The Effectiveness of the Online Module 'Je Smartphone de Baas' Among Dutch University Students in Reducing Smartphone Use

Judith Schiltkamp (5541875)

Name supervisor: Dr Regina van den Eijnden

Master Study of Youth

17-06-2021

Abstract

The number of adolescents using a smartphone is still rising across the world. There is increasing evidence that intensive smartphone use can cause negative outcomes, such as lower school results and loss of social well-being. Therefore, Utrecht University developed an online module 'Je smartphone de Baas' to reduce (problematic) smartphone use among their students. The aim of this experimental study was to investigate the effectiveness of the intervention in reducing problematic smartphone use (PS) and smartphone use during studying (SDS) and if it leads to behavioural change via increased motivation and self-efficacy. A Cluster Randomized Controlled Trial was conducted with a final sample of 117 Dutch first-year Interdisciplinary Social Sciences students aged between 17 and 25 years old. One pretest (T0) and two posttest measurements (T1, T2) were conducted. As expected, results showed a significant effect of the intervention on PS. In addition, the intervention was associated with a higher motivation to change one's smartphone use. Furthermore, the moderation effect implied that students who were more compliant showed less PS T2/SDS T2. In supporting students to change their smartphone use the intervention should be disseminated.

Keywords: students, problematic smartphone use, smartphone use during studying, motivation, self-efficacy

Samenvatting

Het aantal adolescenten dat een smartphone gebruikt stijgt nog steeds wereldwijd. Er is steeds meer bewijs dat intensief smartphonegebruik kan leiden tot negatieve uitkomsten, zoals lagere schoolresultaten en verlies van sociaal welbevinden. De Universiteit Utrecht heeft daarom een online module 'Je smartphone de Baas' ontwikkeld om (problematisch) smartphonegebruik onder hun studenten te verminderen. Het doel van deze experimentele studie was om te onderzoeken of de interventie effectief is in het verminderen van problematisch smartphonegebruik (PS) en smartphonegebruik tijdens het studeren (SDS) en of het leidt tot gedragsverandering via verhoogde motivatie en self-efficacy. Een Cluster Randomized Controlled Trial werd uitgevoerd met een uiteindelijke steekproef van 117 Nederlandse eerstejaars Interdisciplinaire Sociale Wetenschappen studenten tussen de 17 en 25 jaar. Een pretest (T0) en twee posttest metingen (T1, T2) werden uitgevoerd. Zoals verwacht, toonden de resultaten een significant effect van de interventie op PS. Daarnaast was de interventie geassocieerd met een hogere motivatie om iemands smartphonegebruik te veranderen. Verder impliceerde het moderatie-effect dat studenten die meer compliant waren minder PS T2/SDS T2 vertoonden. De interventie zou verspreid moeten worden om studenten te ondersteunen bij het verminderen van hun smartphone gebruik.

Trefwoorden: studenten, problematisch smartphonegebruik, smartphonegebruik tijdens het studeren, motivatie, self-efficacy

The Effectiveness of the Online Module 'Je Smartphone de Baas' among Dutch University
Students in Reducing Smartphone use

The number of people using a smartphone is still rising across the world, especially
among adolescents, and is one of the top health concerns of the last ten years (Poushter, 2016;
Anderson & Jiang, 2018). Adolescents use their smartphone mostly to participate in social
media use, which is defined as "online media that allow its' users to produce, collaborate on,
and share content with other users" (Shakir et al., 2018; Kuss & Griffiths, 2017). In 2014,
24% of American adolescents aged 13-17 reported being online almost constantly and this
rate increased to 45% in 2018 (Anderson & Jiang, 2018). Many adolescents consider social
media use as their favourite leisure time activity (Willemse et al., 2012). One of the major
advantages of social media is that it facilitates adolescents' involvement with peers online
(Kuss & Griffiths, 2017; Ryan & Xenos, 2011).

Besides to the advantages of social media use, there are also some disadvantages;
adolescents who are highly involved in online social activities are more likely to experience
smartphone use problems (Lopez-Fernandez et al., 2014). Problematic smartphone use (PS) is
defined by addiction-like smartphone behaviours, such as loss of control over smartphone use
(Boer et al., 2020; Griffiths et al., 2014; Van den Eijnden et al., 2016; Park & Lee, 2011).
Loss of control is the inability to curb one's smartphone use impulses (Boer et al., 2020; Park
& Lee, 2011). When adolescents experience loss of control over their smartphone use, it may
negatively affect the ability to manage schoolwork responsibilities (Boer et al., 2020).
Therefore, students with smartphone use problems may replace schoolwork and offline social
activities with smartphone use, which could negatively influence their school results and
social well-being. In addition, PS is associated with other negative outcomes, such as
increased attention problems and school maladjustment (Boer et al., 2020; Szczegielniak et
al., 2013). Considering this from a public health viewpoint, it is necessary to reduce PS
among adolescents.

Therefore, Utrecht University developed an online module named 'Je smartphone de
Baas' ('In control of your smartphone'). To our knowledge, this is the first intervention that is
designed to prevent and reduce smartphone use among students. The goal of this online
module is to make students more aware of their smartphone use and possible consequences, to
stimulate their insight into the (risk) factors that trigger their smartphone use and to encourage
them to make specific plans to change their smartphone behaviour. The intervention elements
mainly focus on changing individual factors and are basically following the principles of the
Capability Opportunity Motivation - Behaviour (COM-B) model (Michie et al., 2011) and the

Theory of Planned Behaviour (TPB) (Ajzen, 1991) attempting to improve student's motivation and self-efficacy to change their smartphone behaviour. This study tests the effectiveness of the intervention in reducing PS and smartphone use during studying (SDS) (hypothesis 1 and 2). It will also address how the intervention leads to behavioural change via increased motivation and self-efficacy. This information can be used to improve the online module, and for the development of future intervention and theoretical models in reducing (problematic) smartphone use.

