



## Research article

## Development and validation of the smartphone addiction risk children questionnaire (SARCQ)

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## ABSTRACT

Smartphone abuse interferes with all activities in daily life. Young people who tend to have a smartphone addiction (SA) also have social, familiar and academic problems. Furthermore, smartphone provides immediate access to communication as well as avoids experiencing social anxiety. This research aims to evaluate the factorial structure of Smartphone Addiction Risk Children Questionnaire (SARCQ), a specific questionnaire created to assess the risk of SA in primary school children (8–11 years). An exploratory factor analysis before and a confirmatory factor analysis after were performed in order to establish the factorial structure of the questionnaire. Results showed a two-factor structure explaining 49.30% of total variance. The outstanding dimensions are: "I'm not afraid with you" (INAWY) and "Linus blanket" (LB). SARCQ will be useful to assess the risk of SA in childhood in order to operate early effective therapeutic interventions.

## 1. Introduction

The use of smartphone has been increasing in the last twenty years. As a consequence, the access to information and data is easier and faster when compared to Personal Computer (PC) (Škařupová et al., 2016). As an example, after the launch of iPhone by Apple, three billion people have been using smartphone since 2007 (Ericsson, 2019).

Smartphone is useful for communication, work, socialization and to get information, but its overuse could cause serious and problematic consequences (Al-Barashdi et al., 2015; Chóliz, 2010).

There are three types of problematic use of smartphone: (i) very dangerous use (e.g. while driving a car); (ii) dispersive use (e.g. use of smartphone during a school lesson); (iii) overuse (Walsh et al., 2007). All these types of misuse could be associated to smartphone addiction (Chóliz, 2012). New technology addiction includes: (i) Internet Addiction (IA) (Kuss et al., 2014); (ii) Internet Gaming Addiction (IGA) (Kuss and Griffiths, 2012); (iii) Smartphone Addiction (SA) (Chóliz, 2012). All these types of addiction show communalities and differences. Their symptoms are similar but the smartphone addiction is subtler due to its easiness of use (e.g. children of all ages can use it) as well as to its versatility and real helpfulness (Elhai et al., 2017).

In 2013, 0.8% of the Italian population were classified as IAD (Kuss et al., 2019) and this percentage increases up to 5% among the

adolescents (Poli et al., 2012; Taranto et al., 2015). Likewise, Rusconi et al. (2012) found a percentage of 2% in subjects from 14 to 18 years old. Recently, Pan et al. (2020) in their epidemiological meta-analysis show that the percentage of IAD in Italy ranged from 1.2% to 22.1% in the last ten years. Furthermore, a problematic smartphone use was observed in Italy in 6.3% of adolescents and this condition is associated with other behavioral addictions (Martinotti et al., 2011). According to ISTAT (2018), 85% and 72% of the Italian adolescents (aged from 11 to 17 years old), daily use smartphone and the Internet, respectively with a prevalence of female (87.5%).

Several researchers proposed many definitions of SA but they all propose a problematic use of human-machine interactions leading to abuse and exclusive relationships at the detriment of many areas of the individual existence, among whom the most important is socialization in presence (Griffiths, 1999; Lin et al., 2014; Gutiérrez et al., 2016).

To understand the construct of problematic smartphone use, it is helpful to comment addiction in the context of the more established models of substance use. Most prominent psychological models of addiction show that compulsory use develops out of a process of positive and negative reinforcement (Robinson and Berridge, 2003; Elhai et al., 2017). The positive reinforcement model of addiction is helpful to explain how smartphone use progresses to pathological use. (i.e. incentive sensitization theory; Robinson and Berridge, 2001).

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Negative reinforcement models suggest that addiction develops as a way to cope with negative emotions. Negative reinforcement models offer a possible mechanism for smartphone use maintenance.

Several pathways are related to negative reinforcement models, as habitual use and checking behaviors (Oulasvirta et al., 2012); seeking reassurance (Billieux et al., 2015); and reluctance to miss information (Przybylski et al., 2013).

Two additional pathways are relevant to both negative and positive reinforcement models because they involve hedonic behaviors intended to boost positive emotions, but also warding off negative ones such as extraversion and impulsivity (Billieux et al., 2015; Smetaniuk 2014; Sororet al. 2015). The extraversion pathway can involve sensation seeking and reward sensitivity, and the impulsivity pathway involves lack of self-control and regulation in managing smartphone use (Billieux et al., 2015). This pathway is also relevant to antisocial personality traits, disinhibition, and attentional deficits (Billieux et al., 2015). Therefore, it should be remarked that the pathways include variables that involve personality traits.

Many personality and socialization problems are directly or indirectly associated to SA. In fact, a relationship between loneliness, shyness and SA has been reported in adults (Bian and Leung, 2015; Kim et al., 2017). Like IA (Reed et al., 2017), SA exhibits deficit of attention, anxiety, loneliness, communication avoidance, reduction of social adaptation and other symptoms belonging to chemical addiction such as drug or alcohol addiction (Kim, 2013; Mendoza et al., 2018). Several studies showed a relationship between IA and social anxiety (Sapacz et al., 2016; Weinstein et al., 2015; Yü lens and Ü zer, 2018; Pzapiorka et al., 2021); low empathy, low openness and low self-esteem (You et al., 2019). Menendez-García et al., 2020 demonstrated an association between SA and Attention Deficit Hyperactivity Disorder (ADHD) in children and adolescents. This association was observed also in Asian samples (Lee et al., 2018; You et al., 2019; Zheng et al., 2014).

