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Too good to be cautious:

High implicit self-esteem predicts self-reported dangerous mobile phone use

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2 **High implicit self-esteem predicts self-reported dangerous mobile phone use**

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1 **Abstract**

2 Mobile phone use and misuse have become a pressing challenge in today's society. Dangerous
3 mobile phone use, such as the use of a mobile phone while driving, is widely practiced, **though**
4 **banned in several jurisdictions. Research aiming at unfolding** the psychological predictors of
5 dangerous mobile phone use **have so far been scarce**. Especially, researchers have never taken
6 the role of self-esteem into account, which is unfortunate **given prior** research linking self-
7 esteem to addictive mobile phone use. In the present study, we evaluated the associations
8 between both explicit and implicit self-esteem and dangerous mobile phone use, with a
9 particular focus on phoning while driving. **To do so**, we assessed implicit self-esteem among
10 95 participants (89 females) via the Implicit Association Test and explicit self-esteem via a self-
11 reported measure. Problematic mobile phone use and demographic data were assessed with
12 self-reported measures. Implicit self-esteem predicted dangerous mobile phone use, even after
13 we controlled for demographic data and mobile phone dependence. Explicit self-esteem,
14 however, was related to neither dependence nor dangerous use of the mobile phone, thereby
15 supporting the importance of distinguishing between **explicit and implicit self-esteem**. Our
16 results set the scene for new research avenues regarding mobile phone use while driving.

17 *Keywords:* Mobile phone, Driving, Self-esteem, Implicit, Explicit, Risk assessment.

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1 **1. Introduction**

2 Mobile phone use has seen a worldwide increase over the two last decades. Along with
3 the blossoming research about the influence of mobile communication in human behaviors, a
4 continually growing number of studies have shown some beneficial impacts of mobile use, such
5 as communication optimization (Geser, 2004) and the development of mobile-based
6 applications to improve mental and physical health (Blake, 2008; Fjeldsoe, Marshall, & Miller,
7 2009; Khazaal, Favrod, Sort, Borgeat, & Bouchard, 2018; **see also Heeren, 2018**). On the other
8 hand, mobile phone use may also yield adverse consequences (for comprehensive reviews, see
9 Billieux, 2012; Billieux, Maurage et al., 2015). Adverse consequences include addiction-like
10 symptoms (Bianchi & Phillips, 2005; Long et al., 2016), mobile phone-mediated antisocial
11 behaviors (e.g., “phubbing”: snubbing someone in a social setting by concentrating on one’s
12 phone instead of talking to the person directly; Chotpitayasunondh & Douglas, 2016),
13 cyberbullying (Nicol & Fleming, 2010), and adolescent sexting (De Graaf, Verbeek, Van den
14 Borne, & Meijer, 2018).

15 **On top of that**, one of the most challenging issues in contemporary research is the
16 dangerous use of the mobile phone, which mainly encompasses its use while driving (Collet et
17 al., 2010; Ortiz et al., 2018; Oviedo-Trespalacios et al., 2017). Indeed, **between 60% and 85%**
18 of individuals used their mobile phone while driving and almost 40% of drivers considered this
19 habit a non-dangerous activity (for a review, see Lipovac, Đerić, Tešić, Andrić, & Marić, 2017).
20 However, driver distraction is responsible for about 25% of car crashes (Lipovac et al., 2017).
21 Accordingly, laboratory studies have shown that mobile phone use affects numerous aspects of
22 driving performance, such as attentional and psychomotor abilities (e.g., Svenson & Patten,
23 2005), which, in turn, strongly increase the risk of car crashes (Collet et al., 2010). Likewise,
24 texting when driving has become a key predictor of car accidents, as it negatively affects
25 attention (e.g., maintaining vigilance) and monitoring (e.g., maintaining a consistent speed,

1 responding to traffic events) abilities (Caird, Johnston, Willness, Asbridge, & Steel, 2014).
2 Nonetheless, although a few studies have unraveled positive associations between dangerous
3 mobile phone use and various sociodemographic factors, including being a male (Billieux et
4 al., 2008; Lipovac et al., 2017), young (Brusque & Alauzet, 2008), and highly educated
5 (Márquez, Cantillo, & Arellana, 2015), uncertainty still abounds regarding the mechanisms that
6 trigger such use, **especially while driving**.

7 To date, one of the most common explanations of mobile phone use while driving
8 focuses on personality traits. **Personality dispositions**, such as heightened sensation-seeking
9 traits (Billieux et al., 2008), a tendency to have low self-control, high impulsivity (Hayashi,
10 Rivera, Modico, Foreman, & Wirth, 2017), or compromised delay discounting (Hayashi, Russo,
11 & Wirth, 2015), are related to phoning while driving. Yet, despite increasing research linking
12 personality dispositions and dangerous mobile phone use, none has focused on self-esteem,
13 which comes as a surprise given prior research bridging self-esteem to actual and problematic
14 mobile phone use.

15 Self-esteem is defined as the way an individual evaluates him- or herself (Leary &
16 Baumeister, 2000) and can be assessed both explicitly and implicitly. Explicit self-esteem is
17 measured by self-reported questionnaires that ask people how satisfied they are with
18 themselves. Although **self-reported** measures are informative about explicit cognitions,
19 scholars have argued that they have limited sensitivity for identifying individual differences
20 (Greenwald & Farnham, 2000). Moreover, they are likely to yield evaluation bias (Bosson,
21 Swann, & Pennebaker, 2000). In contrast, implicit self-esteem is assessed with indirect
22 measures in order to understand the automatic and unconscious nature of self-esteem. The
23 Implicit Association Test (IAT) is currently one of the most commonly used research tools to
24 capture implicit cognitions (e.g., Bar-Anan & Nosek, 2014; Roachat, Maurage, Heeren, &
25 Billieux, 2019). It relies on categorization between a target concept (e.g., me, others) and an

1 attribute (e.g., positive, negative) and provides an index of the strength of the implicit
2 association on the basis of response latencies (Greenwald, McGhee, & Schwartz, 1998).
3 Current research underlines the importance of combining explicit and implicit measures, which
4 may reflect distinct concepts (Bosson et al., 2000; Rochat et al., 2019).