Motivation to change

The use of the COM-B model is suggested by West (2013) as a possible strategy for understanding and changing processes leading to addictive-like behaviours. As PS can be regarded addiction-like behaviour, the COM-B model was used as an underlying theory for the development of the online module. According to the COM-B model, motivation can be defined as all the brain processes that energize and direct behaviour procedures that promote addiction as well as recovery (Michie et al., 2011). No research was found about the effectiveness of the COM-B model in increasing motivation to reduce (problematic) smartphone use. However, a review containing 26 articles did show an effect using the COM-B model to quit smoking (Mersha et al., 2020). The reviewed articles consistently showed a direct relationship between the level of motivation to quit smoking and actually quitting smoking. This suggests that increasing motivation to change (problematic) smartphone use may lead to a reduction in (problematic) smartphone use, as both smoking and smartphone use are addiction-like behaviours (West, 2013). Therefore, on basis of the COM-B model, a couple of intervention elements were deduced to increase students' motivation to change their smartphone use. During the online module, students were asked to 1) determine specific goals and set their motivation towards these goals, and 2) make plans with the intention of implementation (Doh et al., 2016; Gollwitzer & Sheeran, 2006; Manwong et al., 2018; Su et al., 2011). Accordingly, the following third and fourth hypothesis were formulated: 3) It is expected that the effect of the intervention on PS will be mediated by students' motivation to change, 4) it is expected that the effect of the intervention on SDS will be mediated by students' motivation to change.

Self-efficacy

Besides motivation, capability is also an important factor in changing behaviour according to the COM-B model (Michie et al., 2011). Capability is someone's perception of their own possession of the skills and knowledge to change their behaviour. This is also

referred to as self-efficacy. The perception of not having the capability to change smartphone behaviour could negatively impact someone's behaviour.

In addition, according to the TPB one's behaviour is set by the intention to perform a specific behaviour (Ajzen, 1991). This intention is influenced by attitudes, subjective norms, and perceived behavioural control. A very important factor in stimulating the level of motivation is perceived behavioural control, which correlate strongly with self-efficacy (Ajzen, 1991; Bandura, 1977). As stated by Bandura (1977), individuals are more likely to be motivated when they have a feeling of self-efficacy, i.e., a person's confidence in his/her own ability to successfully influence their environment (Bandura, 1977). Students have been given exercises aimed at increasing their self-efficacy, e.g., thinking about what they could change regarding their smartphone use and how they could do this. Therefore, the following fifth and sixth hypothesis were formulated: 5) It is expected that the effect of the intervention on PS will be mediated by students' level of self-efficacy to change, 6) it is expected that the effect of the intervention on SDS will be mediated by students' level of self-efficacy to change.

Treatment integrity

Treatment integrity is the extent to which the intervention is implemented as intended (Vermilyea et al., 1984). When treatment integrity is high, it increases the likelihood of finding similar outcomes in follow up research to those in the original study (Craig et al., 2008). On the other hand, when treatment integrity is low, this may reflect implementation failure rather than ineffectiveness of the intervention itself. However, there is no direct relation between treatment integrity and treatment outcome (Bond et al., 2011). In the present study, treatment integrity specifically refers to the extent to which the students followed the online module. Therefore, a high treatment integrity means a relatively large number of participants that has followed the module as intended. Treatment integrity will be investigated as a possible moderator. Accordingly, the following seventh and eighth hypothesis were formulated: 7) It is expected that decreases in PS following the intervention will be higher among adolescents who followed the module as intended, in comparison to adolescents who did not, 8) It is expected that decreases in SDS following the intervention will be higher among adolescents who followed the module as intended, in comparison to adolescents who did not.

Current study

A new addiction-like behaviour, PS, has become one of the top health concerns over the past ten years. 'Je smartphone de Baas' is, as far as we know, the first online module that aims to prevent and reduce (problematic) smartphone use among students. Little is known

about how this problem can be remedied. Therefore, the online module is based on the effectiveness of the COM-B model and the TPB to influence addiction-like behaviour such as smoking and has shown promising results. For this reason, the present study aims to provide more insight into the effectiveness of an intervention that consists of elements of the COM-B model and the TPB, to mitigate the loss of control that is experienced around smartphone use and therefore achieve a reduction in smartphone use. More than 200 Dutch students in higher education participated in the present cluster randomized controlled trial, including an experimental condition and a control condition. Students in both conditions were asked to participate in three online self-report surveys, one before the intervention (T0), one immediately after the intervention (T1), and one three months after the intervention (T2). Based on previous research, favourable effects of the online module on reducing student's PS are expected.

Figure 1

Research Model Effectiveness Intervention on PS/SDS, via Motivation and Self-efficacy
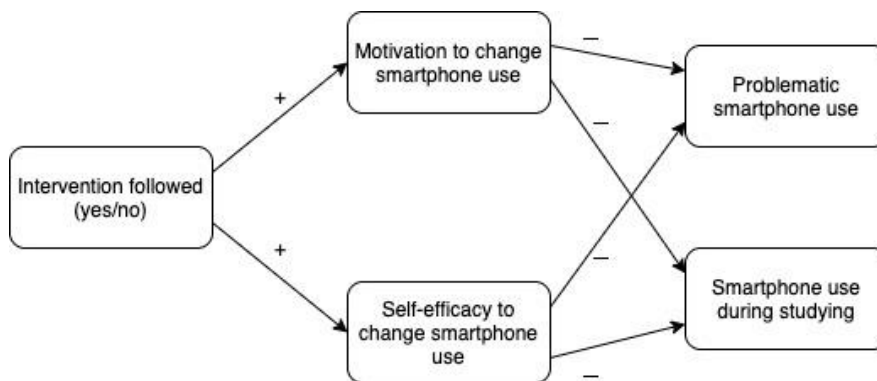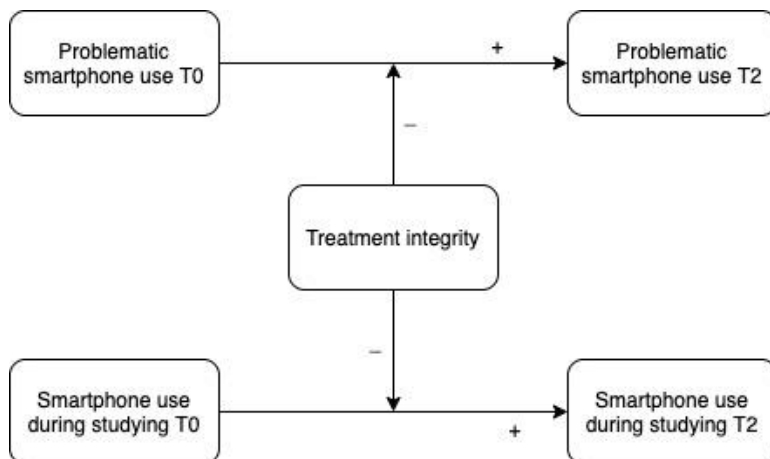