Given the multiple repercussions of SA in both personal and social contexts, the search for evidence-based preventive strategies is essential.

Like SA, interventions to prevent IA should also be focused on parents (Lin and Gau, 2013). A meta-analysis (Yen et al., 2007) on the prevention of Internet addiction found an association between some characteristics of the family and the development of IA among adolescents. Yu and Shek (2013), remarked a good parent-child relationship among family protection factors. Some authors (Yen et al., 2007; Flora, 2015) suggest a family-centered approach to prevention.

Hence, it is crucial to have a tool to investigate how the use of smartphones mediates relationships with parents but also with the peer group, which plays an important psychological role in the developmental age.

Another suggestion from the literature of IA is the need to develop tests for the assessment of forms of these addictions (Throuvala et al., 2019; King et al., 2018), which are also distinguished in relation to the tool used to connect (i.e. PC, smartphone), differentiated by age, and adapted to the culture of reference.

In literature, some instruments to assess SA are the Smartphone Addiction Scale (SAS, Kwon et al., 2013), the Smartphone Addiction Measurement Instrument (SAMI, Tossel et al., 2015), and the Smartphone Addiction Inventory (SPAI, Lin et al., 2014).

To date, a questionnaire to assess smartphone risk in children in Italy does not exist. Therefore, this research aims to implement the questionnaire for generalized smartphone addiction risk in children. In fact, generalized problematic smartphone use refers to a multidimensional and generalized behavioral patterns of smartphone use that could cause negative effects (Ponte et al., 2015; Chen et al., 2020).

Smartphone Addiction Risk Children Questionnaire (SARCQ) is a questionnaire aiming to assess the risk of SA in primary school children (8–11 years) in Italy. Thus, the evaluation of factorial structure by exploratory-confirmatory factor analysis will be crucial to use the questionnaire also in other contexts.

## 2. Materials and methods

### 2.1. Participants

This study was carried out on a sample of 470 children, 253 males and 218 females, with an average age of 108.3 months (SD = 9.7). Table 1 shows the frequency distribution of the age variable across the sample.

All the parents of participants signed the informed consent. The research was approved by the Ethic Board of the University of Cagliari. The Smartphone Addiction Risk Children Questionnaire (SARCQ) was administered to each child collectively in classrooms (primary school) under supervision of three researchers. All participants and their parents were informed that both questionnaire and data collection were anonymous, and an identification code was created for each participant. Since all the participants were teenagers, parents read and signed a document containing information on the aim of the research, data processing and informed consent for the processing of data, the participation in the survey, and the use of the data for research purposes. This study was carried out in respect of the provisions of the Declaration of Helsinki in 1995 (as revised in Edinburgh, 2000).

All participants were Caucasian. They were recruited from 6 schools of the district of Cagliari, south Sardinia, Italy, from March 2019 to June 2019. These schools accepted to take part in this research after a general request addressed to all the schools belonging to this district.

### 2.2. Materials

#### 2.2.1. Questionnaire development

Preliminary steps were constructed through research of existing tests on smartphone problematic use or addiction.

The test construction was based on other tests such as: Smartphone Addiction Scale Short Version (SAS-SV, Kwon et al., 2013), the smartphone Overuse Screening Questionnaire (SOS-Q, Lee et al., 2017), the Problematic Smartphone Use Scale (Bianchi and Philips, 2005) and the Smartphone Addiction Inventory (SPAI, Lin et al., 2014).

A group of Psychology scholars, experts in new technology addiction, were commissioned to translate the scales into the Italian language and to choose the items adapted to 8-year old children.

The chosen questionnaires assess issues such as: preoccupation with smartphone use (e.g. I check my smartphone to see if anyone has called or sent a message to me); distress if the smartphone is off or not available (e.g. I get angry if I cannot use my smartphone); problems with relationship or activity in general (e.g. I use my smartphone instead of doing something else); loss of control and overuse (e.g. I go to sleep late because I use my smartphone); use of smartphone to avoid negative emotions (e.g. I use my smartphone to get better when I'm sad) and, last, use of smartphone as a transitional object (Winnicott, 1971) (e.g. When I take my smartphone with me I feel closer to mom and dad). A transitional object is something, usually a physical object (Winnicott, 1971), that provides psychological comfort to the child progressively replacing the symbiotic mother-child bond. After the first draft, each question was submitted to a sample of 20 children (aged 8–10 years) to verify the understanding and ask them a new version with words familiar to the children language and slang. The questionnaire should not be too long because children have a low sustained attention.

In the first page questions about age, gender, and use or not of smartphone was introduced to select the sample. The following items were removed:

Table 1. Frequency distribution of age.

8 years	9 years	10 years	11 years
18	187	220	46

- 1) "I use smartphone instead of playing with my friend" because it is similar to: "I use smartphone instead of doing something else".
- 2) "I take my smartphone with me" was removed because nearly all sample had answered "Yes".
- 3) "I need to spend an increasing amount of time on smartphone to achieve some satisfaction as before" was removed because not clear for the sample.