5 Of note, prior research has highlighted the role of self-esteem vis-à-vis mobile phone
6 use. First, individuals with low self-esteem prefer indirect communication to face-to-face
7 communication. Second, low self-esteem is a strong predictor of problematic behaviors
8 (Billieux, 2012). Indeed, low self-esteem is associated with increased problematic mobile
9 phone use, although inconsistently, with small-to-medium effect sizes and mainly with explicit
10 measures (for a review, see De-Sola Gutiérrez et al., 2016). Nevertheless, to date, no research
11 has directly explored the links between self-esteem and dangerous mobile phone use, which is
12 unfortunate, as mobile phone use while driving has been frequently observed among individuals
13 with high driving confidence (Struckman-Johnson, Gaster, Struckman-Johnson, Johnson, &
14 May-Shinagle, 2015) and high education levels (Márquez et al., 2015). This observation hence
15 brings into question the involvement of low self-esteem. Indeed, low self-esteem is related to
16 addictive use of the mobile phone, but it is likely that self-esteem plays a different role in
17 relation to dangerous use, for example, with higher levels relating to risky driving. Such a view
18 aligns with studies suggesting that high self-esteem is associated with violence or risky
19 behaviors (e.g., high self-esteem individuals seem to be particularly confident that they would
20 win a fight and are therefore more willing to engage in it; Baumeister, Smart, & Boden, 1996).

21 Given the literature outlined above, the present study aimed at revealing the relations
22 between, on the one hand, explicit and implicit self-esteem and, on the other hand, dangerous
23 mobile phone use, with a particular focus on phoning while driving. To this purpose, we used
24 both explicit and implicit measures of self-esteem and capitalized on a validated self-reported

1 questionnaire to assess problematic use of the mobile phone (Billieux et al., 2008) in order to
2 best capture dangerous use.

3

4 **2. Method**

5 ***2.1. Participants***

6 We recruited 95 French-speaking volunteers (89 women, 93.7%) who owned a mobile
7 phone. Participants were between 18 and 42 years old ($M = 22.09$, $SD = 3.57$) and 63.2% of
8 them had a driver's license. All participants included in the study had answered at least one
9 item of the subscale that measured dangerous mobile phone use. Participants were recruited
10 from the community via media and listserv advertisements inviting people to participate in the
11 study. The study was conducted in 2008¹, according to the Declaration of Helsinki. Informed
12 consent was obtained from all participants in the study.

13

14 ***2.2. Procedure***

15 Participants first performed the IAT (Greenwald, McGhee, & Schwartz, 1998). The task
16 was programmed and presented by using E-Prime 2 Professional (Psychology Software Tools,
17 Pittsburgh, PA, USA). Participants then filled in the self-reported measures in paper form,
18 including demographic information, explicit self-esteem (the Rosenberg Self-Esteem Scale
19 [RSE]; Rosenberg, 1965), and mobile phone use (Problematic Mobile Phone Use Questionnaire
20 [PMPUQ]; Billieux et al., 2008). We used the validated French version of these scales (RSE:
21 Vallière & Vallerand, 1990; PMPUQ: Billieux et al., 2008). To avoid a carryover effect (i.e.

¹ This project was initiated in the context of a master thesis conducted at the University of Geneva. Because this project was not part of a PhD or a funded research program, its finalization and publication has been delayed until 2018.

1 the possible effect of one measure on the following ones), we counterbalanced the order of
2 completion of the self-reported measurement tools across participants.

3

4 **2.3. Measures**

5 *2.3.1. Implicit self-esteem*

6 The IAT (Greenwald et al., 1998) was used to assess implicit self-esteem. This measure
7 constitutes a widely used test (Bar-Anan & Nosek, 2014), particularly adapted to measure
8 constructs such as self-esteem (Greenwald & Banaji, 1995). The IAT is a computerized task
9 that assesses the strength of the association between two concepts, in this case “me/other” and
10 “positive/negative.” The score is based on latencies to classify stimuli that appear in the center
11 of the screen into one of the two target categories: “me” (e.g., *I, me, mine, my-self, my*) or
12 “other” (e.g., *they, other, them, their, him*) and/or into one of the two attribute categories:
13 “positive” (e.g., *beauty, success, peace, family*²) or “negative” (e.g., *death, pain, prison,*
14 *poverty*³). The name of the categories appeared at the upper right or left of the screen. In order
15 to assign stimuli to the correct category, participants were instructed to press the “E” key for
16 the category presented in the upper right corner of the screen and the “I” key for the category
17 presented in the upper left corner of the screen. The IAT used in the current study consisted of
18 five blocks: Blocks 1, 2, and 4 were practice blocks and thus not taken into account in the final
19 score. Block 3 was a congruent block, meaning that the target category “me” shared the
20 response key with the “positive” attribute (both presented in the upper left corner of the screen),
21 whereas the target category “other” shared the response key with the “negative” attribute (both
22 presented in the upper right corner of the screen). Block 5 was an incongruent block, in which
23 the category “me” shared the response key with the “negative” attribute (upper left corner of
24 the screen), and the category “other” shared the response key with the “positive” attribute