Figure 2

Research Model Influence of PS/SDS T0 on T2, Moderated by Treatment Integrity

Note. Only participants of intervention condition included

Method

Procedure and participants

In September 2020, all Dutch first-year Interdisciplinary Social Sciences (ISS) students at Utrecht University were selected to participated in this study. At the beginning of the academic year, they received an information letter with the invitation to participate and were informed that participation was entirely voluntary. Around 250 students were willing to participate. The students were randomly assigned to one of the two conditions: intervention condition versus control condition. Data of the students were collected during the "Tutoraat Basis Programma". The pretest questionnaire at baseline (T0) was filled out after the first tutorial lecture in September 2020 at home. The first short term posttest was collected at the end of the second tutorial group meeting in November 2020, the long-term posttest questionnaire was filled out during the tutorial lecture in January 2021. Every student who finished at least two questionnaires received a €5, - gift card. In addition, prizes up to a value of €250, - were raffled among the participants. The study is approved by the Ethics Committee of the Faculty of Social and Behavioural Sciences of Utrecht University and filed under number 20-382.

Participants

For the current study all students were selected who participated in both the T0 and T2 measurement. The program started with 167 students between the age 17 and 25 years (M = 18.81, SD = 1.35). A total of 117 students (70,06%) completed the follow-up assessment at T2, of which 61 participated in the intervention condition (see Table 1). Of these 117 students, the average age was 18.81 (SD = 1.41) and 82.1% were girls. Non-response could be due to refusing participation, having to leave class early or absence from school on the day the questionnaire was administered. Attrition analyses showed no differences at T0 between students who completed the follow-up assessment at T2 and students who did not considering the age and gender.

Intervention design

The Behaviour Change Wheel (BCW) model was used to develop an effective behaviour change intervention (Michie et al., 2011). The BCW model uses the three components of the COM-B model to provide intervention functions. Based on the BCW the intervention consisted of 6 sections, 1) introduction, 2) pros and cons of smartphone use, 3) daily schedule of smartphone use, 4) goals and triggers regarding smartphone use, 5) plans to change smartphone use 6) summary. The online module was composed through video's, animations, exercises and tips. Students were randomly assigned to one of the two conditions

(0 = control group versus 1 = intervention group). The first four sections of the intervention were assigned as homework for the intervention condition, they had to finish it before the second tutorial group meeting. The last two sections were finished during the online second tutorial group meeting. Students of the control condition received curriculum as usual, which was about time-management.

Measures

    Problematic smartphone use was measured at T0 and T2. The variable consisted of 10 items. Response options ranged from "not true at all" (1) to "totally true" (5) on a 5-point scale. An example item was "I constantly check my smartphone so I won't miss other people's messages". The mean score of the 10 items was computed for both measure moments. Higher scores indicate more PS, Cronbachs Alpha's were .82 for T0 and .86 for T2.

    Smartphone use during studying was measured by four items at T0 and T2. An example item was "Because of my smartphone use, I start studying later than I would like to". The response options ranged from "never" (1) to "very often" (5), rated on a 5-point scale. Mean scores were computed for both measure moments. Higher scores indicate more SDS, Cronbachs Alpha's were .81 for T0 and .76 for T2.

    Motivation to change smartphone use during studying was measured by one item "I would like to reduce my smartphone use while studying", and was rated on a 5-point scale ranged from "not true at all" (1) to "totally true" (5). Higher scores indicate higher motivation.

    Self-efficacy to change one's smartphone use consisted of three items, an example is "If I want to, I can really change my smartphone use while studying". It was rated from "not true at all" (1) to "totally true" (5) on a 5-point scale. The mean score of the three items was computed. The third item was reversely scored, so that higher scores reflected higher self-efficacy, Cronbachs Alpha was .69.

    Treatment integrity was only measured among students of the intervention condition. Treatment integrity was calculated by using the data that were collected while students were engaging in the module. On basis of their answers to the exercises of module 2 to 5 two independent assessors estimated scores for treatment exposure and treatment responsiveness. Treatment exposure was measured by the sum of assessment scores about if students had completed the intervention assignments, rated with "not completed" (0) and "completed" (1). The mean score for each intervention section was computed. Treatment responsiveness was assessed per intervention section. Students were scored on how adequate they answered the questions in the module "low" (0), "adequate" (1) and "high" (2). The mean score of treatment exposure and the score of treatment responsiveness were multiplied and that

became the score on treatment integrity for each intervention section. Last the interaction terms were computed by multiplying the mean centered treatment integrity variable with the outcome variables mean score at T0.

Analyses

Frist, all data obtained from the interviews were processed in IBM SPSS Statistics 27. Descriptive analyses were conducted to check whether randomization had resulted in a balanced distribution of important characteristics (group size, age, gender, PS, SDS) of the students across the two conditions. An independent t-test was carried out to examine whether these variables were significantly different between the groups. Spearman and Pearson correlations were used to calculate associations between all study variables.

A linear regression analyses were performed to analyse the direct effect of the intervention on PS/SDS, controlling for PS T0/SDS T0. Next, the follow-up steps of Baron and Kenny were used to test if the (expected) effect of the intervention on PS/SDS was mediated by motivation or self-efficacy. First, the effect of the intervention on the mediating variables motivation or self-efficacy was analysed. Second, the effect of motivation and self-efficacy on PS/SDS was tested. In the last step, the effect of the intervention was tested after controlling for the mediating variable. Finally, the Sobel test was used to examine whether the mediated effect was statistically significant. Complete mediation occurs if there is a significant indirect effect of the intervention on PS/SDS and the effect of the intervention on PS/SDS is no longer significant when motivation or self-efficacy is taken into account. Because of the small sample size, a p-value of < .05 (one-sided) was used to determine statistical significance. Motivation and self-efficacy were not included in the questionnaire at T0. Therefore, it was not possible to control for both these mediating variables. In the analyses with PS at T2 and SDS at T2 as outcome measures, we controlled for these variables at T0. To assess whether treatment integrity was a moderator, the interaction variables were added to the model, controlling for the outcome variable at T0.

Results

Descriptive Results

An independent samples t test was used to compare the differences between both conditions for gender, age, PS (T0) and SDS (T0). The t test was non-significant for gender, $t(107.03) = -.97$, $p = .332$, non-significant for age, $t(111.29) = -.28$, $p = .782$, non-significant for PS (T0), $t(111,34) = -1.71$, $p = .085$, and non-significant for SDS (T0), $t(112.91) = -1.27$, $p = .201$. No significantly differences were found between the two conditions in terms of

gender, age, PS and SDS, indicating that the characteristics for both conditions were comparable at T0.