The last version of questionnaire included 13 questions and two distractors with questions on the Internet. This choice was made because the child does not focus only on the smartphone and partially avoids responses due to social desirability.

### 2.2.2. Smartphone Addiction Risk Children Questionnaire (SARCQ)

Smartphone Addiction Risk Children Questionnaire (SARCQ) is a 13-item questionnaire. The items measuring smartphone addiction are 11 and two are distraction items.

The smartphone addiction items were:

- item 1: "I check my smartphone to see if anyone has called or sent me a message";
- item 2: "I need to keep my smartphone with me to feel more confident";
- item 3: "I feel alone if I can't use my smartphone";
- item 4: "When I take my smartphone with me I feel closer to mom and dad";
- item 5: "I get angry if I cannot use my smartphone";
- item 6: "I use my smartphone instead of doing something else (for example: play, draw, stay with friends)";
- item 7: "When I take my smartphone with me, I feel safer";
- item 8: "I use my smartphone to get better when I'm sad";
- item 9: "Mom and dad are calmer when I take my smartphone with me";
- item 10: "I feel sad if something bad is happening and I cannot use my smartphone";
- item 11: "I go to sleep late because I use my smartphone".

Distractor items were:

"I usually use the computer to do my homework", and "I usually use the computer to play".

The answers were at 3-point Likert scale: 1-never; 2-sometimes, 3-always.

This 3-pointed scale is frequently used in children tests (e.g. Big Five Children, Barbaranelli et al., 2003), because, at their age (i.e. 8-10 years), they are not able to perform more complicated discriminations than can be found in more complex scales.

On the first page of the questionnaire there were these questions:

"Are you a boy or a girl?"

"Do you use the smartphone?"

"How old are you?"

### 2.3. Data analysis

The data collection consists of the answers of each subject to the SARCQ where: 1 (strong disagreement); 2 (moderate agreement); 3 (total agreement) for each of the 11 statements in the questionnaire.

The exploratory factor analysis aims to extract latent-dimensioned factors underlying item scores.

All questionnaires (470) were statistically treated both from a descriptive and structural point of view, through the application of exploratory factor analysis (EFA) followed by a confirmatory factor analysis (CFA). The 1-way ANOVA was carried out to observe differences between males and females.

Further, the confirmatory factor analysis was performed. This analysis allows to calculate the individual factorial scores from two latent traits. Through a linear composition of the factor loadings estimated by the CFA model multiplied by the scores provided by the participants to each item associated with the latent trait components.

## 3. Results

The data set has been initially processed by the statistical package SPSS 24 and then by package LisRel 8.8. The graph has been plotted by R package 4.0.

Concerning the preliminary question: "Do you use the smartphone?" 89% answered "Yes".

Frequencies, mean and standard deviation (SD), skewness and kurtosis were performed for individual items. Skewness and Kurtosis were used to evaluate the relevance of the expected normal asymmetry of SARCQs items in the direction of little or moderate children's problems. Specifically, skewness ranged from -.067 to 1.224 and Kurtosis ranged from -1.521 to 2.093. Table 2 displays the main descriptive statistics and their standard errors.

Table 3 shows the frequency distributions obtained for each scale value across the 11 items of SARCQ.

Figure 1 shows the trends of agreement-disagreement with the statements of the questionnaire. Scores 1 are the frequencies of response of "full disagreement"; scores 2 are the frequencies of "moderate agreement"; scores 3 are the frequencies of "full agreement".

Therefore, score 1 and score 3 show the highest and lowest frequencies, respectively. Score 2 in an intermediate position, denotes a full decreasing monotonicity of the scale values with respect to the frequency distribution of the individual items.

Further, the different frequency profiles (Figure 1), exhibit the degree of internal discrimination to each single item is high with the exception of item 1: "I check my smartphone to see if anyone has called or sent me a message", which shows an equipartition of the sample regarding the agreement frequencies to the three values of the Likert scale (1-never; 2-sometimes, 3-always). Conversely, the highest level of internal discrimination has been observed for item 3: "I feel alone if I can't use my smartphone".

No significant differences between males and females for each item of SARCQ have been observed ( $p < 0.05$ ).

### 3.1. Factor analyses

#### 3.1.1. Exploratory factor analysis

In order to evaluate the factor structure of SARCQ, a EFA was performed. Results of the exploratory factor analysis (EFA) to assess the number of underlying dimensions of SARCQ, and related factor loadings for each dimension, are shown in Table 4. Like SPSS 24, the ML extraction method was used to reach the best link between the EFA solution and the algorithmic solution used by the LisRel 8.8 software (Jöreskog, 1967, Finney, DiStefano, 2013). The 2-factor solution of EFA explained 49.30% of the total variance. The factors were named INAWY (I'm not afraid with you) and LB (Linus Blanket).

Using the EFA solution, a confirmatory factor analysis of first order was submitted to the statistical package LisRel 8.8 (see Jöreskog and Sörbom, 1988).