² French translation: beauté, succès, paix, famille

³ French translation: mort, douleur, prison, pauvreté

1 (upper right corner of the screen). Faster correct responses in the congruent block than in the
2 incongruent one indicate that participants more strongly associate positive than negative stimuli
3 to the self (i.e., high implicit self-esteem). IAT scores were computed from the scoring
4 algorithm proposed by Greenwald, Nosek, and Banaji (2003), a validated procedure presenting
5 robust psychometric properties compared to traditional methods (e.g., Back, Schmukle, &
6 Egloff, 2005). Error responses were discarded. Responses of lower than 300 ms were replaced
7 by 300 ms and responses of higher than 3000 ms were replaced by 3000 ms. The average
8 response times of Block 5 were subtracted from the average response times of Block 3. The
9 resulting score was divided by the standard deviation of all correct response times in Blocks 3
10 and 5. The reliability of the IAT has been supported by a good split-half internal consistency (r
11 = .69; Bosson et al., 2000) and a good test-retest reliability (median r = .56; for a review, see
12 Nosek, Greenwald, & Banaji, 2007). In the current study, we also found good reliability
13 coefficients (i.e., correlation between the two experimental blocks: r = .75, p < .001 and
14 correlations between trials: all r s > .49, all p s < .001; Rosenthal & Rosnow, 1991).

15

16 2.3.2. *Explicit self-esteem*

17 The RSE (Rosenberg, 1965) is the most commonly used tools to assess self-esteem (e.g.,
18 Donnellan, Ackerman, & Brecheen, 2016). This scale is a 10-item self-report questionnaire that
19 assesses the cognitive and affective facets of explicit self-esteem (e.g., “On the whole, I am
20 satisfied with myself”). Participants answered each item on a four-point Likert scale, higher
21 scores indicating higher self-esteem. In this study, we used the French version of the RSE
22 (Vallière & Vallerand, 1990), which has good internal consistency (α = .89) as well as good
23 test-retest reliability (r = .85). In the current sample, the reliability of the RSE was supported
24 by reliability coefficients (i.e., correlations between each item and the total score: all r s > .50,
25 all p < .001) and a good internal reliability, with a Cronbach’s alpha of .85.

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2.3.3. *Problematic mobile phone use*

The PMPUQ (Billieux et al., 2008) is a comprehensive measure of mobile phone use, widely used (e.g., Kuss et al., 2018), and including specific items to assess dangerous use. This scale is a 30-item self-report questionnaire that evaluates mobile phone use through four dimensions of potential misuse (i.e., dangerous use, prohibited use, dependence, and financial problems). In the current study, the dangerous use subscale (e.g., “While driving, I find myself in dangerous situations because of my mobile phone use”) was the main dependent variable, whereas the dependence subscale (e.g., “I get irritated when I am forced to turn my mobile phone off”) was used as a control variable of the model. The dangerous use subscale is based on five items, the first being a general question and the other four concerning phoning while driving. One item therefore assesses unspecific dangerous mobile phone use (“I use my mobile phone in situations that would qualify as dangerous”). The two other subscales of the PMPUQ (i.e., prohibited use and financial problems) were not used for the current study. For each item, participants were asked to respond on a four-point Likert scale, higher scores indicating higher levels of mobile phone misuse. The PMPUQ has good psychometric properties, including good structural validity and internal reliability (with a Cronbach’s alpha of .73 for dangerous use score and of .84 for the dependence score; Billieux et al., 2008). The current study aligns with those observations, with Cronbach’s alpha of .70 for dangerous use score and of .82 for the dependence score. Likewise, the correlations between the four factors (all $r_s > .27$, all $p_s < .01$) as well as of those factors with the total score (all $r_s > .59$, all $p_s < .001$) were significant and medium-to-large.

Prior to completing the PMPUQ, all participants were asked to answer several general questions regarding their mobile phone use; i.e., how long had they owned a mobile phone (1 = “less than one year,” 2 = “from 1 to 5 years,” 3 = “more than 5 years”), how many phone

1 calls did they make per day (1 = “from 0 to 2 calls,” 2 = “from 3 to 5 calls,” 3 = “more than 5
2 calls”), how much time did they spend on the phone per day (1 = “from 0 to 10 min,” 2 = “from
3 10 to 30 min,” 3 = “more than 30 min”), and how many text messages did they send per day (1
4 = “from 0 to 3 SMS,” 2 = “from 4 to 10 SMS,” 3 = “more than 10 SMS”).

5

6 **3. Results**

7 ***3.1. Correlation analyses***

8 An initial correlation matrix is provided in Table 1. We used the Benjamini–Hochberg
9 false-discovery procedure (Benjamini & Hochberg, 1995) to hold the expected proportion of
10 falsely rejected null hypothesis at 5% for the 45 correlations we computed. A few significant
11 pairwise correlations stood out after applying this correction: dangerous mobile phone use was
12 positively associated with the number of daily calls made ($r = .39$), the duration of daily calls
13 ($r = .30$) as well as implicit self-esteem ($r = .31$). Other significant relationships were observed
14 between variables related to actual and problematic mobile phone use (see Table 1 for details).

15

16 --- Table 1 about here ---

17

18 ***3.2. Regression analyses***

19 We computed a hierarchical linear model to predict dangerous mobile phone use from
20 the demographic variables in Step 1 (sex and age), variables related to the actual use of the
21 mobile phone in Step 2 (the number of years the participants had a mobile phone, the number
22 of phone calls per day, the duration of phone calls, and the number of text messages sent per
23 day), mobile phone dependence in Step 3 (the dependence dimension of the PMPUQ, used as
24 a control variable), and explicit and implicit self-esteem in Step 4. The full model (see Table 2)
25 accounted for 32% of the variance in dangerous mobile phone use ($R^2 = .03, .24, .25, \text{ and } .32$

1 for Steps 1 to 4, respectively). In the first step, no significant predictor was found. In the second
2 step, age ($B = .25, p = .011$) and number of daily calls made ($B = .34, p = .003$) were observed
3 as significant predictors. In the third step, mobile phone dependence did not significantly
4 predict dangerous use ($B = .06, p = .591$) after we controlled for demographic variables and
5 variables related to actual mobile phone use. In the last step, whereas explicit self-esteem did
6 not predict mobile phone use while driving ($B = -.15, p = .121$), implicit self-esteem did ($B =$
7 $.26, p = .007$) over and above demographic data, actual use, and mobile phone dependence
8 (Table 2).