Table 1

Baseline (T0) Characteristics of Students, Distinguished between Intervention Group and Control Group

	Conditions	
Variable	*Intervention condition*	*Control condition*
Total sample		
Group size, *n* (%)	122 (51.7)	114 (48.3)
Girl, *n* (%)	69 (80.2)	67 (82.7)
Age, years: mean (SD)	18.86 (1.48)	18.75 (1.16)
Final sample		
Group size, N (%)	61 (52.1)	56 (47.9)
Girls, *n* (%)	52 (85.2)	44 (78.6)
Age, years: mean (SD)	18.84 (1.58)	18.79 (1.22)
SDS T0, mean (SD)	3.14 (.72)	2.98 (.72)
PS T0, mean (SD)	2.78 (.64)	2.60 (.49)

Note. PS Problematic smartphone use; *SDS* Smartphone use during studying.

Correlations

Table 2 presents the Spearman correlations for association the intervention/control group and Pearson's correlations for associations between all other study variables. Not in line with the expectations, there appeared to be no significant correlations between intervention/control group, age, and gender on the one hand and any other study variables on the other hand. The scores on PS and SDS at T0 were significantly correlated with these scores at T2, indicating that more PS and SDS at T0 were related to more PS and SDS at T2. In addition, more PS at T0 and T2 was significantly related with more SDS at T0 and T2. Furthermore, a higher level of motivation was significantly correlated with more PS at T0 and T2 and SDS at T0 and T2. This suggests that students who have higher motivation to change smartphone use also show more PS and SDS, which is in contrast to the expectations. Furthermore, a significantly negative correlation emerged between self-efficacy at T1 and PS and SDS at T0 and T2. This implies that a low level of self-efficacy was related to more PS and SDS. In addition, the scores on self-efficacy at T1 significantly negatively correlated with

the scores on motivation at T1, suggesting that a high level of self-efficacy was related to a low level of motivation to change SDS. In conclusion, the intervention did not correlate with any study variable, which was not as expected. Most other variables did correlate as predicted, only motivation correlated in the opposite direction in relation to self-efficacy, PS and SDS.

Table 2

Intercorrelations of Intervention, Students Descriptive, PS, SDS, Motivation, and Self-efficacy

Variables	1.	2.	3.	4.	5.	6.	7.	8.
1. Intervention/ control group	-							
2. Age	-.037	-						
3. Gender	.092	-.110	-					
4. PS (T0)	.122	-.018	.158	-				
5. PS (T2)	-.035	-.074	.089	.692**	-			
6. SDS (T0)	.131	-.058	-.067	.568**	.518**	-		
7. SDS (T2)	.028	-.061	.024	.491**	.561**	.593**	-	
8. Motivation	.158	.051	.177	.484**	.519**	.508**	.582**	-
9. Self-efficacy	-.095	.129	-.061	-.348**	-.352**	-.539**	-.483**	-.366**

Note. PS Problematic smartphone use; *SDS* Smartphone use during studying. Spearman's rho was used for intervention/control group; Pearson's correlation coefficient was used for all other correlations.

* $p < 0.05$; ** $p < 0.01$

Problematic smartphone use

Direct effect of following the intervention on problematic smartphone use

First the direct effect of the intervention (reference = control condition) on students' PS at T2 was tested. Results showed that the intervention had a significant negative effect on PS at T2, while controlling for PS at T0 (see Table 3.1). This suggests that students who followed the intervention reported a lower level of PS a few months later compared to the students in the control group.

Indirect effect of following the intervention on students' problematic smartphone use via motivation

Step 2 is to test the indirect effect of the intervention on students' PS via motivation. First the effect of the intervention on motivation at T1 was examined, which predicted significant higher levels of motivation to change smartphone use ($B = .289$, $SE = .169$, $p = .046$). That is, students who followed the intervention were more motivated to change their smartphone behaviour compared to the students in the control condition. Next, the full mediation model was tested, presented in Table 3.2. A significant effect was found of motivation to change smartphone use at T1 on students' PS at T2. In addition, the effect of intervention was tested, while controlling for motivation. Results show that the effect of intervention on PS is no longer significant, when controlling for motivation. In the last step, the Sobel test (1982) was used to determine whether the mediating effect via motivation was statistically significant. The indirect effect of the intervention on PS via motivation was not significantly different from zero, effect size was 1.46 ($p = 0.07$). In sum, the mediation path was non-significant, suggesting that the effect of the intervention on students' PS did not result from an increased motivation to change one's smartphone use.

Indirect effect of following the intervention on students' problematic smartphone use via self-efficacy

For the same reason as for motivation, the indirect effect of the intervention on students' PS via self-efficacy will be tested. Starting to test the effect of the intervention on self-efficacy at T1. The intervention did not predict significantly the score on self-efficacy at T1 ($B = -.080$, $SE = .132$, $p = .274$), the assumptions for mediation, as described by Baron & Kenny, are not met. Therefore, a mediated effect of the intervention on PS via self-efficacy was not possible.

Table 3.1

Lineair Regression Between Intervention/Control Group and PS T2

Model	N	B	β	SE	p	ΔR^2
Model 1: Control variable						.476
Problematic smartphone use T0	116	.804	.693	.078	<.001	
Model 2: Predictors						.013
Intervention/control group	116	-.154	-.115	.091	.046	

Note. P-values for one-sided tests.

Table 3.2

Lineair Regression Between Intervention/Control Group and Problematic Smartphone Use T2 and Motivation (M)

Model	N	B	β	SE	p	ΔR^2
Model 1: Control variable						.538
Problematic smartphone use T0	95	.860	.737	.082	<.001	
Model 2: Mediator						.033
Motivation	95	.176	.219	.063	.003	
Model 3: Predictor						
Intervention/control group	95	-.141	-.106	.092	.063	

Note. P-values for one-sided tests.

Smartphone Use During Studying

Direct Effect of Following the Intervention on Smartphone Use During Studying

The direct effect of following the intervention on SDS at T2 was examined while controlling for SDS at T0. No significant effect was found (see Table 4.1). This indicates that the intervention has no effect on students' SDS. Therefore, the assumptions for mediation, as described by Baron & Kenny, are not met and it is not possible to test for a mediation effect.