#### 3.1.2. Confirmatory factor analysis

In order to verify the factor's structure of exploratory factor analysis, a confirmatory factor analysis was performed using LisRel 8.8 (Jöreskog, 1969; Jöreskog, 1979). Table 5 shows the values of the estimated structural parameters  $\Lambda_x$  that points out the strength of the association between the item and the latent tracts involving both the INAWY and LB factors. The two-dimensional solutions offered by the confirmatory factor analysis has been parametrically reported in Table 5.

**Table 2.** Main statistical description of the total sample.

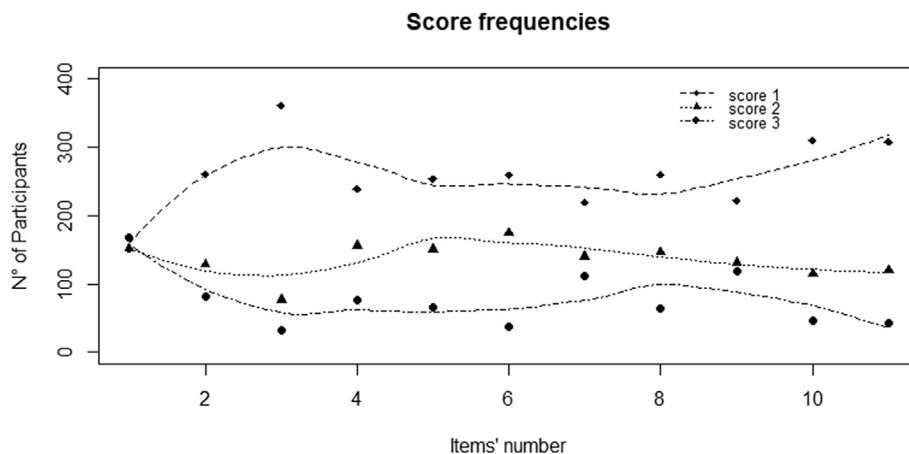
Descriptive Statistics								
	Mean	S. E. of the mean	Median	Std. Deviation	Skewness	S. E. of Skewness	Kurtosis	S. E. of Kurtosis
Item 1	2.04	.038	2	.823	-.067	.113	-1.521	.225
Item 2	1.62	.035	1	.762	.769	.113	-.874	.225
Item 3	1.3	.027	1	.594	1.809	.113	2.093	.225
Item 4	1.65	.034	1	.742	.654	.113	-.916	.225
Item 5	1.6	.033	1	.722	.768	.113	-.720	.225
Item 6	1.53	.029	1	.638	.805	.113	-.39	.225
Item 7	1.77	.037	2	.807	.444	.113	-1.327	.225
Item 8	1.59	.033	1	.721	.809	.113	-.667	.225
Item 9	1.78	.038	2	.821	.428	.113	-1.389	.225
Item 10	1.44	.031	1	.665	1.224	.113	.234	.225
Item 11	1.44	.030	1	.655	1.212	.113	.247	.225

**Table 3.** Score by items: Frequencies of the total sample.

Frequencies											
	item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11
Score 1	151	261	361	239	254	259	220	260	222	310	308
Score 2	152	129	77	156	151	175	140	146	131	115	120
Score 3	168	81	33	76	66	37	111	65	118	46	43

The association between latent tracts and items was marked in bold to show the strong association between items and latent tract, respectively for INAWY and LB structural components. All the  $\lambda^x$  parameters were statistically different from zero ( $p < 0.05$ ).

The two latent dimensions, respectively INAWI and LB, show a significant correlation with a structural parameter value equal to  $\varphi = 0.62$  ( $t = 16.55$ ;  $p < 0.05$ ) that exhibits a moderate association between the two latent components. By means of the EFA and CFA we were able to



**Figure 1.** Frequency splines for each score and items.

**Table 4.** Factorial solution with maximum-likelihood method.

Factorial solution											
Items	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11
F1	.578	.576	.614	.518	.707	.543	.720	.749	.513	.712	.605
F2	.262	.247	-.207	.465	-.322	-.200	.377	-.213	.474	-.385	-.075

**Table 5.** Confirmatory factor solution (Lambda-X).

LAMBDA-X											
Items	1	2	3	4	5	6	7	8	9	10	11
INAWY			<b>0.65*</b>		<b>0.77*</b>	<b>0.58*</b>		<b>0.78*</b>		<b>0.79*</b>	<b>0.60*</b>
LB	<b>0.64*</b>	<b>0.63*</b>		<b>0.66*</b>			<b>0.83*</b>		<b>0.66*</b>		

**Table 6.** Main indexes of goodness of fit.

Goodness of fit indexes						
DF	GFI	AGFI	RMR	RMSEA	NFI	$\chi^2/DF$
43	0.94	0.91	0.029	0.075	0.96	3.526

confirm the two-factor structure of SARCQ, considering the goodness of fit index reported in Table 6. EFA and CFA solutions, jointly, denote a latent structure interpretation converging to a two-dimensional interpretation, conveyed by items (3, 5, 6, 8, 10, 11), to the first factor named (INAWY). This effectively represents the addiction and the inability of handling negative emotions and loneliness.

The second factor named (LB) was related to smartphone usage as a transitional object: the confirmatory analysis highlighted the strong association of the items 1, 2, 4, 7, 9 with this latent dimension.

Figure 2 shows the parametric solution obtained from the confirmatory factor analysis with the ML solution method.

