that parental phubbing might be one of the many indicators that identify low responsive or neglectful practices.

Finally, we discuss the differences accounted for by sociodemographic variables. Female and non-native adolescents were more sensitive to both parental and parent-specific phubbing, and no differences emerged between being phubbed by mother or father. This result allows us to generalize the effect of gender and ethnic origin, claiming that females and first and second

generation of migrants are more susceptible to parental phubbing. However, these findings do not mean that parents are more likely to phub their children if the latter were females or migrants, but only that females and migrant adolescents perceive to be more phubbed by their parents. The design of the present research does not allow us to look for the reasons behind these results. Concerning family educational background, we did not find any significant effect on children's perceived phubbing. Although the literature on digital inequality has found solid associations between education level and both perceived digital overuse (Gui & Büchi, 2018) and digital parental mediation style (Livingstone et al., 2015; Nikken & Opree, 2018), in our sample it seems that educational differences do not translate into a different perception of being phubbed.

The main limitation of the present study concerns its correlational nature. Future studies should adopt other methodologies (e.g., experimental, longitudinal) to explore causal links between parental phubbing on adolescents' development and psychological health, to uncover the underlying processes and limit or reduce the adverse effects of this practice. Future studies should also consider younger children to investigate the effects of parental phubbing at different stages of development. Finally, research is needed further to specify the association between parental phubbing and sociodemographic variables.

Conclusions

What are the consequences of the current massive use of smartphones on people's social lives? The present study proposed a new measure that can account for adolescents' perception of experiencing phubbing from their parents, the Parental Phubbing Scale (PPS). The large sample size, the rigorousness of the analyses, and the quality of the results obtained make the PPS a reliable and valid instrument for the research on the underinvestigated phenomenon of parental phubbing. Moreover, the positive association between parental phubbing and social disconnection from parents confirmed the link between phubbing and social exclusion.

Waytz and Gray (2018) have recently tried to theorize the conditions under which technology can impact sociability. The authors claimed that technology might enhance sociability when devices and social media are used to both complement pre-existing, deep offline relationships, or to maintain them when face-to-face interactions are otherwise difficult to attain. Conversely, technology might impair sociability when superficial online interactions supplant deeper face-to-face relationships. However, phubbing, despite having clear negative effects on a person's sociality as reviewed above (e.g., Roberts & David, 2016; Wang et al., 2017), does not necessarily fall into this case. In fact, phubbing might also occur when a "superficial" offline interaction is disrupted by someone communicating online (e.g., via text messages) with a significant other (e.g., the partner or a family member). In this sense, inspired by the effects of phubbing, we argue that the Waytz and Gray's principle about the negative impact of technology on sociability should be rephrased in broader terms as following: technology might impair sociability when offline interactions are disrupted by online ones. In our opinion, the issue is not in the superficiality or depth of the interactions that can occur online and offline, but in the disruption of ongoing offline interactions due to incoming online ones. Greater efforts are needed to explore the impact of these emerging technologies on the ways humans connect each other.

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Table 1. Sample characteristics (N = 3,289): Descriptive statistics of students' sociodemographic and school characteristics.

Variable (value)	Mean (SD)	Frequency (%)
Age	15.2 (0.6)	
Missing		1 (0.0)
Gender		
Male (1)		1,586 (48.2)
Female (2)		1,699 (51.7)
Missing		4 (0.1)
Ethnic origins		
Native (1)		2,859 (87.2)
Other country (2)		420 (12.8)
Missing		10 (0.3)
Mother educational level		
Low (1)		748 (22.7)
Middle (2)		1,548 (47.1)
High (3)		854 (26.0)
Missing		96 (2.9)
Father educational level		
Low (1)		1,000 (30.4)
Middle (2)		1,345 (40.9)
High (3)		769 (23.4)
Missing		175 (5.3)
Type of school		
Lyceum (1)		1,739 (52.9)
Technical Institute (2)		1,106 (33.6)
Professional Institute (3)		444 (13.5)
Missing		0 (0.0)

Table 2. The results of the measurement invariance analyses by children's gender and ethnic origins, and parents' education levels.