Table 4.1

Lineair Regression Between Intervention/Control Group and Smartphone Use During Studying T2

Model	N	B	β	SE	p	ΔR^2
Model 1: Control variable						.346
Smartphone use during studying T0	116	.549	.590	.070	<.001	
Model 2: Predictors						-.004
Intervention/control group	116	-.039	-.030	.102	.350	

Note. P-values for one-sided tests.

Treatment Integrity Problematic Smartphone Use

      The impact of treatment integrity for students of the intervention condition and the interaction terms of PS T0 and treatment integrity were analysed per module (part 2-5). No effect was found of treatment integrity on PS T2, Table 5 shows the results. Treatment integrity section 3 and 5 were both significant moderators. The Slope test shows both interactions, see Figure 2 and 3. Among students who initially had a high score on PS, those with a high treatment integrity part 3, scored significantly lower on PS at T2. The same applies for part 5.

Treatment Integrity Smartphone Use During Studying

      The impact of treatment integrity for students of the intervention condition and the interaction terms of SDS T0 and treatment integrity were also analysed per module (module 2-5). No effects were found of the treatment integrity parts on SDS at T2 (see Table 6). Treatment integrity part 3 was a significant moderator. The Slope test shows the interaction, shown in Figure 4. Among students who initially had a high score on SDS, those with a high treatment integrity module 3, scored significantly lower on SDS at T2.
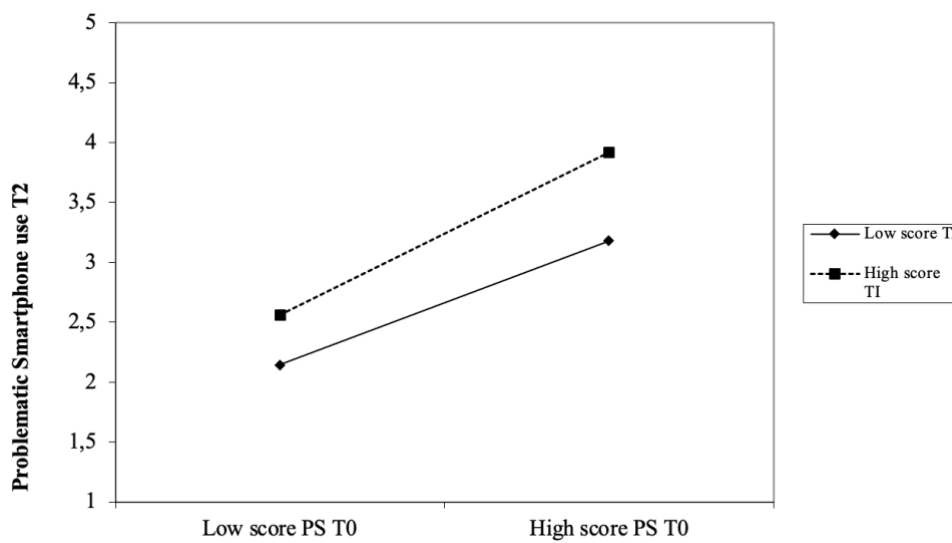
Table 5

Results of Linear Regression Analyses with Predictor: Treatment Integrity

	Problematic Smartphone use (T2)	
	β	p
Step 1:		
PS (T0)	.734	<.001
Step 2:		
TI part 2	-.087	.230
TI part 3	-.175	.069
TI part 4	.001	.496
TI part 5	.205	.051
Step 3:		
PS(T0)*TI part 2	.075	.238
PS(T0)*TI part 3	.211	.042
PS(T0)*TI part 4	.135	.115
PS(T0)*TI part 5	-.260	.007

Note. TI Treatment Integrity; *PS* Problematic smartphone use; P-values for one-sided tests.
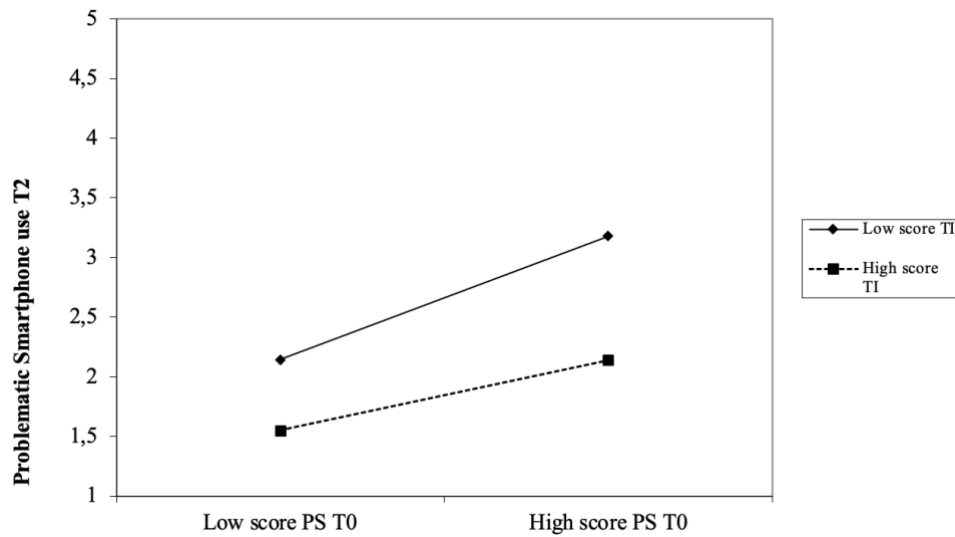
Figure 2

Relationship Between Problematic Smartphone Use at T0 and T2, Moderated by Treatment Integrity Part 3

Note. PS Problematic smartphone use; *TI* Treatment integrity.

Figure 3

Relationship Between Problematic Smartphone Use at T0 and T2, Moderated by Treatment Integrity Part 5

*Note.* PS Problematic smartphone use; *TI* Treatment integrity

Table 6

Results of Linear Regression Analyses with Predictor: Treatment Integrity

	Smartphone use during studying (T2)	
	β	*p*
Step 1:		
SDS (T0)	.591	<.001
Step 2:		
TI part 2	-.150	.149
TI part 3	.015	.459
TI part 4	.031	.409
TI part 5	.012	.467
Step 3:		
SDS(T0)*TI part 2	-.199	.372
SDS(T0)*TI part 3	-1.171	.049
SDS(T0)*TI part 4	.250	.340
SDS(T0)*TI part 5	.188	.095

Note. SDS Smartphone use during Studying; *TI* Treatment Integrity; P-values for one-sided tests.