A second order factor analysis has been applied to the data set. To verify the satisfactory adequacy of the first order solution, a second order analysis has been carried out. Results obtained from the second order solution show that no second order dimensions tends to be relevant. Therefore, the two-component solution seems to convey the most adequate data interpretation and dimensional reduction of the collected data. Analyzing in detail the Lambda- $\lambda$  ( $\lambda^x$ ) values (Table 5) the following items proved to be more consistent with factor INAWY: item 10, "I feel sad if something bad is happening and I cannot use my smartphone" ( $\lambda^x = 0.79$ ); item 8: "I use my smartphone to get better when I'm sad" ( $\lambda^x = 0.78$ ) and item 5: "I get angry if I cannot use my smartphone" ( $\lambda^x = 0.77$ ). As for LB factor, item 7: "When I take my smartphone with me, I feel safer" is the more efficient in terms of explained variance ( $\lambda^x = 0.83$ ).

The residual explained variance of factor LB is equally partitioned among the remaining items: 1, 2, 4, 9 with a  $\lambda^x$  mean value of 0.65.

Table 7 and Table 8 show the theta-delta parametric values associated to the random errors, and estimated by the CFA model solution for INAWY and LB latent traits, respectively. No significant values have been evaluated as different from zero.

Table 9 and Table 10 show the reliability coefficients ( $R^2$ ) for each item with respect to the confirmed two-factor solution for INAWY and for LB, respectively. All the estimated parameters passed the zero-difference test.

Figure 2 shows the graphic solution of the confirmatory factor model with structural standardized parametric values.

The Cronbach's alpha reliability coefficients for the two dimensions are equal to 0.849 for INAWY and 0.814 for LB, respectively.

Goodness of fit indexes (GFI and AGFI) were very high and the error components (RMR and RMSEA) were very low.

Last, the factor scores for each subject related to each dimension (INAWY and LB) were computed.

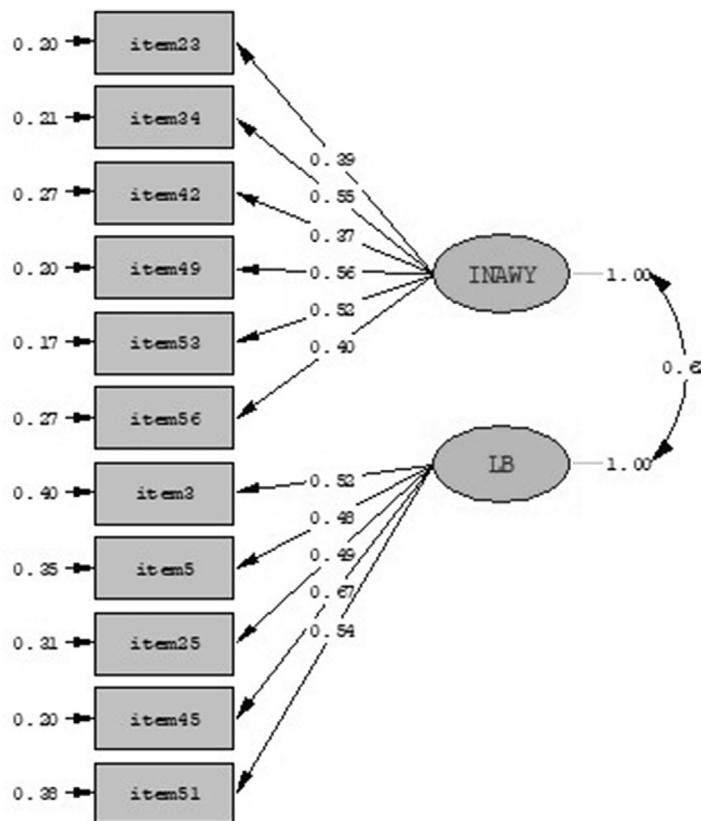
Figure 3 shows the score distribution for INAWY and LB, respectively.

**Table 7.** Theta-delta for INAWY

Item 3	Item 5	Item 6	Item 8	Item 10	Item 11
0.57	0.41	0.66	0.39	0.38	0.64

**Table 8.** Theta-delta for LB.

Item 1	Item 2	Item 4	Item 7	Item 9
0.59	0.61	0.56	0.31	0.57



Chi-Square=151.92, df=43, P-value=0.00000, RMSEA=0.073

**Figure 2.** Factor structure of the confirmatory model.

**Table 9.** Squared multiple correlations for INAWY.

Item 3	Item 5	Item 6	Item 8	Item 10	Item 11
0.43	0.59	0.34	0.61	0.62	0.36

**Table 10.** Squared multiple correlations for LB.

Item 1	Item 2	Item 4	Item 7	Item 9
0.41	0.39	0.44	0.69	0.43

Table 11 shows the percentage distribution of weighted scale values for the two factor dimensions.

**4. Discussion**

Smartphone has become a prevalent technology, useful for fast access to digital information and communication (Lemola et al., 2015). This kind of technology is useful for working, communication and relationships, but its overuse is associated with adverse and problematic effects (Al-Barashdi et al., 2015; Chen et al., 2016; James and Drennan, 2005; Wang et al., 2015). The problematic use of smartphone interferes with activities in daily life and affects interpersonal relationships (Al-Barashdi et al., 2015).