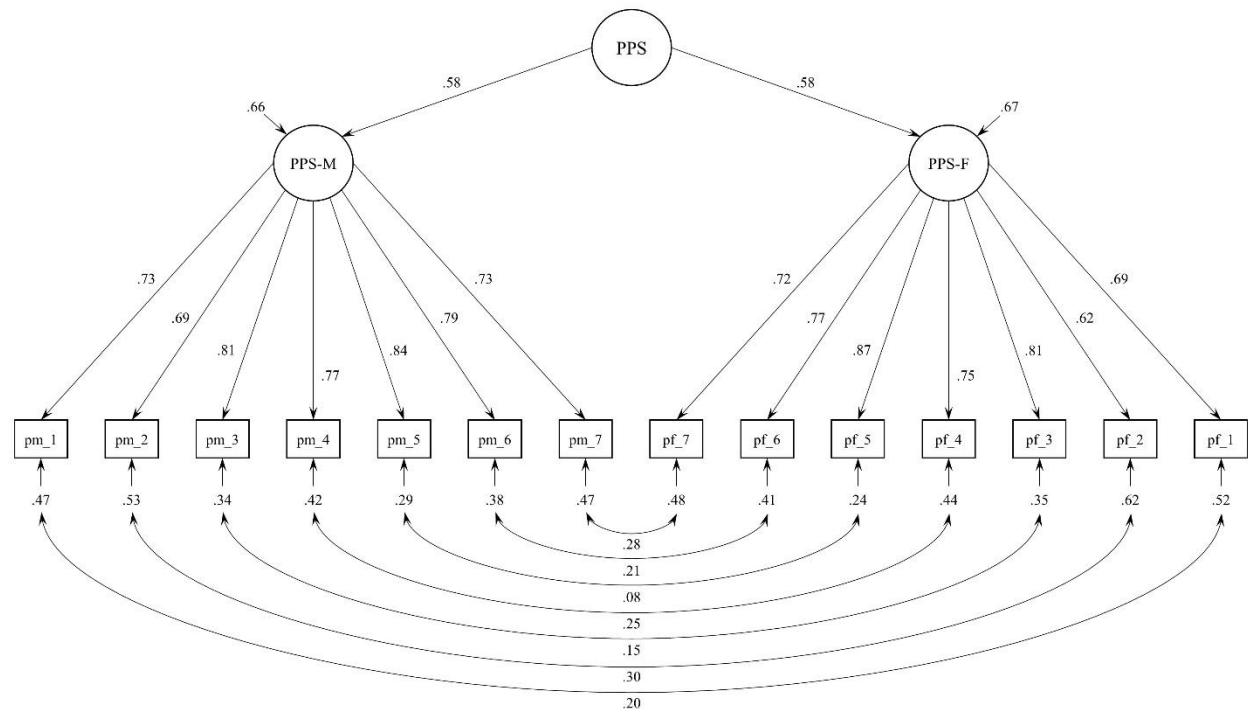
Fit Indices (MLMV estimation method)										
	χ^2	df	χ^2 p-val	RMSEA [90% C.I.]	CFI	TLI	Mc	$\Delta\chi^2$ p-val	ACFI	ΔMc
Gender										
Baseline models										
males	470.7	69	<.001	.062 [.056-.067]	.951	.935	—	—	—	—
females	429.7	69	<.001	.056 [.051-.061]	.961	.949	—	—	—	—
Configural	900.5	138	<.001	.059 [.055-.063]	.956	.942	.655	—	—	—
Weak	923.4	150	<.001	.057 [.053-.060]	.956	.946	.658	.104	.000	-.003
Strong	1039.9	164	<.001	.058 [.055-.061]	.950	.944	.656	<.001	.006	.002
Residual cov.	1042.6	171	<.001	.057 [.053-.060]	.950	.947	.658	.097	.000	-.002
Structural	1070.8	174	<.001	.057 [.054-.060]	.949	.9496	.658	<.001	.001	.000
Ethnic origins										
Baseline models										
natives	713.4	69	<.001	.058 [.054-.062]	.957	.943	—	—	—	—
others	178.6	69	<.001	.063 [.052-.074]	.952	.937	—	—	—	—
Configural	898.0	138	<.001	.059 [.055-.062]	.956	.942	.655	—	—	—
Weak	931.7	150	<.001	.057 [.054-.061]	.955	.945	.657	.056	.001	.002
Strong	990.7	164	<.001	.056 [.053-.060]	.952	.947	.659	<.001	.003	.002
Residual cov.	990.1	171	<.001	.055 [.052-.058]	.953	.950	.661	.500	-.001	.002
Structural	998.5	174	<.001	.054 [.051-.058]	.952	.950	.662	.027	.001	.001
Mother's education level										
Baseline models										
low	271.6	69	<.001	.064 [.056-.072]	.953	.938	—	—	—	—
middle	423.3	69	<.001	.058 [.053-.064]	.956	.943	—	—	—	—
high	243.6	69	<.001	.055 [.048-.063]	.959	.946	—	—	—	—
Configural	932.4	207	<.001	.059 [.055-.062]	.956	.942	.677	—	—	—
Weak	969.9	231	<.001	.056 [.052-.060]	.955	.947	.683	.478	.001	.006
Strong	1015.5	259	<.001	.053 [.050-.057]	.954	.952	.689	.747	.001	.006
Residual cov.	1023.7	273	<.001	.052 [.049-.055]	.955	.955	.693	.425	-.001	.004
Structural	1030.5	279	<.001	.051 [.048-.055]	.955	.956	.694	.134	.000	.001
Father's education level										
Baseline models										
low	318.0	69	<.001	.061 [.054-.068]	.954	.939	—	—	—	—
middle	378.8	69	<.001	.058 [.053-.064]	.957	.944	—	—	—	—
high	234.5	69	<.001	.057 [.049-.065]	.958	.945	—	—	—	—
Configural	929.3	207	<.001	.059 [.055-.062]	.956	.943	.678	—	—	—
Weak	975.8	231	<.001	.056 [.053-.060]	.955	.947	.683	.053	.001	.005
Strong	1040.7	259	<.001	.055 [.051-.058]	.953	.950	.687	.011	.002	.004
Residual cov.	1058.2	273	<.001	.053 [.050-.057]	.953	.953	.690	.067	.000	.003
Structural	1076.5	279	<.001	.053 [.050-.056]	.952	.953	.690	.004	.001	.000

Table 3. The results of the MIMIC models. Standardized estimates (and standard errors) are reported.

	Model 1		Model 2
	PPS-M	PPS-F	PPS
Student characteristics			
Gender (ref. female)			
males	-0.071 (0.021)**	-0.058 (0.022)**	-0.109 (0.033)**
Ethnic origins (ref. natives)			
others	0.074 (0.020)**	0.053 (0.020)**	0.103 (0.028)**
Parents characteristics			
Mother's education (ref. low)			
middle	-0.021 (0.025)	- -	- -
high	-0.040 (0.023)	- -	- -
Father's education (ref. low)			
middle	- -	-0.018 (0.022)	- -
high	- -	-0.002 (0.021)	- -
Parents' education (ref. low)			
middle	- -	- -	-0.022 (0.043)
high	- -	- -	-0.039 (0.044)

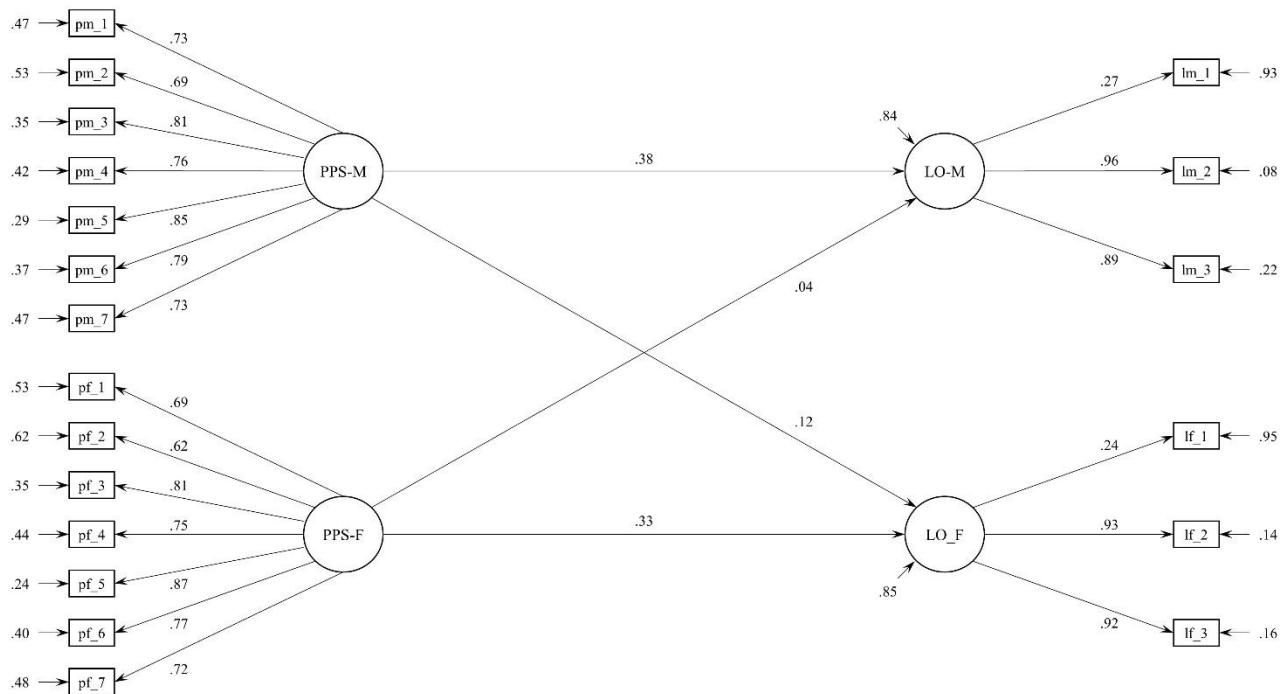
p-value: * ≤ 0.05 ** ≤ 0.01

Figure 1 – The results of the confirmatory factor analysis on the PPS: Standardized parameters are displayed.



Note: PPS = overall dimension of parental phubbing, PPS-M = phubbing perceived from mother, PPS-F = phubbing perceived from father. All the parameters were significant at level $p < .05$.

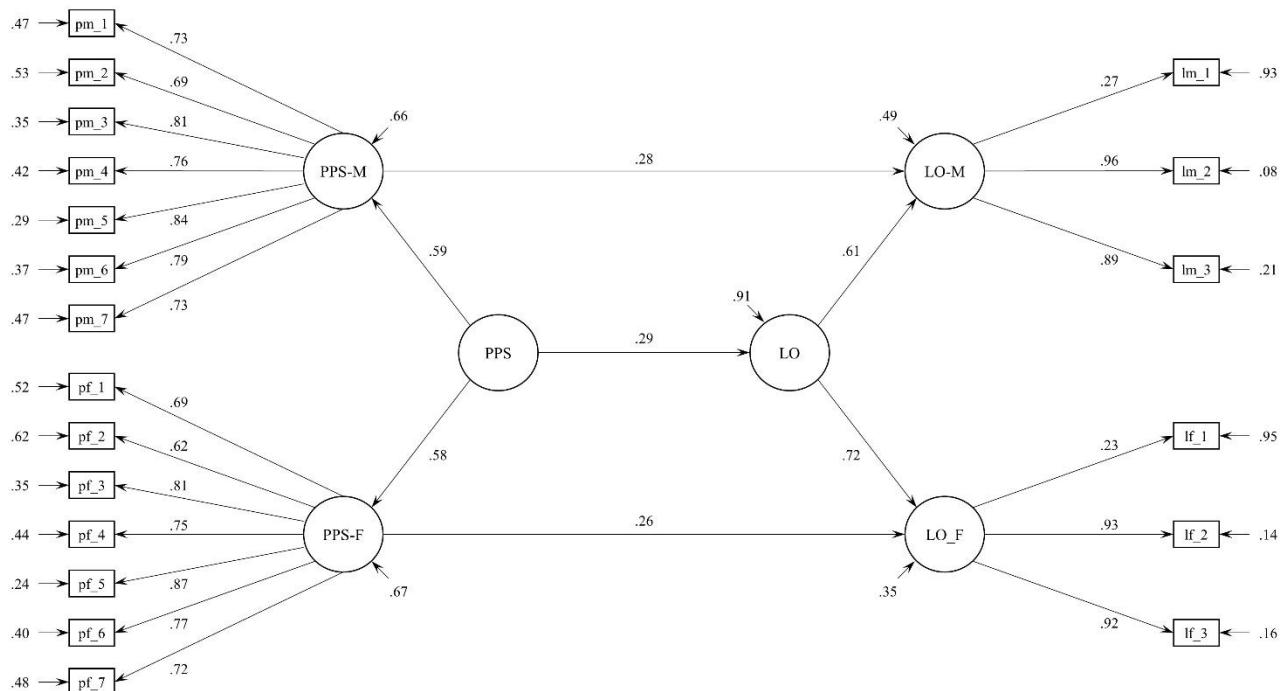
Figure 2 – The results of the structural equation model testing the association between source-specific dimensions of parental phubbing and perceived disconnection from parents: Standardized parameters are displayed.