Figure 4

Relationship Between Smartphone Use During Studying at T0 and T2, Moderated by Treatment Integrity Part 3
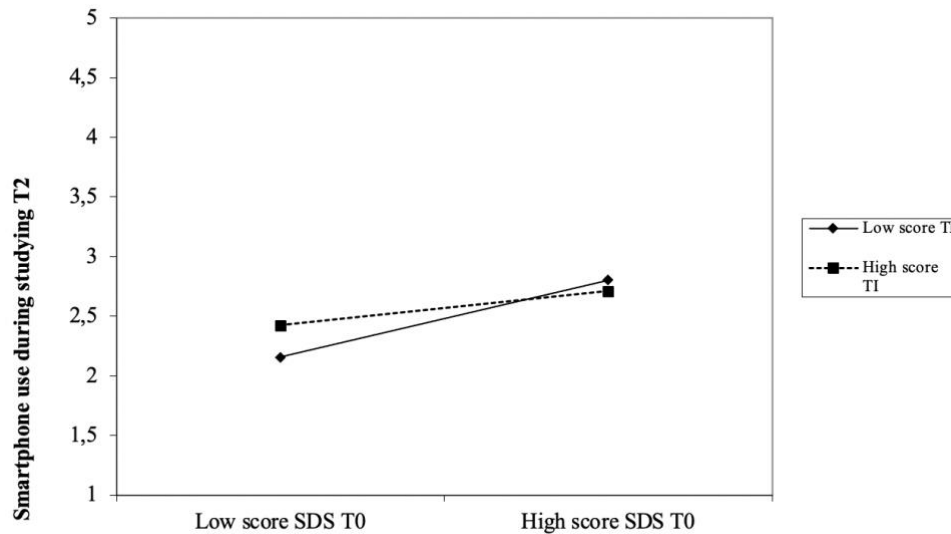
Note. SDS Smartphone use during studying; *TI* Treatment integrity

Discussion

This is the first cluster randomized controlled trial that tested if the new intervention 'Je smartphone de Baas' ('*In control of your smartphone*') influenced students' PS and SDS, and whether this effect was mediated by motivation to change SDS and the level of self-efficacy to change smartphone use. As expected, results showed a significant effect of the intervention 'Je smartphone de Baas' on PS a few months later. However, not on SDS. Although the intervention was associated with a higher motivation to change one's smartphone us, there was no evidence that the impact of the intervention resulted from higher levels of self-efficacy to change smartphone use. Furthermore, the moderation effect implied that students who were more compliant showed less PS T2/SDS T2, compared to students who were less compliant.

Direct Effects Intervention

The first hypothesis assumed that the intervention would have an effect on PS. The students who followed the intervention did show less PS than the control group. This finding is in line with expectations that an intervention, based on the COM-B model and TPB, will reduce PS (Ajzen, 1991; Michie et al., 2011).

Unlike hypothesis one, hypothesis two was not confirmed. It did not seem that the intervention had an effect on SDS. A possible explanation for this can be found in the fact that the intervention was only conducted once. Literature shows that an intervention is more

effective if it is repeated (Lally et al., 2010). Recommended is to add a follow-up intervention to refresh students' memory on what they have learned. In addition, when implementing the intervention, the school situation was totally changed due to the pandemic of coronavirus disease 2019 (COVID-19). The questionnaire at T2 was administered during the second lockdown and all Dutch universities were closed at that time. Studying at home may have made it more difficult to reduce smartphone use, for example due to a lack of social pressure to concentrate during lectures instead of using your smartphone. Future research is needed to shed more light on the effect of the intervention in times when corona is no longer an issue.

Mediated Effect: Motivation and Self-efficacy

In contrast with hypothesis three and four, the relation between the intervention and PS/SDS was not mediated by motivation. Besides, the findings did not suggest that the effect of the intervention on PS/SDS was mediated by self-efficacy, inconsistent with hypothesis five and six. However, the intervention did have a significant effect on motivation, indicating that students who followed the intervention were more motivated to change SDS than the control group. In addition, results suggest that the students who were highly motivated to change their behaviour, reported more PS than students who were less motivated. The latter finding was the adverse of what was expected. The COM-B model identifies three factors (capability, opportunity and motivation) that influence behavioural change (Michie et al., 2011). A possible explanation for this finding may be that students who use their smartphone a lot during studying, were more motivated to change their behaviour. However, they did not possess the skills (capability) to actually change their behaviour. In addition, opportunity seems to be an important factor as well to behavioural change. Due to the corona pandemic, the opportunity to change smartphone behaviour may have been experienced as low. Especially when collecting the data at T2, the Netherlands was having a strict lockdown. Physical opportunities to meet people in real life instead of online were not approved by the government at the time of the implementation of the intervention. Desirable behaviour was to stay at home, which may have led to more smartphone use (Király et al., 2020). This could explain why a higher motivation to change still had no effect on changing students' PS. Besides, it is important to note that we did not control for motivation and self-efficacy at T0, while testing the impact of the intervention on motivation and self-efficacy T1, as motivation and self-efficacy T0 was not measured in the current study. This made it impossible to test for initial differences between the intervention and control group at baseline. Therefore, initial differences in motivation and self-efficacy between the intervention and the control group cannot be ruled out and may have affected the findings. For future studies it would be

interesting to measure motivation and self-efficacy at T0 and T1, which will make it possible to test for initial differences between the two conditions. In addition, future research is needed at the time when education is given in the regular way to see if the intervention has an effect on smartphone behaviour via motivation and self-efficacy.

Moderated Effect: Treatment Integrity

The results of the current study showed the importance of two specific modules of the intervention. Students who were compliance to module three and five module were more likely to reduce their PS at T2, compared to students who were less compliant. The compliance to module three was also moderating the effect on the relation between SDS at T0 and SDS at T2. This is partly in line with hypothesis seven and eight, that decreases in PS/SDS following the intervention will be higher among adolescents who followed the module as intended, in comparison to adolescents who did not. This effect seems to emphasise the importance of treatment integrity for these two modules. Based on this, students who thought about their daily smartphone use, the pros and cons of their use and seriously made plans to change their smartphone use are expected to show less PS after finishing the online module.