Concerning literature (negative and positive reinforcement models of addiction and parental and social protective factors), this research aimed at evaluating the risk of SA in children. Hence, a questionnaire has been created: Smartphone Addiction Risk Children Questionnaire (SARCQ). The 11 items of SARCQ are related to two dimensions:

- A) The first dimension named “I’m not afraid with you” (INAWY) is related to handle negative emotions and loneliness. This dimension is related to the use of smartphone to avoid negative emotions and its use as a relief. It is related to escape from reality, stress and unhappiness (Goldberg, 1995). Moreover, it is also related to the use of smartphone instead of dealing with negative emotions such as fear, sadness and anger. Boys and girls increase the smartphone use to compensate the negative feeling due to negative emotions: “I don’t feel them so they aren’t there!” This dimension is also related to the “addiction”: boys and girls feel bad if they cannot have their smartphone with them. The

items correlated to INAWY are: “I feel alone if I can’t use my smartphone”, “I get angry if I can’t use my smartphone”, “I use my smartphone instead of doing something else (for example: play, draw, stay with friends)”, “I use my smartphone to get better when I’m sad”, “I feel sad if something bad is happening and I cannot use my smartphone” and “I go to sleep late because I use my smartphone”.

- B) The second factor “Linus’ blanket” (LB) is inspired by the well-known cartoon’s character who held a protective blanket. This dimension is related to the use of smartphone in relationship with parents and friends and not to miss them. Thus, the smartphone becomes a transitional object for boys and girls. This dimension is related to socialization difficulties and avoids any direct contact with the others or to sublimate their absence. LB is correlated to: “I check my smartphone to see if anyone has called or sent me a message”, “I need to keep my smartphone with me to feel more confident”, “When I take my smartphone with me I feel closer to mom and dad”, “When I take my smartphone with me, I feel safer” and “Mom and dad are calmer when I take my smartphone with me”.

**5. Conclusions**

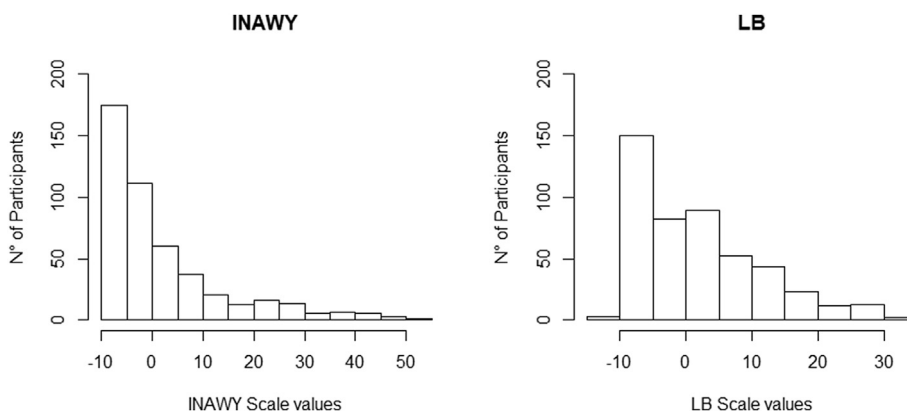
Smartphone overuse can give repercussions in both personal and social contexts. Thus, the preventive aspect is crucial. In fact, the present research aimed to develop a tool to evaluate the risk of SA in children, able to support the recognition of the need for preventive (or early therapeutic treatments) interventions on addiction. Hence, prevention will certainly be more effective by intervening during childhood and/or adolescence rather than during adulthood when disturbs caused by SA can be serious and more difficult to cope with.

Thus, this research adds a new specific assessment tool, suitable for a very young population, which can also be used for screening.

This research also shows some limitations and opportunities for future studies.

The validation of this questionnaire could be a potential starting point for some further research in very young children. Smartphone use is affected by cultural aspects and varies across social groups and countries. Furthermore, it changes over time.

More details about problematic smartphone use risk is useful. For example, more information on the context: Facebook, Whatsapp, Instagram could be an interesting future research area.



**Figure 3.** Score distribution for INAWY and LB.

**Table 11.** Scale scores.

	Min	10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
INAWY	-9.69	-6.75	-5.87	-5.87	-4.46	-2.62	-0.55	3.57	9.16	22.34	52.13
LB	-11.57	-6.26	-6.26	-5.33	-3.32	-0.05	2.16	5.37	10.07	15.55	31.73

## Declarations

### Author contribution statement

Stella Conte: Conceived and designed the experiments; Wrote the paper.

Carla Ghiani: Conceived and designed the experiments; Performed the experiments.

Eraldo Nicotra: Analyzed and interpreted the data.

Andrea Bertucci: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Roberto Truzoli: Conceived and designed the experiments; Wrote the paper.

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### Data availability statement

Data will be made available on request.

### Declaration of interests statement

The authors declare no conflict of interest.

### Additional information

No additional information is available for this paper.