Note: PPS-M = phubbing perceived from mother, PPS-F = phubbing perceived from father, SD-M = social disconnection perceived from mother; SD-F = social disconnection perceived from father.

All the parameters were significant at level $p < .05$.

Figure 3 – The results of the structural equation model testing the association between overall dimensions of parental phubbing and perceived disconnection from parents: Standardized parameters are displayed.



Note: PPS = overall dimension of parental phubbing, PPS-M = phubbing perceived from mother, PPS-F = phubbing perceived from father, SD = overall dimension of social disconnection from parents, SD-M = social disconnection perceived from mother; SD-F = social disconnection perceived from father. All the parameters were significant at level $p < .05$.

Supplementary Material

Factor Validity

Factor validity concerns the extent to which the selected observable items adequately cover the model specification of the latent construct(s) being studied. The model specification is a set of equations that should reproduce the theoretical relationships across variables; in the context of factor validity, these relationships mainly include loadings of observed variables on latent ones (i.e., constructs) and correlations among the latters. In other words, testing for the factor validity of a theoretical construct concerns defining the model specifications that best fits the available data. The statistical technique of Confirmatory Factor Analysis (CFA) is the most appropriate to test factor validity and compare different model specifications, thus it has been chosen to conduct these analyses.

Measurement and Structural Invariance

The measurement invariance test allowed to check whether the psychometric properties of the latent construct and, therefore, the equations used to create the latent factor scores can be considered equal across sub-populations of interest (1). One of the major threats to this assumption is represented by the risk of measurement bias. It consists in a potential difference between the estimated and the true parameter resulting from the presence of a nuisance factor that produces an undesirable source of measurement variance (2,3). If not seriously taken into account, this kind of bias could drive to inaccurate inferences about the results of any comparative analysis, especially if it works differently on the different sub-populations of interest (1). Considering that one of the purposes of this study was to properly quantify the average differences on PPS-M and PPS-F across groups, we kept under control these interfering factors applying the standard procedure for testing measurement invariance through the *Multi-Group Confirmatory Factor Analysis* (MG-CFA) (4,5). The same technique has also been adopted to evaluate the degree of variability in the first order latent factors variance (i.e., PPS-M and PPS-F) and their correlational relationships across groups of students. This additional

analysis, commonly referred as structural invariance test in the literature (6,7), allowed to check the cross-group stability in both the distribution of PPM-F and PPM-M and the way they relate to each other. Both measurement and structural invariance tests are based on the comparison of the fit of a series of hierarchically nested models. In each step of the analysis, an increasing number of equality constraints were fixed among the estimated parameters, allowing to check the presence of any significant difference in the model specification across groups.

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