9 --- Table 2 about here ---

10

11 **4. Discussion**

12 The main aim of this study was to examine the relationship between dangerous mobile
13 phone use, the most representative example being phoning while driving, and both explicit and
14 implicit self-esteem. Younger age, an elevated number of daily calls made, and high implicit
15 self-esteem emerged as significant predictors of dangerous mobile phone use. Notably, **these**
16 **relations** remained after we controlled for demographic data, actual mobile phone use, and
17 mobile phone dependence.

18 Perhaps the most striking finding was the observation that high implicit self-esteem
19 predicts dangerous mobile phone use. Given previous findings linking problematic mobile
20 phone use (especially addictive use) to lower levels of explicit self-esteem (Bianchi & Phillips,
21 2005; De-Sola Gutiérrez et al., 2016; Elhai et al., 2017), our findings may appear at odds with
22 prior research. However, **these results** should not come as a surprise.

23 First, although prior research has suggested that low self-esteem may trigger excessive
24 mobile phone use via a “reassurance pathway,” whereby the need to maintain relationships and
25 obtain reassurance from others drives mobile phone (over)use (Billieux et al., 2015; Billieux,

1 Philippot, et al., 2015; Wang et al., 2018), individuals using mobile phone while driving have
2 been identified as exhibiting high self-confidence (Struckman-Johnson et al., 2015). **Therefore,**
3 it is not surprising that high implicit self-esteem is at play in the present study. **Especially, one**
4 **cannot exclude** a functionally distinct role of high versus low self-esteem in problematic mobile
5 phone use — that is, a differential function between people who use a mobile phone while
6 driving and those who excessively use their mobile phone. **This perspective** strongly aligns with
7 Baumeister and colleagues’ proposal (1996) that individuals with high self-esteem are more
8 prone to engaging in dangerous behaviors (e.g., they may tend to think that they can manage
9 the double task of phoning and driving).

10 Second, our findings dovetail with previous studies pointing out the role of high self-
11 esteem in risky behaviors, although most **earlier** works relied on explicit measures of self-
12 esteem (i.e., the RSE and the Single-Item Self-Esteem Scale). For instance, high self-esteem
13 has been associated with extreme physical activity (Ertl et al., 2018), alcohol use among college
14 students (Inandi et al., 2009), stronger commitment in Facebook groups (Lo Coco et al., 2018),
15 and specific patterns of video game involvement (Billieux, Thorens, et al., 2015). Likewise,
16 individuals with high self-esteem make more risky choices during decision-making tasks,
17 especially in loss situations (Zhang, Chen, Gao, Liu, & Liu, 2018). From a conceptual
18 perspective, explicit and implicit self-esteem are considered to be related yet distinct constructs
19 (Gawronski & Bodenhausen, 2006), with **explicit self-esteem** referring to propositional
20 processes (i.e., conscious evaluations and beliefs) and **implicit self-esteem** to associative
21 processes (i.e., activated beyond subjective truth or falsity). In the current study, **the distinct**
22 **nature of these processes** has been supported by the tools used (De Houwer & Moors, 2012):
23 for explicit evaluation, participants were asked to assess how they consider themselves; on the
24 other hand, for implicit evaluation, participants were not directly instructed to make
25 associations between the self and the concepts proposed (positive and negative). Accordingly,

1 high explicit self-esteem refers to an intentional positive self-evaluation, whereas high implicit
2 self-esteem reflects spontaneous associations between the self and positive thoughts
3 (Gawronski & Bodenhausen, 2006; Koole & DeHart, 2007). Considering both explicit and
4 implicit evaluations, a specific association between implicit self-esteem and dangerous mobile
5 phone use was observed, whereas explicit self-esteem was not related to any variables after the
6 Benjamini–Hochberg correction. This observation thus reinforces the idea that explicit and
7 implicit measures of self-esteem tap into distinct and non-isomorphic psychological constructs
8 (Bosson et al., 2000; Zhao et al., 2017). Moreover, **it** also suggests that mobile phone use while
9 driving may be better predicted by automatic affective reactions toward the self than by
10 conscious propositional self-evaluation processes. **These results raise** the likelihood that the
11 underlying constructs that have the potential to explain this relationship are not conscious or
12 directly accessible. Future studies should thus further investigate the possible role of high self-
13 esteem in risky behaviors by using both explicit and implicit self-esteem measurements.

14 In follow-up research, several issues require further examination. First, an important
15 limitation is the cross-sectional nature of the data, precluding strong inferences regarding the
16 cause-effect relationships among the variables (Maurage, Heeren, & Pesenti, 2013). To best
17 capture the causal and temporal relationships between self-esteem and dangerous mobile phone
18 use, longitudinal and experimental methods are warranted. Second, **our study was not**
19 **preregistered and participants were relatively young and predominantly female. Preregistered**
20 **replications, including a better-balanced gender-ratio and age-distribution, are thus clearly**
21 **needed to examine whether the relations between self-esteem and dangerous mobile phone use**
22 **differ across gender and age. Third, the study was conducted in Switzerland. Future studies**
23 **should thus extend this investigation in different countries, particularly in countries where using**
24 **the mobile phone while driving is a predominant behavior or where driving licenses can be**
25 **obtained at younger ages (e.g., 16 years old), such as in the United States (Centers for Disease**

1 Control and Prevention, 2013). Fourth, although sample sizes like those of the present study
2 are usually not regarded as small in this research field, a simulation study has revealed that a
3 sample of about 250 participants is usually considered as adequate to achieve stable estimates
4 for correlations (Schönbrodt & Perugini, 2013). However, a power analysis (setting the level
5 of α at 0.05, power $[1 - \beta]$ at .80) based upon previous correlational studies linking self-esteem
6 and mobile phone use (Hong, Chiu, & Huang, 2012; Walsh, White, Cox, & Young, 2011)
7 indicated that a total sample size of at least 84 participants yields enough power to detect small-
8 to-medium effect sizes ($r = .30$) in the present study. Fifth, although the present study focuses
9 on self-esteem and dangerous mobile phone use among individuals with a mobile phone and
10 driving experience, we did not quantify the latter construct (e.g., number of kilometers per day,
11 average time spent in traffic jams). This issue is particularly important given that some of our
12 participants did not hold a definitive driver's license. Future studies should thus further take
13 driving characteristics into account. Finally, we mainly focused on mobile phone use while
14 driving. However, many researchers have suggested that the study of dangerous mobile phone
15 use can transcend driving and be extended to other situations (e.g., phoning while involved in
16 climbing, phoning while cooking).

17

18 **5. Conclusion**

19 This study evaluates the role of self-esteem in dangerous mobile phone use beyond the
20 recognized involvement of self-esteem in addictive use of a mobile phone. These results show
21 that high implicit self-esteem predicts dangerous mobile phone use, and this association remains
22 after controlling for sociodemographic data, actual use of the mobile phone, and dependence
23 symptoms.

1 **References**

- 2 Back, M. D., Schmukle, S. C., & Egloff, B. (2005). Measuring Task-Switching Ability in the
3 Implicit Association Test. *Experimental Psychology*, 52(3), 167-179.
4 <https://doi.org/10.1027/1618-3169.52.3.167>
- 5 Bar-Anan, Y., & Nosek, B. A. (2014). A comparative investigation of seven indirect attitude
6 measures. *Behavior Research Methods*, 46, 668–688. [https://doi.org/10.3758/s13428-](https://doi.org/10.3758/s13428-013-0410-6)
7 [013-0410-6](https://doi.org/10.3758/s13428-013-0410-6)
- 8 Baumeister, R. F., Smart, L., & Boden, J. M. (1996). Relation of threatened egotism to violence
9 and aggression: the dark side of high self-esteem. *Psychological Review*, 103(1), 5-33.
- 10 Bianchi, A., & Phillips, J. G. (2005). Psychological predictors of problem mobile phone use.
11 *Cyberpsychology and Behavior*, 8(1), 39-51. <https://doi.org/10.1089/cpb.2005.8.39>
- 12 Billieux, J. (2012). Problematic use of the mobile phone: a literature review and a pathways
13 model. *Current Psychiatry Reviews*, 8, 299-307.
14 <https://doi.org/10.2174/157340012803520522>
- 15 Billieux, J, Maurage, P., Lopez-Fernandez, O., Kuss, D. J., & Griffiths, M. D. (2015). Can
16 disordered mobile phone use be considered a behavioral addiction? An update on
17 current evidence and a comprehensive model for future research. *Current Addiction*
18 *Reports*, 2, 156-162. <https://doi.org/10.1007/s40429-015-0054-y>
- 19 Billieux, J., Van der Linden, M., & Rochat, L. (2008). The role of impulsivity in actual and
20 problematic use of the mobile phone. *Applied Cognitive Psychology*, 22, 1195-1210.
21 <https://doi.org/10.1002/acp.1429>
- 22 Billieux, J., Philippot, P., Schmid, C., Maurage, P., De Mol, J., & Van der Linden, M. (2015).
23 Is Dysfunctional Use of the Mobile Phone a Behavioural Addiction? Confronting
24 Symptom-Based Versus Process-Based Approaches: Conceptualizing Mobile Phone

1 Dysfunctional Use. *Clinical Psychology & Psychotherapy*, 22(5), 460-468.
2 <https://doi.org/10.1002/cpp.1910>

3 Billieux, J., Thorens, G., Khazaal, Y., Zullino, D., Achab, S., & Van der Linden, M. (2015).
4 Problematic involvement in online games: A cluster analytic approach. *Computers in*
5 *Human Behavior*, 43, 242-250. <https://doi.org/10.1016/j.chb.2014.10.055>

6 Billieux, J., Van der Linden, M., & Rochat, L. (2008). The role of impulsivity in actual and
7 problematic use of the mobile phone. *Applied Cognitive Psychology*, 22(9), 1195-1210.
8 <https://doi.org/10.1002/acp.1429>

9 Blake, H. (2008). Innovation in practice: mobile phone technology in patient care. *British*
10 *Journal of Community Nursing*, 13(4), 160-165.
11 <https://doi.org/10.12968/bjcn.2008.13.4.29024>

12 Bosson, J. K., Swann, W. B., & Pennebaker, J. W. (2000). Stalking the perfect measure of
13 implicit self-esteem: The blind men and the elephant revisited? *Journal of Personality*
14 *and Social Psychology*, 79(4), 631-643. <https://doi.org/10.1037//0022-3514.79.4.631>

15 Brusque, C., & Alauzet, A. (2008). Analysis of the individual factors affecting mobile phone
16 use while driving in France: Socio-demographic characteristics, car and phone use in
17 professional and private contexts. *Accident Analysis & Prevention*, 40(1), 35-44.
18 <https://doi.org/10.1016/j.aap.2007.04.004>

19 Caird, J. K., Johnston, K. A., Willness, C. R., Asbridge, M., & Steel, P. (2014). A meta-analysis
20 of the effects of texting on driving. *Accident Analysis & Prevention*, 71, 311-318.
21 <https://doi.org/10.1016/j.aap.2014.06.005>

- 1 Centers for Disease Control and Prevention (2013). Mobile Device Use While Driving —
2 United States and Seven European Countries, 2011. Online Publications, retrieved from
3 <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6210a1.htm>.
- 4
- 5 Chotpitayasunondh, V., & Douglas, K. M. (2016). How “phubbing” becomes the norm: The
6 antecedents and consequences of snubbing via smartphone. *Computers in Human*
7 *Behavior*, *63*, 9-18. <https://doi.org/10.1016/j.chb.2016.05.018>
- 8 Collet, C., Guillot, A., & Petit, C. (2010). Phoning while driving I: a review of epidemiological,
9 psychological, behavioural and physiological studies. *Ergonomics*, *53*(5), 589-601.
10 <https://doi.org/10.1080/00140131003672023>
- 11 De Graaf, H., Verbeek, M., Van den Borne, M., & Meijer, S. (2018). Offline and Online Sexual
12 Risk Behavior among Youth in the Netherlands: Findings from “Sex under the Age of
13 25”. *Frontiers in Public Health*, *6*. <https://doi.org/10.3389/fpubh.2018.00072>
- 14 De Houwer, J., & Moors, A. (2012). How to define and examine implicit processes? In R.
15 Proctor & E. J. Capaldi (Eds.), *Psychology of science: Implicit and explicit processes*
16 (pp. 183-198). Oxford: Oxford University Press.
- 17 De-Sola Gutiérrez, J., Rodríguez de Fonseca, F., & Rubio, G. (2016). Cell-Phone Addiction: A
18 Review. *Frontiers in Psychiatry*, *7*. <https://doi.org/10.3389/fpsy.2016.00175>
- 19 Donnellan, M. B., Ackerman, R. A., & Brecheen, C. (2016). Extending Structural Analyses of
20 the Rosenberg Self-Esteem Scale to Consider Criterion-Related Validity: Can
21 Composite Self-Esteem Scores Be Good Enough? *Journal of Personality Assessment*,
22 *98*(2), 169-177. <https://doi.org/10.1080/00223891.2015.1058268>
- 23 Elhai, J. D., Dvorak, R. D., Levine, J. C., & Hall, B. J. (2017). Problematic smartphone use: A
24 conceptual overview and systematic review of relations with anxiety and depression

1 psychopathology. *Journal of Affective Disorders*, 207, 251-259.
2 <https://doi.org/10.1016/j.jad.2016.08.030>

3 Ertl, M. M., Longo, L. M., Groth, G. H., Berghuis, K. J., Prout, J., Hetz, M. C., & Martin, J. L.
4 (2018). Running on empty: high self-esteem as a risk factor for exercise addiction.
5 *Addiction Research & Theory*, 26(3), 205-211.
6 <https://doi.org/10.1080/16066359.2017.1347257>

7 Fjeldsoe, B. S., Marshall, A. L., & Miller, Y. D. (2009). Behavior change interventions
8 delivered by mobile telephone short-message service. *American Journal of Preventive*
9 *Medicine*, 36(2), 165–173. <https://doi.org/10.1016/j.amepre.2008.09.040>.

10 Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in
11 evaluation: An integrative review of implicit and explicit attitude change. *Psychological*
12 *Bulletin*, 132(5), 692-731. <https://doi.org/10.1037/0033-2909.132.5.692>

13 Geser, H. (2004). Towards a Sociological Theory of the Mobile Phone. In: *Sociology in*
14 *Switzerland: Sociology of the Mobile Phone*. Online Publications, retrieved from
15 http://socio.ch/mobile/t_geser1.pdf.

16 Greenwald, A. G., & Banaji, M. R. (1995). Implicit Social Cognition: Attitudes, Self-Esteem,
17 and Stereotypes. *Psychological Review*, 102(1), 4-7.

18 Greenwald, A. G., & Farnham, S. D. (2000). Using the Implicit Association Test to Measure
19 Self-Esteem and Self-Concept. *Journal of Personality and Social Psychology*, 79(6),
20 1022-1038. <https://doi.org/10.1037/0022-3514.79.6.1022>.

21 Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual
22 differences in implicit cognition: the implicit association test. *Journal of Personality*
23 *and Social Psychology*, 74, 1464-1480.

- 1 Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit
2 Association Test: I. An improved scoring algorithm. *Journal of Personality and Social
3 Psychology, 85*(2), 197–216.
- 4 Hayashi, Y., Rivera, E. A., Modico, J. G., Foreman, A. M., & Wirth, O. (2017). Texting while
5 driving, executive function, and impulsivity in college students. *Accident Analysis &
6 Prevention, 102*, 72-80. <https://doi.org/10.1016/j.aap.2017.02.016>
- 7 Hayashi, Y., Russo, C. T., & Wirth, O. (2015). Texting while driving as impulsive choice: A
8 behavioral economic analysis. *Accident Analysis & Prevention, 83*, 182-189.
9 <https://doi.org/10.1016/j.aap.2015.07.025>
- 10 Heeren, A. (2018). Commentary: The impact of digital technology on psychological treatments
11 and their dissemination. *Frontiers in Psychology, 9*, 1571.
12 <https://doi.org/10.3389/fpsyg.2018.01571>
- 13 Hong, F.-Y., Chiu, S.-I., & Huang, D.-H. (2012). A model of the relationship between
14 psychological characteristics, mobile phone addiction and use of mobile phones by
15 Taiwanese university female students. *Computers in Human Behavior, 28*(6),
16 2152-2159. <https://doi.org/10.1016/j.chb.2012.06.020>
- 17 İnandı, T., Özer, C., Akdemir, A., Akoğlu, S., BabayigiT, C., Turhan, E., & Sangün, Ö. (2009).
18 Violence, Psychological Features, and Substance Use in High School Students in Hatay:
19 a Cross-sectional Study. *Medical Journal of Trakya University, 26*(3), 189-196.
- 20 Khazaal, Y., Favrod, J., Sort, A., Borgeat, F., & Bouchard, S. (2018). Editorial: Computers and
21 Games for Mental Health and Well-Being. *Frontiers in Psychiatry, 9*.
22 <https://doi.org/10.3389/fpsyg.2018.00141>
- 23 Koole, S. L., & Dehart, T. (2007). Self-Affection without Self-Reflection: Origins, Models, and
24 Consequences of Implicit Self-Esteem. In C. Sedikides & S. Spencer, *The Self in Social
25 Psychology*, (pp. 36-86). New York: Psychology Press.

- 1 Kuss, D. J., Kanjo, E., Crook-Rumsey, M., Kibowski, F., Wang, G. Y., & Sumich, A. (2018).
2 Problematic Mobile Phone Use and Addiction Across Generations: The Roles of
3 Psychopathological Symptoms and Smartphone Use. *Journal of Technology in*
4 *Behavioral Science*, 3(3), 141-149. <https://doi.org/10.1007/s41347-017-0041-3>
- 5 Leary, M. R., & Baumeister, R. F. (2000). The nature and function of self-esteem: Sociometer
6 theory. In *Advances in Experimental Social Psychology* (Vol. 32, p. 1-62).
7 [https://doi.org/10.1016/S0065-2601\(00\)80003-9](https://doi.org/10.1016/S0065-2601(00)80003-9)
- 8 Lipovac, K., Đerić, M., Tešić, M., Andrić, Z., & Marić, B. (2017). Mobile phone use while
9 driving-literary review. *Transportation Research Part F: Traffic Psychology and*
10 *Behaviour*, 47, 132-142. <https://doi.org/10.1016/j.trf.2017.04.015>
- 11 Lo Coco, G., Maiorana, A., Mirisola, A., Salerno, L., Boca, S., & Profita, G. (2018).
12 Empirically-derived subgroups of Facebook users and their association with personality
13 characteristics: a Latent Class Analysis. *Computers in Human Behavior*, 86, 190-198.
14 <https://doi.org/10.1016/j.chb.2018.04.044>
- 15 Long, J., Liu, T.-Q., Liao, Y.-H., Qi, C., He, H.-Y., Chen, S.-B., & Billieux, J. (2016).
16 Prevalence and correlates of problematic smartphone use in a large random sample of
17 Chinese undergraduates. *BMC Psychiatry*, 16(1), 408. [https://doi.org/10.1186/s12888-](https://doi.org/10.1186/s12888-016-1083-3)
18 [016-1083-3](https://doi.org/10.1186/s12888-016-1083-3)
- 19 Márquez, L., Cantillo, V., & Arellana, J. (2015). Mobile phone use while driving: A hybrid
20 modeling approach. *Accident Analysis & Prevention*, 78, 73-80.
21 <https://doi.org/10.1016/j.aap.2015.02.016>
- 22 Maurage, P., Heeren, A., & Pesenti, M. (2013). Does Chocolate Consumption Really Boost
23 Nobel Award Chances? The Peril of Over-Interpreting Correlations in Health Studies.
24 *The Journal of Nutrition*, 143(6), 931-933. <https://doi.org/10.3945/jn.113.174813>

- 1 Nicol, A., & Fleming, M. J. (2010). "i h8 u": The Influence of Normative Beliefs and Hostile
2 Response Selection in Predicting Adolescents' Mobile Phone Aggression—A Pilot
3 Study. *Journal of School Violence*, 9(2), 212-231.
4 <https://doi.org/10.1080/15388220903585861>
- 5 Nosek, B. A., Greenwald, A. G., & Banaji, M. R. (2007). The Implicit Association Test at Age
6 7: A Methodological and Conceptual Review (Pp. 265-292). In J.A. Bargh (Ed.),
7 *Automatic processes in social thinking and behavior*. Psychology Press.
- 8 Ortiz, C., Ortiz-Peregrina, S., Castro, J. J., Casares-López, M., & Salas, C. (2018). Driver
9 distraction by smartphone use (WhatsApp) in different age groups. *Accident Analysis*
10 *& Prevention*, 117, 239-249. <https://doi.org/10.1016/j.aap.2018.04.018>
- 11 Oviedo-Trespalacios, O., King, M., Haque, Md. M., & Washington, S. (2017). Risk factors of
12 mobile phone use while driving in Queensland: Prevalence, attitudes, crash risk
13 perception, and task-management strategies. *PLOS ONE*, 12(9), e0183361.
14 <https://doi.org/10.1371/journal.pone.0183361>
- 15 Rochat, L., Maurage, P., Heeren, A., & Billieux, J. (2019). Let's Open the Decision-Making
16 Umbrella: A Framework for Conceptualizing and Assessing Features of Impaired
17 Decision Making in Addiction. *Neuropsychology Review*, 29(1), 27-51.
18 <https://doi.org/10.1007/s11065-018-9387-3>
- 19 Rosenberg, M. (1965). *Society and the Adolescent Self-Image*. Princeton, NJ: Princeton
20 University Press.
- 21 Rosenthal, R. & Rosnow, R. L. (1991). *Essentials of Behavioral Research: Methods and Data*
22 *Analysis*. Second Edition. McGraw-Hill Publishing Company, pp. 46-65.

- 1 Schönbrodt, F. D., & Perugini, M. (2013). At what sample size do correlations stabilize?
2 *Journal of Research in Personality*, 47(5), 609-612.
3 <https://doi.org/10.1016/j.jrp.2013.05.009>
- 4 Struckman-Johnson, C., Gaster, S., Struckman-Johnson, D., Johnson, M., & May-Shinagle, G.
5 (2015). Sex differences in psychosocial predictors of texting while driving. *Accident*
6 *Analysis & Prevention*, 74, 218-228. <https://doi.org/10.1016/j.aap.2014.10.001>
- 7 Svenson, O., & Patten, C. J. D. (2005). Mobile phones and driving: a review of contemporary
8 research. *Cognition, Technology & Work*, 7(3), 182-197.
9 <https://doi.org/10.1007/s10111-005-0185-3>
- 10 Vallière, E. F., & Vallerand, R. J. (1990). Traduction et validation canadienne-française de
11 l'échelle de l'estime de soi de Rosenberg. *International Journal of Psychology*, 25,
12 305-316.
- 13 Walsh, S. P., White, K. M., Cox, S., & Young, R. McD. (2011). Keeping in constant touch: the
14 predictors of young Australians' mobile phone involvement. *Computers in Human*
15 *Behavior*, 27(1), pp. 333-342. <https://doi.org/10.1016/j.chb.2010.08.011>
- 16 Wang, P., Wang, X., Wu, Y., Xie, X., Wang, X., Zhao, F., ... Lei, L. (2018). Social networking
17 sites addiction and adolescent depression: A moderated mediation model of rumination
18 and self-esteem. *Personality and Individual Differences*, 127, 162-167.
19 <https://doi.org/10.1016/j.paid.2018.02.008>
- 20 Wang, P., Zhao, M., Wang, X., Xie, X., Wang, Y., & Lei, L. (2017). Peer relationship and
21 adolescent smartphone addiction: The mediating role of self-esteem and the moderating
22 role of the need to belong. *Journal of Behavioral Addictions*, 6(4), 708-717.
23 <https://doi.org/10.1556/2006.6.2017.079>

1 Zhang, X., Chen, X., Gao, Y., Liu, Y., & Liu, Y. (2018). Self-promotion hypothesis: The impact
2 of self-esteem on self–other discrepancies in decision making under risk. *Personality
3 and Individual Differences, 127*, 26-30. <https://doi.org/10.1016/j.paid.2018.01.031>

4 Zhao, L., Yu, X., Zhang, L., & Ren, Z. (2017). Stability of implicit self-esteem among internet
5 addicted college students in china. *Social Behavior and Personality: An International
6 Journal, 45*(2), 339-352. <https://doi.org/10.2224/sbp.6135>

7

Table 1. Summary of first-order correlations among the study variables.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Sex	-	-	-	-	-	-	-	-	-
2. Age	-0.05	-	-	-	-	-	-	-	-
3. MP-Years	0.11	0.11	-	-	-	-	-	-	-
4. MP-Daily Calls	0.12	-0.11	0.21	-	-	-	-	-	-
5. MP-Daily Duration	0.05	-0.24	0.21	0.55*	-	-	-	-	-
6. MP-SMS	0.17	-0.21	0.13	0.41*	0.57*	-	-	-	-
7. PMPUQ-Dependence	0.09	-0.26	0.14	0.37*	0.52*	0.41*	-	-	-
8. PMPUQ-Dangerous use	-0.09	0.17	0.06	0.39*	0.30*	0.19	0.18	-	-
9. RSE	0.01	0.09	0.17	-0.02	-0.17	-0.27	-0.14	-0.15	-
10. IAT-SE	0.05	-0.07	0.16	0.24	0.19	0.24	0.10	.31*	0.07

Note. * Correlations were significant at $p < .05$, corrected for multiple correlations by using the false discovery procedure (Benjamini–Hochberg procedure). Sex (1 = female, 2 = male); MP-Years = numbers of years of mobile phone ownership; MP-Daily Calls = daily calls made with the mobile phone; MP-Daily Duration = daily duration of calls made with the mobile phone; MP-SMS = number of text messages sent daily; PMPUQ-Dependence = Problematic Mobile Phone Use Questionnaire – Dependence subscale; PMPUQ-Dangerous use = Problematic Mobile Phone Use Questionnaire – Dangerous use subscale; RSE-SE = Rosenberg Self-Esteem Scale; IAT-SE = Implicit Association Test – Self Esteem (D score; Greenwald et al., 2003).

Table 2. Hierarchical linear model predicting dangerous use of the mobile phone (i.e., PMPUQ score, mobile phone while driving) from demographic variables (sex and age), actual use of mobile phone variables (number of years participant has had a mobile phone, number of calls made per day, mean duration of calls made, and number of text messages sent per day), dependence on mobile phone, explicit self-esteem, and implicit self-esteem.

Predictor	B	SE(B)	β	R^2
Step 1				.03
Intercept	1.71	0.16		
Sex	-0.25	0.33	-0.08	
Age	0.06	0.02	0.16	
Step 2				.24***
Intercept	1.78	0.15		
Sex	-0.40	0.30	-0.12	
Age	0.06	0.02	0.25*	
Number of years participant has had mobile phone	-0.14	0.20	-0.07	
Number of calls made per day	0.39	0.13	0.34**	
Mean duration of calls	0.18	0.14	0.17	
Number of text messages sent per day	0.05	0.14	0.04	
Step 3				.25**
Intercept	1.78	0.15		
Sex	-0.40	0.31	-0.13	
Age	0.06	0.02	0.26*	
Number of years participant has had mobile phone	-0.15	0.20	-0.07	
Number of calls made per day	0.39	0.13	0.34**	
Mean duration of calls	0.16	0.14	0.15	
Number of text messages sent per day	0.04	0.15	0.03	
Dependence on mobile phone	0.08	0.15	0.06	
Step 4				.32***
Intercept	1.77	0.15		
Sex	-0.38	0.29	-0.12	
Age	0.06	0.02	0.27**	
Number of years participant has had mobile phone	-0.15	0.20	-0.07	
Number of calls made per day	0.36	0.13	0.31**	
Mean duration of calls	0.14	0.14	0.13	
Number of text messages sent per day	-0.07	0.15	-0.05	
Dependence on mobile phone	0.09	0.14	0.07	
Explicit self-esteem	-0.25	0.16	-0.15	
Implicit self-esteem	1.22	0.44	0.26**	
Total R^2				.33

Note. PUMPUQ = Problematic Mobile Phone Use Questionnaire.

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