## References

- Al-Barashdi, H., Bouazza, A., Jabur, N., 2015. Smartphone addiction among university undergraduates: a literature review. *J. Sci. Res. Rep.* 4 (3), 210–225.
- Bian, M., Leung, L., 2015. Linking loneliness, shyness, smartphone addiction symptoms, and patterns of smartphone use to social capital. *Soc. Sci. Comput. Rev.* 33 (1), 61–79.
- Bianchi, A., Philips, J.G., 2005. Psychological predictions of problem mobile phone use. *CyberPsychol. Behav.* 8 (1), 39–51.
- Billieux, J., Maurage, P., Lopez-Fernandez, O., Kuss, D.J., Griffiths, M.D., 2015. Can disordered mobile phone use be considered a behavioral addiction? An update on current evidence and a comprehensive model for future research. *Curr. Add. Rep.* 2 (2), 156–162.
- Chen, J., Liang, Y., Mai, C., Zhong, X., Qu, C., 2016. General deficit in inhibitory control of excessive smartphone users: evidence from an event-related potential study. *Front. Psychol.* 7, 511.
- Chen, I.H., Pakpour, A.H., Leung, H., Potenza, N.M., Su, J.A., Lin, C.Y., Griffiths, M.D., 2020. Comparing generalized and specific problematic smartphone Internet use: longitudinal relationship between smartphone application based addiction and social media addiction and psychological distress. *J. Behav. Addict.*
- Chóliz, M., 2010. Mobile phone addiction: a point of issue. *Addiction* 105 (2), 373–374.
- Chóliz, M., 2012. Mobile-phone addiction in adolescence: the test of mobile phone dependence (TMD). *Prog. Health Sci.* 2 (1), 33–44.
- Elhai, J.D., Dvorak, R.D., Levine, J.C., Hall, B.J., 2017. Problematic smartphone use: a conceptual overview and systematic review of relations with anxiety and depression psychopathology. *J. Affect. Disord.* 207, 251–259.
- Ericsson, 2019. *Mobility Report. Q2 Update*, 1–4. <https://www.ericsson.com/en/press-releases/2015/6/ericsson-mobility-report-70-percent-of-worlds-population-using-smartphones-by-2020>.
- Flora, K., 2015. Internet Addiction Disorder Among Adolescents and Young Adults: the Picture in Europe and Prevention Strategies. <https://hephaestus.nup.ac.cy/handle/11728/82>.
- Griffiths, M., 1999. Internet addiction: fact or fiction? *Psychol.* 12 (5), 246–250.
- Gutiérrez, J.D.S., de Fonseca, F.R., Rubio, G., 2016. Cell-phone addiction: a review. *Front. Psychiatr.* 7, 175.
- James, D., Drennan, J., 2005. Exploring addictive consumption of mobile phone technology. In: Australian and New Zealand Marketing Academy Conference. Perth, Australia.
- Jöreskog, K.G., 1967. Some contributions to maximum likelihood factor analysis. *Psychometrika* 32 (4), 443–482.
- Jöreskog, K.G., 1969. A general approach to confirmatory maximum likelihood factor analysis. *Psychometrika* 34 (2), 183–202.
- Joreskog, K.G., 1979. *Advances in Factor Analysis and Structural Equation Models*. Abt Books, Cambridge.
- Joreskog, K.G., Sörbom, D., 1988. *Lisrel 7: A Guide to the Program and Applications*. Spss, Chicago.
- Kim, H., 2013. Exercise rehabilitation for smartphone addiction. *J. Exer. Rehabil.* 9 (6), 500–505.
- Kim, E., Cho, I., Kim, E.J., 2017. Structural equation model of smartphone addiction based on adult attachment theory: mediating effects of loneliness and depression. *Asian Nurs. Res.* 11 (2), 92–97.
- King, D.L., Delfabbro, P.H., Doh, Y.Y., et al., 2018. Policy and prevention approaches for disordered and hazardous gaming and internet use: an international perspective. *Prev. Sci.* 19 (2), 233–249.
- Kuss, D., Griffiths, M.D., 2012. Internet gaming addiction: a systematic review of empirical research. *Int. J. Ment. Health Addiction* 10, 278–296.
- Kuss, D., Griffiths, M., Karila, L., Billieux, J., 2014. Internet addiction: a systematic review of epidemiological research for the last decade. *Curr. Pharmaceut. Des.* 20, 4026–4052.
- Kwon, M., Lee, J.Y., Won, W.Y., et al., 2013. Development and validation of a smartphone addiction scale (SAS). *PLoS One* 8 (2), 505e51.
- Lee, H.K., Kim, J.H., Fava, M., Mischoulon, D., Park, J.H., Shim, E.J., Lee, E.H., Lee, H.J., Jean, H.J., 2017. Development and validation study of smartphone overuse screening questionnaire. *Psychiatr. Res.* 257, 352–357.
- Lee, J.Y., Kim, S.Y., Bae, K.Y., Kim, J.M., Shin, I.S., Yoon, J.S., Kim, S.W., 2018. Prevalence and risk factors for problematic Internet use among rural adolescents in Korea. *Asia Pac. Psychiatr.* 10, e12310.
- Lemola, S., Perkinson-Gloor, N., Brand, S., Dewald-Kaufmann, J.F., Grob, A., 2015. Adolescents' electronic media use at night, sleep disturbance, and depressive symptoms in the smartphone age. *J. Youth Adolesc.* 44 (2), 405–418.