Limitation, Strengths and Future Research

The present cluster randomized controlled trial has several important strengths. One of which is that it is based on experimental data which makes it possible to find causal relationships. In addition, the effects on behaviour were measured a few months after finishing the online module, which provides of more information on the long-term effects of the intervention. Another strength is the innovativeness of the study. This study is, to the best of our knowledge, the first to explore the effectiveness of an intervention in reducing smartphone use.

Regardless of these strengths, there are several limitations that should be mentioned, as well. First, due to the small sample size, the study has less statistical power (Button et al., 2013). This shortcoming has been partially addressed by one-sided testing. However, the chance of a Type II error remains higher due to the small sample size, this occurs when the effect of an intervention is considered insignificant, while in fact the intervention is effective. Future research should preferably use a larger sample size to examine the intervention effects. Second, motivation was measured by only one item. Future research should use a validated scale with more items, because this would be a more reliable measure of motivation while it is such an important factor to change behaviour. Third, students' self-reports were used which could have led to socially desirable answers, objective measures are more preferred.

Conclusion and Practical Implications

  In the current study we gained initial insights into the effect of the first intervention designed to reduce (problematic) smartphone use. The results showed a significant reduction in PS use among Dutch students. The intervention seems to be the first effective intervention in reducing one of the top health concerns at the moment. Therefore, it is recommended to disseminate the intervention among Dutch university students. It remains for future studies to examine the generalizability of the intervention. When implementing the intervention, the main focus should be on students' compliance to module three and the final module, as these seem to be the most important modules in reducing PS. The intervention can be seen as the pioneer in reducing (problematic) smartphone use. The results are very promising and given the circumstances regarding the corona pandemic, its impact can be even stronger when the corona pandemic has ended. Follow-up research will have to provide more insight into this matter.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Anderson, M., & Jiang, J. (2018). Teens, social media & technology 2018. *Pew Research Center*, *31*, 1673-1689. Retrieved from https://apo.org.au/node/175701

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. https://doi.org/10.1037/0033-295X.84.2.191

Boer, M., van den Eijnden, R. J., Boniel-Nissim, M., Wong, S. L., Inchley, J. C., Badura, P., ... & Stevens, G. W. (2020). Adolescents' intense and problematic social media use and their well-Being in 29 countries. *Journal of Adolescent Health*, *66*(6), 89-99. https://doi.org/10.1016/j.jadohealth.2020.02.014

Boer, M., Stevens, G., Finkenauer, C., & van den Eijnden, R. (2020). Attention deficit hyperactivity disorder-symptoms, social media use intensity, and social media use problems in adolescents: Investigating directionality. *Child Development*, *91*(4), 853-865. https://doi.org/10.1111/cdev.13334

Bond, G. R., Becker, D. R., & Drake, R. E. (2011). Measurement of fidelity of implementation of evidence-based practices: Case example of the IPS Fidelity Scale. *Clinical Psychology: Science and Practice*, *18*, 125-140. https://doi.org/10.1111/j.1468-2850.2011.01244.x

Button, K. S., Ioannidis, J. P., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S., & Munafò, M. R. (2013). Power failure: why small sample size undermines the reliability of neuroscience. *Nature Reviews Neuroscience, 14*(5), 365-376. https://doi.org/10.1038/nrn3475

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Petticrew, M. (2008). Developing and evaluating complex interventions: the new Medical Research Council guidance. *BJM, 337*. https://doi.org/10.1136/bmj.a1655

Doh, Y. Y., Rhim, J., & Lee, S. (2016). A conceptual framework of an online-offline integrated intervention program for adolescents' healthy smartphone use. *Addicta: The Turkish Journal on Addictions, 3*(3), 319-338. doi:10.15805/addicta.2016.3.0105

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology, 38*, 69-119. https://doi.org/10.1016/S0065-2601(06)38002-1

Griffiths, M., Kuss, D., & Demetrovics, Z. (2014). Social networking addiction: An overview of preliminary findings. *Clinical Psychology Science and Practice, 18*(2), 126-141. https://doi.org/10.1016/B978-0-12-407724-9.00006-9

Király, O., Potenza, M. N., Stein, D. J., King, D. L., Hodgins, D. C., Saunders, J. B., ... & Demetrovics, Z. (2020). Preventing problematic internet use during the COVID-19 pandemic: Consensus guidance. *Comprehensive Psychiatry, 100*, 152180. https://doi.org/10.1016/j.comppsych.2020.152180

Kuss, D. J., & Griffiths, M. D. (2017). Social networking sites and addiction: Ten lessons learned. *International Journal of Environmental Research and Public Health, 14*(3), 311. https://doi-org.proxy.library.uu.nl/10.3390/ijerph14030311

Lally, P., Van Jaarsveld, C. H. M., Potts, H. W. W., & Wardle, J. (2010). How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology, 40*(6), 998–1009. http://dx.doi.org/10.1002/ejsp.674

Lopez-Fernandez, O., Honrubia-Serrano, L., Freixa-Blanxart, M., & Gibson, W. (2014). Prevalence of problematic mobile phone use in British adolescents. *CyberPsychology, Behavior, and social networking, 17*(2), 91-98. https://doi.org/10.1089/cyber.2012.0260

Manwong, M., Lohsoonthorn, V., Booranasuksakul, T., & Chaikoolvatana, A. (2018). Effects of a group activity-based motivational enhancement therapy program on social media addictive behaviors among junior high school students in Thailand: a cluster randomized trial. *Psychology Research and Behavior Management, 11*, 329-339. doi:10.2147/PRBM.S168869

Mersha, A. G., Gould, G. S., Bovill, M., & Eftekhari, P. (2020). Barriers and facilitators of adherence to nicotine replacement therapy: A systematic review and analysis using the capability, opportunity, motivation, and behaviour (COM-B) model. *International Journal of Environmental Research and Public Health, 17*(23), 8895. https://doi.org/10.3390/ijerph17238895

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science, 6*, 42. https://doi.org/10.1186/1748-5908-6-42

Park, B. W., & Lee, K. C. (2011). The effect of users' characteristics and experiential factors on the compulsive usage of the smartphone. *Ubiquitous Computing and Multimedia Applications, 151*, 438–446. https://doi.org/10.1007/978-3-642-20998-7_52

Poushter, J. (2016). Smartphone ownership and internet usage continues to climb in emerging economies: But advanced economies still have higher rates of technology use. *Pew Research Center*. Retrieved from http://www.pewglobal.org/2016/02/22/smartphone-ownership-and-internet-usage-continues-to-climb-in-emergingeconomies/

Ryan, T., & Xenos, S. (2011). Who uses Facebook? An investigation into the relationship between the Big Five, shyness, narcissism, loneliness, and Facebook usage. *Computers in Human Behaviour, 27*, 1658-1664. https://doi.org/10.1016/j.chb.2011.02.004

Shakir, T., Bhandari, N., Andrews, A., Zmitrovich, A., Gadomski, J., McCracken, C., & Morris, C. (2018). Social media and its impact on adolescents. *Pediatrics, 141*(1). https://doi-org.proxy.library.uu.nl/10.1542/peds.141.1_MeetingAbstract.240

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In Leinhardt (Ed.), *Sociological methodology* (pp. 290-312). Washington, DC: American Sociological Association.