- Lin, Y., Gau, S.S., 2013. Association between morningness-eveningness and the severity of compulsive Internet use: the moderating role of gender and parenting style. *Sleep Med.* 14 (12), 1398–1404.
- Lin, Y.H., Chang, L.R., Lee, Y.H., Tseng, H.W., Kuo, T.B.J., Chen, S.H., 2014. Development and validation of the smartphone addiction inventory (SPAI). *PLoS One* 9 (6), e98312.
- Mendoza, J.S., Pody, B.C., Lee, S., Kim, M., McDonough, I.M., 2018. The effect of cellphones on attention and learning: the influences of time, distraction, and nomophobia. *Comput. Hum. Behav.* 86, 52–60.
- Menendez-García, A., Jiménez-Arroyo, A., Rodrigo-Yanguas, M., Marin-Vila, M., Sánchez-Sánchez, F., Roman-Riechmann, E., Blasco-Fontecilla, H., 2020. Adicción a Internet, videojuegos y teléfonos móviles en niños y adolescentes: un estudio de casos y controles (Internet, video game and mobile phone addiction in children and adolescents: a case-control study). *Adicciones* in press.
- Oulasvirta, A., Rattenbury, T., Ma, L., Raita, E., 2012. Habits make smartphone use more pervasive. *Pers. Ubiquitous Comput.* 16, 105–114.
- Przybylski, A.K., Murayama, K., DeHaan, C.R., Gladwell, V., 2013. Motivational, emotional, and behavioral correlates of fear of missing out. *Comput. Hum. Behav.* 29, 1841–1848.
- Pzepliorka, A., Blachnio, A., Cudo, A., Kot, P., 2021. Social anxiety and social skills via problematic smartphone use for predicting somatic symptoms and academic performance at primary school. *Comput. Educ.*
- Reed, P., Romano, M., Re, F., et al., 2017. Differential physiological changes following Internet exposure in higher and lower problematic Internet users. *PLoS One* 12 (5).
- Robinson, T.E., Berridge, K.C., 2003. Addiction. *Annu. Rev. Psychol.* 54, 25–53.
- Sapacz, M., Rockman, G., Clark, J., 2016. Are we addicted to our cell phones? *Comput. Hum. Behav.* 57, 153–159.
- Škarupová, K., Ólafsson, K., Blinka, L., 2016. The effect of smartphone use on trends in European adolescents' excessive Internet use. *Behav. Inf. Technol.* 35 (1), 68–74.
- Smetaniuk, P., 2014. A preliminary investigation into the prevalence and prediction of problematic cell phone use. *J. Behav. Addict.* 3, 41–53.
- Throuvala, M.A., Griffiths, M.D., Rennoldson, M., Kuss, D.J., 2019. School-based prevention for adolescent Internet addiction: prevention is the key. A systematic literature review. *Curr. Neuropharmacol.* 17 (6), 507–525.
- Tosset, C., Kortum, P., Shepard, C., Rahmati, A., Zhong, L., 2015. Exploring smartphone addiction: insights from long-term telemetric behavioral measures. *Int. J. Interact. Mob. Technol.* 9 (2), 37–43.
- Walsh, S.P., White, K.M., Young, R.M., 2007. Young and connected: psychological influences of mobile phone use amongst Australian youth. In: Goggin, G., Hjorth, L. (Eds.), *Mobile Technologies: from Telecommunications to media*, 2. Routledge, New York, USA, pp. 204–207.
- Wang, J.L., Wang, H.Z., Gaskin, J., 2015. Wang LH. The role of stress and motivation in problematic smartphone use among college students. *Comput. Hum. Behav.* 53, 181–188.
- Weinstein, A., Dorani, D., Elhadif, R., Boukouza, Y., Yomulnik, A., Donnon, P., 2015. Internet addiction is associated with social anxiety in young adults. *Ann. Clin. Psychiatr.* 27 (1), 4–9. PMID: 25696775.
- Winnicott, D.W., 1971. *Gioco e realtà*. Fabbri Editore, Milano.
- Yen, J.Y., Yen, C.F., Chen, C.C., Chen, S.H., Ko, C.H., 2007. Family factors of internet addiction and substance use experience in Taiwanese adolescents. *Cyberpsychol. Behav.* 10, 323–329.
- You, Z., Zhang, Y., Zhang, L., Xu, Y., Chen, X., 2019. How does self-esteem affect mobile phone addiction? The mediating role of social anxiety and interpersonal sensitivity. *Psychiatr. Res.* 271, 526–531.

Yu, L., Shek, D.T.L., 2013. Internet addiction in Hong Kong adolescents: a three-year longitudinal study. *J. Pediatr. Adolesc. Gynecol.* 26 (3), S10–S17.

Yülens, B., Üzer, A., 2018. The relationship between internet addiction, social anxiety, impulsivity, self-esteem and depression in a sample of Turkish undergraduate medical students. *Psychiatr. Res.* 267, 313–318.

Zheng, F., Gao, P., He, M., Li, M., Wang, C., Zeng, Q., et al., 2014. Association between mobile phone use and inattention in 7102 Chinese adolescents: a population-based cross-sectional study. *BMC Publ. Health* 14, 1022.