Su, W., Fang, X., Miller, J. K., & Wang, Y. (2011). Internet-based intervention for the treatment of online addiction for college students in China: a pilot study of the Healthy Online Self-helping Center. *Cyberpsychology, Behavior, and Social Networking, 14*(9), 497-503. doi:10.1089/cyber.2010.0167

Szczegielniak, A., Palka, J., & Krysta, K. (2013). Problems associated with the use of social networks: A pilot study. *Psychiatria Danubina, 25*(2), 212-215. Retrieved from https://pubmed.ncbi.nlm.nih.gov/23995179/

Van den Eijnden, R. J. J. M., Lemmens, J., & Valkenburg, P. M. (2016). The Social media Disorder Scale: Validity and psychometric properties. *Computers in Human Behaviour, 61*, 478-487. https://doi.org/10.1016/j.chb.2016.03.038

Vermilyea, B. B., Barlow, D. H., & O'Brien, G. T. (1984). The importance of assessing treatment integrity: An example in the anxiety disorders. *Journal of Behavioral Assessment, 6*, 1-11. https://doi.org/10.1007/BF01321456

West, R. (2013). *European Monitoring Centre for Drugs and Drug Addiction: EMCDDA Insights - Models of Addiction.* Publications Office of the European Union.

Willemse, I., Waller, G., Süss, D., Genner, S., & Huber, A. L. (2012). *JAMES – Jugend, Aktivitäten, Medien – Erhebung Schweiz.* Zürich: Zürcher Hochschule für Angewandte Wissenschaften.

Appendix 1. Interdisciplinary

Microsystem

Relationships with peers. A motivation of using a smartphone and specifically using social media, can be the ease to connect with their peers (Antheunis et al., 2014). It is very simple to communicate with each other using social media, and adolescents can easily form relationships by joining online services that provide group and individual interaction options.

Parental monitoring. Different parental monitoring can lead to different time spent on social media (Padilla-Walker et al., 2017). Active parental monitoring and connective co-use (e.g., engaging in media with the intent to connect with their children) are directly associated with less media use.

Media content. Exposure to aggressive violence media content is related to anti-social behaviour (Greitemeyer & Mügge, 2014). Exposure to prosocial behaviour media content is related to the opposite relations (Coyne et al. 2017).

Mesosystem

Maybe the interaction with media content and parental monitoring. Parents could be more approving of prosocial behaviour media content instead of aggressive violence media content.

Exosystem

Parenting work life. When parents are a lot at work and are not very often at home. They will be less capable to monitor their children's' social media use, with the outcome that children will use social media more (Padilla-Walker et al., 2017).

Macrosysteem

Cultural differences. Collectivism vs. individualism can have different motivations to use social media (Hsu et al., 2015). For example, tend to use social media more to seek and obtain information, while collectivistic users are more likely to use social media to obtain emotional support.

Interdisciplinary element research question. When I will change from awareness to motivation it would be useful to intergrade the interaction with peers on microlevel. Besides, the differences of motivation among different cultures are interesting. I am not sure if I can use this element, because the research will focus on the Netherlands.

References

Antheunis, M. L., Schouten, A. P., & Krahmer, E. (2014). The role of social networking sites in early adolescents' social lives. *The Journal of Early Adolescence, 36*(3), 348-371

Coyne, S. M., Padilla-Walker, L. M., Stockdale, L., & Day, R. D. (2011). Game on… girls: Associations between co-playing video games and adolescent behavioral and family outcomes. *Journal of Adolescent Health, 49*(2), 160–165. https://doi.org/10.1016/j.jadohealth.2010.11.249.

Greitemeyer, T., & Mügge, D. O. (2014). Video games do affect social outcomes: a meta-analytic review of the effects of violent and prosocial video game play. *Personality and Social Psychology Bulletin, 40*(5), 578–589. https://doi.org/10.1177/0146167213520459.

Hsu, M. H., Tien, S. W., Lin, H. C., & Chang, C. M. (2015). Understanding the roles of cultural differences and socio-economic status in social media continuance intention. *Information Technology & People, 28*(1), 224-241. https://doi.org/10.1108/ITP-01-2014-0007

Padilla-Walker, L. M., Coyne, S. M., Kroff, S. L., & Memmott-Elison, M. K. (2017). The protective role of parental media monitoring style from early to late adolescence. *Journal of Youth and Adolescence, 47*, 445-459. https://doi.org/10.1007/s10964-017-0722-4

Appendix 2. Contract data use (TED)

Utrecht, 2021

This letter constitutes formal confirmation of the fact that the data from the Utrecht University *Je smartphone de Baas* 2021 have been made available to Judith Schiltkamp of Utrecht University.

These data will not be made available to others, and the data may be used only for analysis and reporting on topics for the thesis, about which agreement has been reached with Dr. Regina van den Eijnden.

Judith Schiltkamp will receive access to the data from the dataset in order to answer the following research questions within the framework of the thesis:

Research question: Does following the online module *Je smartphone de baas* have an effect on smartphone use among Dutch students in higher education.

The following variables will be used:
Dependent variable: Smartphone use (3 items) in general, smartphone use while studying (4 items)
Independent variables: Intervention (1 item)
Other variables: Motivation (1 item), Self-efficacy (3 items) and treatment integrity

No report based on the data from the project entitled *Je smartphone de baas* may be made public, unless permission has been obtained in advance from the Project Coordinator for the *Je smartphone de baas*.

After the expiration of this contract, dated 30-06-21, Judith Schiltkamp shall delete the *Je smartphone de baas* data.

Dates and signature: