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The influence of social media use on school performance of adolescents and the role of sleep problems

#putyoursmartphoneawaywhilereading

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Master Youth Studies

June 11, 2018

Wordcount: 5958

Abstract

Social media use may lead to serious health risks and negative life outcomes, such as poor school performance and increased sleep problems. However, there is a lack of research on this subject. Therefore, this study examined the effect of social media use on school performance (GPA) of adolescents and whether sleep problems mediates this link. Also the effect of smartphone use before going to bed and impulsivity on the link between social media use and sleep problems are studied. Data are retrieved from the Digital Youth Project, a longitudinal study in the Netherlands. In this study, 1099 adolescents are included with an age between 11 and 16 years old. The results suggest that more social media use predicts a lower GPA and increased sleep problems, but sleep problems do not seem to mediate this link. The effect of social media use is particularly high among adolescents who score low on impulsivity. Smartphone use before going to bed does not affect this link, but does predict sleep problems. The outcomes can be used to inform parents, schools and policy makers, and emphasize that amplified attention of Dutch authorities is needed for the effects of social media use on adolescents.

Keywords: social media use, school performance, GPA, sleep problems, smartphone use, impulsivity, adolescents.

Samenvatting

Het gebruik van sociale media kan leiden tot serieuze gezondheidsproblemen en negatieve levensuitkomsten, zoals slechte schoolprestaties en vergrootte slaapproblemen. Er is echter weinig onderzoek naar dit onderwerp, daarom wordt in dit artikel de invloed van het gebruik van sociale media op schoolprestaties van adolescenten onderzocht en of slaapproblemen die invloed mediëren. Ook het effect van smartphone gebruik voor het naar bed gaan en impulsiviteit op de relatie tussen het gebruik van sociale media en slaapproblemen worden onderzocht. Voor dit onderzoek werd data gebuikt van het *Digital Youth Project*, een longitudinaal onderzoek uit Nederland. In het huidige onderzoek werden 1099 adolescenten geïncludeerd, met een leeftijd tussen 11 en 16 jaar. De resultaten suggereren dat meer gebruik van sociale media tot slechtere schoolprestaties en vergrootte slaapproblemen lijkt te leiden. Slaapproblemen lijken deze relatie niet te mediëren. Het effect van sociale media gebruik is voornamelijk groot bij adolescenten met een lage impulsiviteitscore. Smartphone gebruik voor het naar bed gaan lijkt niet van invloed op dit verband, maar voorspelt wel direct slaapproblemen. De uitkomsten kunnen gebruikt worden om ouders, scholen en beleidsmakers te informeren, en onderstrepen dat vergrootte aandacht van Nederlandse autoriteiten nodig is voor de effecten van het sociale media gebruik van adolescenten.

Trefwoorden: sociale media gebruik, schoolprestatie, GPA, slaapproblemen, smartphone gebruik, impulsiviteit adolescenten.

Introduction

Concerns about the social media use of adolescents are growing. Since the internet became portable, young people started to devote more and more time to media (Roberts & Foehr, 2008). Teens mostly access the internet on their smartphone (Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013). In the Netherlands, 98.6 percent of persons aged 12 to 18 years owned a smartphone in 2017, 96.9 percent uses social media, and 95.1 percent uses the internet (almost) every day (Centraal Bureau voor de Statistiek, 2018). Excessive social media use or smartphone use might even result in addictive-like behaviour (Huang, 2014; Touitou, Touitou, & Reinberg, 2016). Moreover, social media use may lead to serious health risks and negative life outcomes, such as poor school performance (Bailin, Milanaik, & Adesma, 2014; Engelander, Terregrossa, & Wang, 2010; Liu, Kirschner, & Karpinski, 2017; Roberts & Foehr, 2008; Van der Schuur, Baumgartner, Sumter, & Valkenburg, 2015). Time spent on social media is costly time that can go at the expense of schoolwork. School performances are very important, because they decide how adolescents' lives will eventually evolve (Huang, 2014). Therefore, the main aim of this study is to examine the effect of social media use on the school performances of adolescents.

A factor that might explain the possible link between social media use and school performance is sleep problems. Social media use can lead to increased sleep problems (Alosaimi, Alyahya, Alshahwan, Mahyijari, & Shaik, 2016; George & Odgers, 2015; Li, Lepp, & Barkley, 2015). About 43 percent of school-aged children reports decreased sleeping hours due to social media use, which in turn causes negative life outcomes and cognitive problems (Alosaimi et al., 2016). Sleep is crucial for the brain functioning and the school performances of adolescents (Dewald, Meijer, Oort, Kerkhof, & Bögels, 2009). Therefore, the second aim of this study is to examine the effect of sleep problems on the relationship between social media use and school performance.

Particularly smartphone use before going to bed can be expected to influence the effect of social media use on sleep problems. Adolescents frequently use social media in the hour before they go to sleep. Additionally, 86 percent have their smartphone in their bedroom (Pieters et al., 2014). It is expected that smartphone use before going to bed will influence the link between social media use and sleep problems, and therefore will be examined in this study. Finally, to what extend social media use influences adolescents' health and functioning depends on the amount of social media they consume and personal characteristics of the adolescent (Reid Chassiakos, Radesky, Christakis, Moreno, & Cross, 2016). A personal characteristic that might be important in this regard is impulsivity, since impulsivity seems to be a predictor of

problematic social media use (De-Sola Gutiérrez, Rodriguez de Fonseca, & Rubio, 2016). Thus, impulsivity might influence the link between social media use and sleep problems, and thence will be further examined in this study.

Social media use and school performance

Recent studies examined the effect of social media use on school performance, and researchers found contradictory results. Three reviews (Hew, 2011; Liu et al., 2017; Van der Schuur et al., 2015) found that social media use has a negative effect on grade point average (GPA), whereas another review found that social media use has a positive effect on GPA (González, Gasco, & Llopis, 2016). The negative effect on school performance seems to be stronger for girls (Liu et al., 2017). The time replacement theory provides an explanation of the negative effect of social media use on school performance. This theory states that time spent on social media, could have been time spent on schoolwork instead (Engelander et al., 2010; Liu et al., 2017). As a result, a higher amount of time spent on social media may be related to lower school performances. However, social media use can also have a positive effect when it is used for academic purposes, for example as a space for collaboration and interaction (González et al., 2016). Thus, the findings on social media use and school performance are somewhat ambiguous, also because of a lack of longitudinal studies. Nevertheless overall findings indicate that social media use is mainly negatively related to GPA. Therefore, it is expected that social media use will have a negative effect on adolescents' school performances (H1).

Liu et al. (2017) and Van der Schuur et al. (2015) mention that the direction of the link between social media use and school performance is difficult to determine. It is expected that adolescents who use more social media have a lower GPA, but it might also be that adolescents with a lower GPA use more social media. Van der Schuur et al. (2015) suggests that adolescents with a lower GPA might be less motivated at school, which may lead to more social media use during school-related activities or to less willingness to regulate their social media use while studying. Thus, the effect of social media use and GPA in two directions. This leads to the assumption that school performance will also have a negative effect on social media use (H2).

The role of sleep problems in the relationship between social media use and school performance

As proposed before, sleep problems might provide an important explanation of the link between social media use and school performance (Alosaimi et al., 2016; George & Odgers, 2015; Li et al., 2015). LeBourgeouis et al. (2017) emphasized the need for future research to

explore this pathway of sleep problems as a mediating process within the relationship between socials media use and school performance. To further explore the pathway of sleep problems mediation, the present study will explore the effect of social media use on sleep problems first.

The effect of social media use on sleep problems has been studied extensively. Reviews, meta-analysis, longitudinal studies and cohort studies report that social media use has a negative effect on several aspects of sleep quality (Bailin et al., 2014; Bartel, Gradisar, & Williamson, 2015; George & Odgers, 2015; Hale & Guan, 2015; Lam, 2014; LeBourgeouis, 2017; Magee, Lee, & Vella, 2014; Reid Chassiakos et al., 2016; Schweizer, Berchtold, Barrense-Dias, Akre, & Suris, 2017; Touitou et al., 2016). There are three mechanisms that can possibly explain the negative influence of social media use: social media might displace sleep time (time replacement theory), the arousal of social media content might make it more difficult to fall asleep, and the bright blue light of smartphones disturb the sleep rhythm of adolescents (LeBourgeouis, 2017; Levenson, Shensa, Sidani, Colditz, & Primack, 2016; Reid Chassiakos et al., 2016; Titova et al., 2015; Touitou et al., 2016). Only a few studies included in those reviews found no association between social media use and sleep problems. This convincing amount of corresponding evidence leads to the expectation that social media use will have a negative effect on sleep problems (H3).

Secondly, the effect of sleep problems on school performance is extensively studied. Three reviews examined whether later school starting times have an effect on the school performances of adolescents (Minges & Redeker, 2016; Wahlstrom & Owens, 2017; Wheaton, Chapman, & Croft, 2016). They all found that later school start times increase the sleep quality, and subsequently attention in class and school performances improved. Another review confirms the importance of sleep for school performance (Shochat, Cohen-Zion, & Tzischinsky, 2014). The meta-analysis of Dewald et al. (2009) argues that this link is stronger for younger participants and affects boys more than girls. Therefore, it is expected that sleep problems will have a negative effect on school performance (H4). Moreover, it is expected that sleep problems will have a mediating role in the effect of social media use on school performance (H5).

The role of smartphone use before going to bed on the relationship between social media use and sleep problems

Smartphone use before going to bed can promote sleep disturbances for adolescents (Pieters et al., 2014), as it may enhance the promoting effect of social media use on sleep problems. The same three mechanisms as mentioned before (sleep time replacement, arousal

and disturbed sleep rhythm) can explain this positive effect. Three reviews and a cohort study report that using social media on a smartphone before going to bed and/or taking a smartphone into the bedroom has a positive effect on sleep problems (Hale & Guan, 2015; LeBourgeouis, 2017; Magee et al., 2014; Reid Chassiakos et al., 2016). Several cross-sectional studies have examined the link between smartphone use before going to bed and sleep problems, and indeed found a positive link (Arrona-Palacios, 2017; Bruni et al., 2015; Fobian, Avis, & Schwebel, 2016; Gradisar et al., 2012; Harbard, Allen, Trinder, & Bei, 2016; Li et al., 2017; Power, Taylor, & Horton, 2017; Reid Chassiakos et al., 2016). Not all studies show a clear link, and therefore request future research to analyse the effects of bedtime media use on sleep problems (Arora, Broglia, Thomas, & Taheri, 2014; Bartel et al., 2015). Based on the foregoing, it is expected that smartphone use before going to bed has a positive moderating effect on the effect of social media use on sleep problems (H6).

The role of impulsivity on the relationship between social media use and sleep problems

Lastly, it is important to study dispositional factors that may increase the risk of sleep problems due to social media use (Van der Schuur et al., 2015). Some individuals might be more affected by the use of social media than others. Impulsivity plays an important role in adolescence and is linked to behavioural addictions (De-Sola Gutiérrez et al., 2016). Reviews found a link between cell-phone addiction and impulsivity (De-Sola Gutiérrez et al., 2016), and a link between an internet addiction and a high hyperactivity/impulsivity score (Wang, Yao, Zhou, Liu, & Lv, 2017). Another review found that media multitaskers also seem to be more impulsive (Uncarpher et al., 2017).

The self-regulation theory might provide an explanation of the influence of impulsivity on the link between social media use and sleep problems. The influence might be due to the duration and interruptive nature of social networking sites and instant messengers (Van der Schuur et al., 2015). The sound or buzzing or lighting up of a smartphone screen when receiving a new message is distracting, and requires a high level of self-regulation to resist. Impulsive adolescents have a lack of self-regulation, and thus cannot resist the distraction. This theory and the results of the reviews indicate that impulsive adolescents use more social media than less impulsive adolescents, and have a higher prevalence of a social media addiction. This would mean that impulsive adolescents use more social media, and as a consequence will sleep less and/or worse (if H3 is correct). Therefore, it is assumed that impulsivity has a positive moderating effect on the effect of social media use on sleep problems (H7).

Based on these seven hypotheses, a research model was constructed (Figure 1).

Current study

This study is innovative because there is a lack of longitudinal studies on the relationship between social media use and school performance. Also, this study will take a closer look at the role of sleep problems, smartphone use before going to bed, and the role of impulsivity as an individual characteristic. Several studies asked for future studies to examine some of these links (Bartel et al., 2015; Dewald et al., 2009; Minges & Redeker, 2016; LeBourgeouis et al., 2017; Wahlstrom & Owens, 2017). By filling this gap of knowledge, this study has an academic contribution and is of added value in the field.

It is of societal relevance for teachers, parents and institutions, who have to deal with the increasing availability of smartphones among adolescents and the consequences of their excessive social media use (Van der Schuur et al., 2015). It may inform parents about the behaviour of their adolescents, and give teachers insights on how social media use and sleep problems may have an influence on school performance. The information provided can be used for interventions and policies, which may help to raise awareness about the effects of social media use on the physical health and cognitive functioning of adolescents. This way it can help to regulate and reduce social media use, and to decrease sleep problems and improve school performances among adolescents.
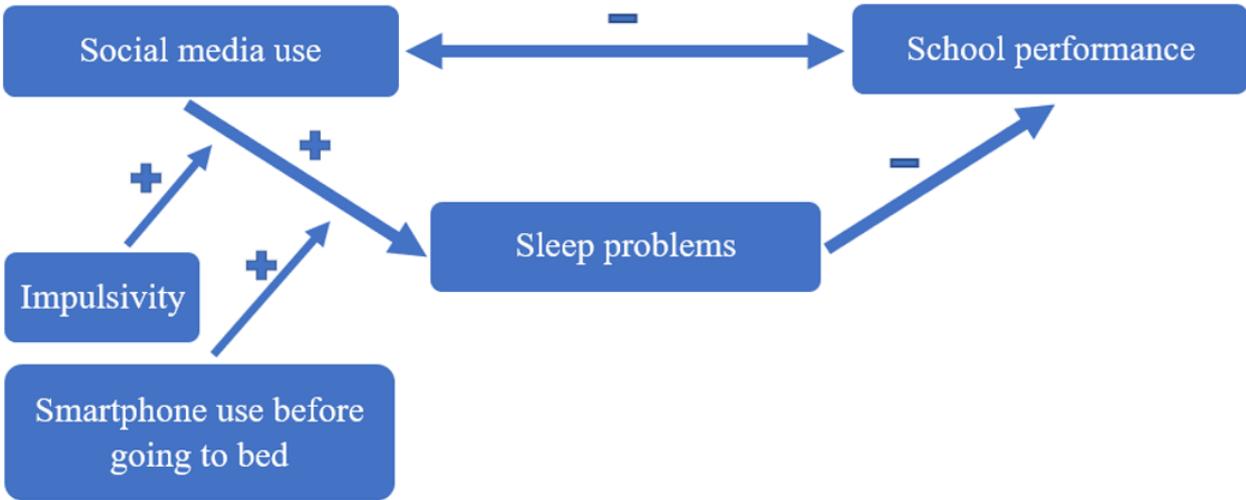
Figure 1. Research model. A negative bidirectional relationship between social media use and school performance, negatively mediated by sleep problems. Impulsivity and smartphone use before going to bed positively moderate the positive relationship between social media use and sleep problems.

Method

Design and procedure

The data from the Dutch 'Digital Youth Project' were used for this current study. This is a longitudinal study based on data collection from adolescents at schools. The study started in 2015 and has annual measurements. Every year, an online survey has to be completed in a classroom setting by participating students. The duration of the survey is about 30 to 40 minutes and is supervised by a research assistant of the Utrecht University. The study procedures were carried out in accordance with the Declaration of Helsinki, and were approved by the board of ethics of the Faculty of Social Sciences at Utrecht University (FETC16-076 Eijnden). Through passive informed consent, parents of the participants gave permission for participation in the project. The adolescents could also renounce themselves, when they did not want to participate or wanted to stop during the survey.

Participants

The current study used data from the second wave (T2) and the third wave (T3) of the Digital Youth Project. Adolescents were included when they participated in both waves, and when they did not have a missing value on GPA at T3, which gave a response of 1101 participants. After excluding 2 outliers because of strange GPA values, the total sample consisted of 1099 respondents (44.4% girls). The age ranged from 11 to 16 years old, with an average of 13.3 at T2. Of the total sample, 80.5% adolescents had a Dutch ethnic background. At T2, 31.0% of the sample was attending low education level, 35.4% was attending middle education and 33.5% was attending high education level.

Instruments

Social media use, as independent variable, was measured by four items of active and passive use of social networking sites and included questions as 'How often a day do you check social networking sites?' and 'How often a week do you like a post, picture or video of another person on social networking sites?' (Van den Eijnden, Lemmens, & Valkenburg, 2016). These questions were measured on a seven-point scale ranging from (1) 'never or less than once a day/week', (2) '1-2 times a day/week', (3) '3-5 times a day/week', (4) '6-10 times a day/week', (5) '11-20 times a day/week', (6) '21-40 times a day/week', to (7) 'more than 40 times a day/week'. The average of times of use was calculated taking the mean of all four questions to make one scale. The reliability analyses revealed a high reliability for this scale at T2 (Chronbach's α = .80) and a good reliability for the scale at T3 (Chronbach's α = .75).

School performance, as dependent variable, was measured by the Grade Point Average (GPA) of the students which were provided by the participating schools. The GPA is the average of the grades of all exam courses.

Sleep problems were measured by five items of the *Groninger slaapkwaliteit schaal* (GSKS) (Meijman, de Vries-Griever, de Vries, & Kampman, 1988). These questions were measured on a five-point scale ranging from (1) 'never' to (5) '(almost) always', and included questions as 'I have the feeling that I did not sleep enough', 'When I wake up at night, I cannot sleep well anymore', and 'I feel rested'. These five questions were taken together into one scale after recoding one question. The reliability analysis revealed a good reliability for this scale at T3 (Chronbach's α = .78).

Impulsivity was also measured on a five-point scale ranging from (1) never to (5) (almost) always, and included six questions as 'I say the answer before the question is finished', 'I have difficulties following the instructions or commands of others', and 'I change from one task to another, without finishing the first one' (Scholte & Van der Ploeg, 2010). These six questions were taken together into one scale. The reliability analyses revealed a high reliability for this scale at T2 (Chronbach's α = .83) and at T3 (Chronbach's α = .81).

Smartphone use before going to bed was measured by one question on a five-point scale ranging from (1) never to (5) very often: 'Do you take your smartphone to your bedroom before going to sleep at night?'.

Data analysis

To analyse the data, IBM SPSS Statistics 24 was used. Before starting the statistical tests, the data were checked on outliers and normal distributions of all variables. Some demographic variables were divided into categories. Education level was divided into high (VWO and HAVO/VWO), middle (HAVO and VMBO/HAVO) and low (VMBO) education. The variable ethnicity was recoded into autochthone (Dutch) and allochthone students. The mean scores of the dependent and independent variables were analysed with a t-test and compared. Pearson correlations and Spearman's rho were used to identify the correlations between all variables. The correlations were analysed to check for possible confounding factors. It was decided to control for all demographic variables (gender, age, education level, and ethnicity) in all analyses. For each statistical test, the assumptions of linearity, heteroscedasticity, and normality of the residuals were checked. No violations of the assumptions were made.

For the main research question regarding the effect of social media use at T2 on school performance at T3, a longitudinal linear regression was conducted. All demographic variables and school performance at T2 were added as predictors. A longitudinal linear regression was also conducted the other way around to test a bidirectional relationship. All demographic variables and social media use at T2 were added as predictors.

To test for a mediation effect of sleep problems, the Baron and Kenny (1986) method was used to perform the mediation analysis. In the first step, the relationship of social media use at T2 on school performance at T3 was examined, while controlling for all demographic variables and school performance at T2. In the second step, the link between social media use at T2 and sleep problems at T3 was investigated, while controlling for the all demographic variables. In step 3, the link between sleep problems at T3 and school performance at T3 was investigated, while controlling for all demographic variables and school performance at T2. As the final fourth step, the link of social media use at T2 and sleep problems at T3 on school performance at T3 was examined, after controlling for all demographic variables, school performance at T2 and sleep quality at T3.

To test the moderation effect of smartphone use before going to bed at T3, and impulsivity at T2 on the pathway of social media use at T2 to sleep problems at T3, the variables social media use, smartphone use before going to bed, and impulsivity were centred. Thereafter, new interaction variables were calculated for social media use and smartphone use before going to bed, and for social media use and impulsivity. A linear regression was performed to analyse the moderation effect of smartphone use before going to bed at T3, while controlling for all demographic variables, the main effects of social media use, the main effect for smartphone use before going to bed at T3, and lastly the interaction variable of social media use and smartphone use before going to bed. Likewise, a linear regression was performed to analyse the moderation effect of impulsivity at T2, while controlling for all demographic variables, the main effects of social media use, the main effect of impulsivity at T2, and lastly the interaction variable of social media use and impulsivity.

Results

Descriptive statistics

The mean of social media use is 3.56 which indicates around 12 to 20 times of passively (checking) or actively (liking, responding or posting) using social networking sites per week (see Table 2). The average GPA of adolescents is 6.47. The mean of sleep problems is 2.63, this means that on average the participants almost never or sometimes have troubles with

sleeping. Table 1 shows that girls on average use more social media than boys, that their GPA is higher, that they have more sleep problems, and that they are less impulsive.

Table 1

Mean scores of gender for social media use scale, sleep problems scale, school performance, smartphone use before going to bed, and impulsivity scale

| | Gender | | N | t | df |
	Boys	Girls			
Social media use (T2)	3.37	3.80	1099	-4.99**	1097
Social media use (T3)	3.54	3.93	1099	-4.08**	1096
Sleep problems (T3)	2.52	2.76	1089	-4.50**	1087
GPA (T2)	6.59	6.90	1085	-7.28**	1083
GPA (T3)	6.40	6.55	1099	-3.65**	1097
Smartphone (T3)	3.30	3.36	1067	-0.60	1065
Impulsivity (T2)	2.01	1.74	1094	6.28**	1092

Note. $*p < .05$. $**p < .01$.

Correlations

Table 2 shows that social media use at T2 and T3 is positively correlated with sleep problems, which means that more use of social media is associated with more sleep problems. Sleep problems and school performance at T3 are not significantly correlated, which means that there might not be an association between those variables. Social media use at T2 and T3 is a negatively correlated with school performance at T2 and T3. This means that more social media use is associated with a lower GPA. Smartphone use before going to bed and impulsivity are also negatively associated with school performance at T2 and T3.

For the demographic variables, Table 2 shows that gender is positively correlated with smartphone use at T2 and T3, sleep problems, and GPA, which means that girls use more social media, have more sleep problems and a higher GPA. Only impulsivity is negatively correlated, which means that boys are more impulsive. A higher age is associated with a lower GPA and older adolescents are more often allowed to take their smartphone into their bedroom. A high education level is negatively related with social media use and positively related to school performance, which means that although a higher education level is associated with more social media use, their GPA is higher. Ethnicity is positively correlated with school performance, which means that Dutch adolescents on average have a higher GPA.

Table 2

Correlation matrix of social media use scale, sleep problems scale, school performance, smartphone use before going to bed, impulsivity scale, gender, age, education level high, education level middle, and ethnicity

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Social media use (T2)	-	.59**	.12**	-.11**	-.15**	.11**	.23**	.15**	.05	-.14**	-.01	.00
2. Social media use (T3)		-	.12**	-.11**	-.14**	.07**	.20**	.15**	-.01	-.11**	-.06	.05
3. Sleep problems (T3)			-	.00	-.03	.10**	.28**	.13**	.04	.05	-.06	-.06
4. GPA (T2)				-	.64**	-.11**	-.13**	.21**	-.28**	.25**	-.07*	.11**
5. GPA (T3)					-	-.08*	-.15**	.11**	-.29**	.10**	.04	.10**
6. Smartphone use (T3)						-	.06*	.01	.17**	.01	-.06	-.05
7. Impulsivity (T2)							-	-.14**	.03	-.06	.01	-.05
Control variables												
8. Gender								-	-.10**	-.13**	.01	-.04
9. Age (T2)									-	-.02	-.21**	-.08**
10. Educ level high (T2)										-	-.53**	.04
11. Educ level middle (T2)											-	.05
12. Ethnicity												-
N	1099	1098	1089	1085	1099	1067	1096	1099	1099	1099	1099	1099
M	3.56	3.71	2.63	6.72	6.47	3.32	1.93	1.44	13.30	0.34	0.35	0.81
SD	1.42	1.35	0.88	0.71	0.70	1.63	0.69	0.50	0.92	0.47	0.49	0.40

Note. $*p < .05$. $**p < .01$. Correlations of variables 1-7 and 9 are determined on *Pearson's r*. Correlations of 8 and 10-12 are determined on *Spearmans rho.*

Social media use and school performance

A linear regression was performed to test whether social media use has a significant effect on GPA. After controlling for all demographic variables and school performance at T2, the influence of social media use at T2 on GPA at T3 shows a significant negative effect (see Table 3).

In addition, a longitudinal linear regression to analyse the effect of GPA on social media use was performed, to test whether there is a bidirectional relationship between social media use and school performance. After controlling for all control variables and social media use at T2, the influence of GPA at T2 on social media use at T3 shows a significant negative effect (see Table 4).

Table 3

Linear regression with school performance at T3 as dependent variable

	B	SE	β	t	B (const.)	R^2 change
Model 1: Control variables				10.00**	3.41	0.43
Gender	-0.05	0.03	-0.03	-1.42		
Age	-0.08	0.02	-0.11	-4.26**		
Education level high	-0.04	0.04	-0.03	-0.92		
Education level middle	-0.09	0.04	-0.06	-2.09*		
Ethnicity	0.06	0.04	0.04	1.53		
GPA (T2)	0.61	0.03	0.63	24.84**		
Model 2: Predictor				10.41**	3.57	0.01
Social media use (T2)	-0.04	0.01	-0.08	-3.32**		

Note. *p < .05. **p < .01.

Table 4

Linear regression with social media use at T3 as dependent variable

	B	SE	β	t	B (const.)	R^2 change
Model 1: Control variables				3.02**	1.64	0.36
Gender	0.16	0.07	0.06	2.33*		
Age (T2)	-0.02	0.04	-0.02	-0.58		
Educ level high (T2)	-0.05	0.09	-0.02	-0.53		
Educ level middle (T2)	-0.13	0.08	-0.05	1.56		
Ethnicity	0.17	0.08	0.05	2.08*		
Social media use (T2)	0.55	0.02	0.58	22.99**		
Model 2: Predictor				4.12**	2.90	0.01
GPA (T2)	-0.14	0.05	-0.08	-2.79**		

*Note. *$p < .05$. **$p < .01$.*

The role of sleep problems in the relationship between social media use and school performance

To test whether sleep problems mediates the effect of social media use on school performance, linear regressions are performed following the four steps of Baron and Kenny (1986). The first and second step show significant effects, social media use seems to significantly predict school performance (see Table 3), and social media use seems to significantly predict sleep problems (see Table 5). However, the third step is not significant, sleep problems do not significantly predict school performance (see Table 6). This means that there is no mediation effect of sleep problems in the relationship between social media use and school performance. The fourth step is performed for a confirmation, and indeed there is no mediation because social media use still significantly predicts school performance after controlling for sleep problems (see Table 6).

Table 5

Step 2 of the mediation analysis with sleep problems as dependent variable

	B	SE	β	t	B (const)	R² change
Model 1: Control variables				4.31**	1.88	0.03
Gender	0.24	0.05	0.14	4.46**		
Age (T2)	0.04	0.03	0.04	1.24		
Educ level high (T2)	0.03	0.07	0.02	0.50		
Educ level middle (T2)	-0.09	0.07	-0.05	-1.25		
Ethnicity	-0.09	0.07	-0.04	-1.39		
Model 2: Predictors				3.98**	1.74	0.01
Social media use (T2)	-0.06	0.02	0.10	3.35**		

Note. *p < .05. **p < .01.

Table 6

Step 3 and 4 of the mediation analysis with school performance as dependent variable

	B	SE	β	t	B (const)	R² change
Model 1: Control variables				9.96**	3.41	0.43
Gender	-0.05	0.03	-0.03	-1.41		
Age (T2)	-0.08	0.02	-0.11	-4.24**		
Educ level high (T2)	-0.04	0.04	-0.03	-0.92		
Educ level middle (T2)	0.09	0.04	0.06	2.08*		
Ethnicity	0.06	0.04	0.04	1.52		
School performance (T2)	0.61	0.03	0.62	24.74**		
Model 2: Mediator				9.99**	3.45	0.00
Sleep problems (T3)	-0.02	0.02	-0.02	-0.83		
Model 3: Predictor				10.36**	3.59	0.01
Social media use (T2)	-0.04	0.01	-0.08	-3.23**		

Note. *p < .05. **p < .01.

The role of smartphone use before going to bed on the relationship between social media use and sleep problems

   The moderating role of smartphone use before going to bed is analysed. The interaction term of social media use and smartphone use before going to bed turns out to not be significant (see Table 7). Smartphone use before going to bed has no effect on the link between social media use and sleep problems. However, the main effect of smartphone use before going to bed is significant, alongside social media use at T2. This means that smartphone use before going to bed significantly predicts sleep problems.

Table 7

Linear regression and moderation analysis with sleep problems as dependent variable

	B	SE	β	t	B (const)	R^2 change
Step 1: Control variables				4.26**	1.88	0.03
Gender	0.24	0.06	0.14	4.41**		
Age (T2)	0.04	0.03	0.04	1.23		
Educ level high (T2)	0.03	0.07	0.02	0.50		
Educ level middle (T2)	-0.09	0.07	-0.05	-1.24		
Ethnicity	-0.09	0.07	-0.04	-1.38		
Step 2: Predictors				4.05**	1.78	0.02
Social media use (T2)	0.06	0.02	0.10	3.05**		
Smartphone use (T3)	0.05	0.02	0.08	2.70**		
Step 3: Interaction-effect				4.03**	1.77	0.00
Social media use*Smartphone use	0.01	0.01	0.02	0.48		

*Note. *$p < .05$. **$p < .01$.

The role of impulsivity on the relationship between social media use and sleep problems

   The moderating role of impulsivity is analysed. The interaction term of social media use and impulsivity is significant (see Table 8). Impulsivity has a negative effect on the link between social media use and sleep problems. Moreover, the main effect of impulsivity is significant, meaning that impulsive adolescents experience more sleeping problems than non-impulsive adolescents. Figure 2 shows the interaction effect and illustrates that the effect of

social media use is particularly high among adolescents who score low on impulsivity. Lastly, gender is significant.

Table 8

Linear regression and moderation analysis with sleep problems as dependent variable

	B	SE	β	t	B (const)	R^2 change
Step 1: Control variable				4.30**	1.88	0.03
Gender	0.24	0.05	0.14	4.45**		
Age (T2)	0.04	0.03	0.04	1.24		
Educ level high (T2)	0.03	0.07	0.02	0.50		
Educ level middle (T2)	-0.09	0.07	-0.05	-1.25		
Ethnicity	-0.09	0.07	-0.04	-1.39		
Step 2: Predictors				3.45**	1.51	0.03
Social media use (T2)	0.04	0.02	0.06	1.99*		
Impulsivity (T2)	0.17	0.04	0.13	4.18**		
Step 3: Interaction-effect				3.37**	1.47	0.01
Social media use*Impulsivity	-0.08	0.03	-0.10	-3.15**		

Note. *$p < .05$. **$p < .01$.
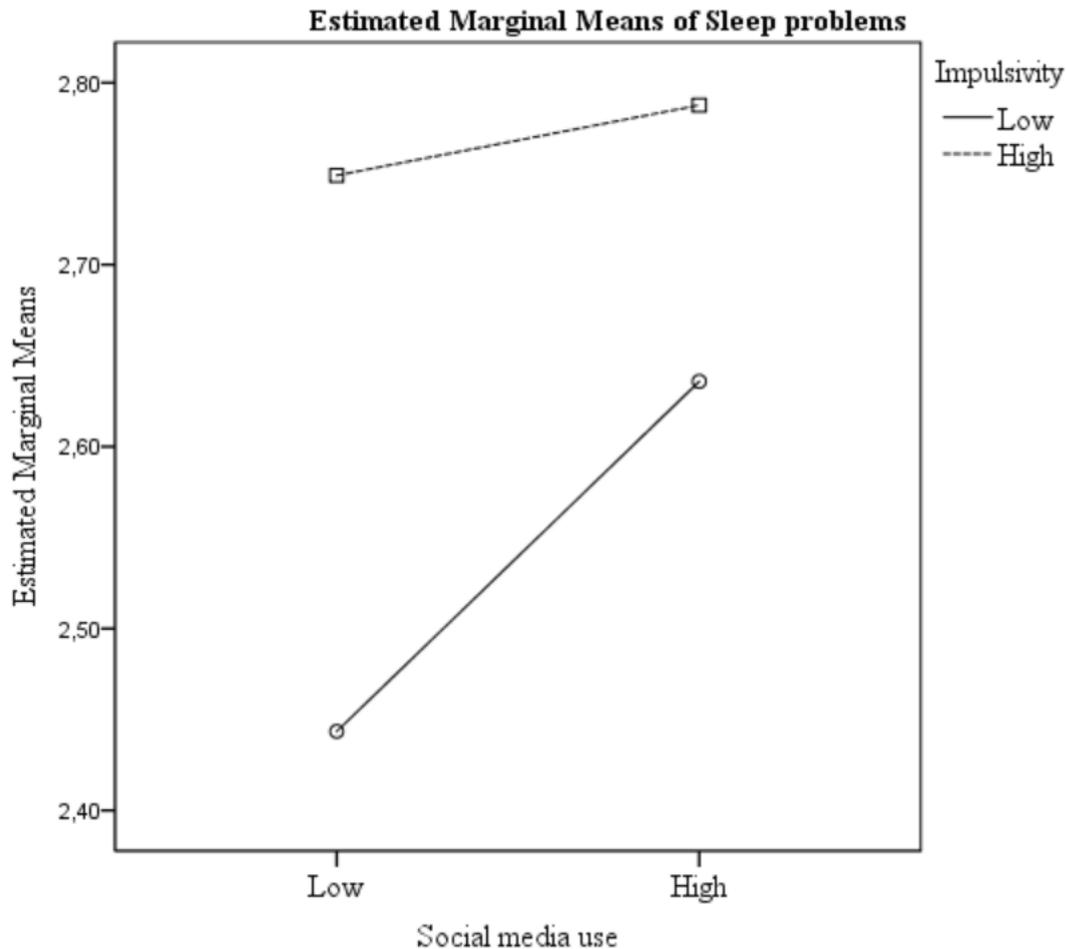
Figuur 2. Estimated marginal means of sleep problems of low and high social media use for low and high impulsivity.

Discussion

The main goal of this longitudinal study was to examine the effect of social media use on the school performances of Dutch adolescents, and to test whether this effect is resulting from an increase of sleep problems. Additionally, it was tested whether smartphone use before going to bed and impulsivity would worsen the effect of social media use on sleep problems. The results of this study show that social media use has a negative effect on both the school performances and the sleep problems of Dutch adolescents, but increased sleep problems do not seem to explain the effect of social media use on school performance. Smartphone use before going to bed does not have an influence on the effect of social media use on sleep problems. However, smartphone use before going to bed seems to significantly predict sleep problems. Impulsivity does not seems to promote the effect of social media use on sleep problems. Instead, the effect of social media use on sleep problems seems to be particularly

high in adolescents who score low on impulsivity. Finally, impulsivity seems to significantly predict sleep problems.

Social media use and school performance

It was expected that social media use would have a negative effect on adolescents' school performances (H1). The results of this study suggest that more social media use indeed leads to worse school performances. This is in line with the findings of recent review studies (Hew, 2011; Liu et al., 2017; Van der Schuur et al., 2015). The time replacement theory (time spent on social media replaces time that could be spent on schoolwork) could explain this effect.

In addition, it was expected that school performance would have a negative effect on social media use (H2). School performance indeed seems to have a negative effect on social media use, thereby indicating a bidirectional relationship between social media use and school outcomes. This is in line with the suspicions of recent studies (Liu et al., 2017; Van der Schuur et al., 2015). An explanation of this effect could be a loss of motivation during school-related activities and while learning, which may lead to more social media use or less motivation to regulate their social media use.

The role of sleep problems in the relationship between social media use and school performance

It was expected that sleep problems would explain a part of the effect of social media use on school performance (H5). Therefore, first the effect of social media on sleep problems was examined. Results of this study indicate that social media use has a positive effect on sleep problems. More social media use predicts more sleep problems, as was expected (H3). This is in line with recent studies (Bailin et al., 2014; Bartel et al., 2015; George & Odgers, 2015; Hale & Guan, 2015; Lam, 2014; LeBourgeouis, 2017; Reid Chassiakos et al., 2016; Touitou et al., 2016). As described before, this effect can be explained by three mechanisms: social media use can displace sleep time (time replacement theory), the arousal of content can make it more difficult to fall asleep, and the bright blue light of smartphones can disturb the sleep rhythm.

Secondly, the influence of sleep problems on school performance was examined (H4), but no effect was found. Possibly there are other factors that mediate between sleep problems and school performance. Recent reviews were not specifically focussed on this link. May be, a lack of published information on this link results from publication bias. Future research should reveal whether this hypothesis indeed needs to be rejected. Because no effect of sleep problems

on school performance was found, this indicates that sleep problems do not explain the effect of social media use on school performance (H5).

The role of smartphone use before going to bed on the relationship between social media use and sleep problems

It was expected that smartphone use before going to bed would worsen the effect of social media use on sleep problems (H6). No effect on this link was found in this study. Research states that 86 percent of adolescents take their smartphone into their bedroom (Pieters et al., 2014). When almost all adolescents do so, this might explain the lack of variance. However, in this study only 55.7 percent often takes their smartphone into their bedroom, 44.3 percent sometimes to never. Therefore, this explanation is rejected.

Although no indirect effect has been found, a direct positive effect of smartphone use before going to bed on sleep problems was found. This indicates that more smartphone use before going to bed leads to more sleep problems. The same three mechanisms as mentioned before can explain this effect: social media can displace sleep time (time replacement theory), the arousal of content can make it more difficult to fall asleep, and the bright blue light of smartphones can disturb the sleep rhythm. It is interesting that the effect of smartphone use before going to bed seems to be strong even alongside social media use. Future research should further investigate this direct effect.

The role of impulsivity on the relationship between social media use and sleep problems

To analyse the impact of individual differences, the role of impulsivity was tested as a dispositional factor that could influence the effect of social media use on sleep problems. It was expected that the effect of social media use on sleep problems would be stronger for impulsive adolescents (H7). The results of this study suggest that there is an effect, but this effect is not stronger for impulsive adolescents. This is not in line with recent reviews and the self-regulation theory (being able to resist the distraction of social media) (Van der Schuur et al., 2015). Moreover, a positive direct effect of impulsivity on sleep problems was found. This means that impulsivity predicts more sleep problems. An explanation of this effect could be the link of impulsivity with attention deficit/hyperactivity disorder (ADHD) (Wang et al., 2017). Adolescents with ADHD frequently suffer from sleep problems (Tsai, Hsu, & Huang, 2016). Thus, sleep problems are also common among impulsive adolescents. Figure 2 shows that high impulsive adolescents already have a high level of sleep problems, therefore social media does not influence those adolescents much (ceiling effect), whereas low impulsive adolescents are

influenced more by social media use and therefore their sleep problems increase stronger. Future research should further investigate this positive moderation in combination with the direct effect of impulsivity on sleep problems.

Strengths and limitations

This study consists of some strong features. First of all, it is a longitudinal study whereby relationships over time are tested, and several variables can be controlled for. Second, analyses showed that all the measurement scales have a good or high reliability. Third, the study includes a large dataset from Dutch adolescents from different schools throughout the Netherlands. This increases the generalisability of this results for Dutch adolescents in the age category of 11 to 16 years old.

Next to those strengths, this study has some limitations. Since the questions about sleeping behaviour are only asked in the third wave, some control analysis could not be performed. With the current data, there could not be controlled for sleep problems in the second wave, while examining the effect of sleep problems on school performance. Also, it was not possible to examine the effect of school performance on sleep problems to test a bidirectional relationship. However, a bidirectional relationship could be possible (Levenson et al., 2016; Magee et al., 2014). Social media use could worsen sleep problems, but the other way around, tiredness might reduce the motivation to participate in active behaviour and in turn stimulate the use of social media. Another limitation is that longitudinal studies are a good indication for causality, but the results cannot give full reliability. It might be that there are more confounding factors in the analysed links, than the variables that were controlled for in the present study. In addition, only participants could be included whose GPA was provided. May be certain schools choose to not disclose the rates of their students because their average GPA is lower than the national average. This may have yielded a bias. Next to that, the surveys are based on self-report. While filling out the survey, adolescents may have given more social desirable answers because their peers were sometimes able to see each other's screens. This may have led to modifications of the outcomes. Besides, the questions about sleep problems and smartphone use were at the end of the survey. This may have caused a loss of attention from adolescents, and to not filling in the survey carefully and precisely anymore.

Recommendations

Future research should examine whether sleep problems indeed do not explain the effect of social media use on adolescents' school performances. Also, the lack of effect of sleep

problems on school performance should be further investigated. Besides that, it is important to check for a bidirectional relationship of sleep problems and social media use when the fourth wave of the Digital Youth Project is collected. With the fourth wave, the effect of sleep problems on school performance can be examined longitudinal while controlling for sleep problems at an earlier wave. Future research should further investigate the negative effect of impulsivity on the link between social media use and sleep problems in combination with the main effect of impulsivity on sleep problems. Also, the main direct effect of smartphone use before going to bed on sleep problems should be further investigated. To minimize the possible bias in the questions about sleep problems and smartphone use, the survey has to be made shorter or these questions should be asked in the beginning of the study. To minimize the self-reporting bias, adolescents should be asked to complete the survey in separate rooms or in a more private classroom setting. Lastly, the current study examined social media as social networking sites, future research could also include instant messengers to study social media as a whole.

Conclusion and possible implications

Social media use appears to have a negative effect on school performances of adolescents. The use of social media also seems to increase sleep problems, this effect seems to be particularly high for adolescents who score low on impulsivity. Impulsivity also seems to predict sleep problems. Smartphone use before going to bed does not seem to influence the effect of social media use on sleep problems, but smartphone use before going to bed does seem to predict sleep problems. Sleep problems do not seem to explain the relationship between social media use and school performance, and do not effect school performance.

These outcomes have several implications for research and practice. In the ongoing discussions in the literature about the positive and negative influences of social media use, this study will support the arguments for a negative influence. The negative effect of social media use on health aspects such as sleep problems and life aspects such as school performance should be watched carefully. This study underscores the importance of investigating the influence of social media use on several aspects in the lives of adolescents to protect them, as this influence can have many serious negative consequences for them in the future. The results of this study emphasizes that amplified attention of Dutch authorities is needed for the effects of social media use on adolescents. The outcomes can be used to inform policy makers to think about policies for adolescents in schools and at home to regulate their social media use.

References

Alosaimi, F. D., Alyahya, H., Alshahwan, H., Al Mahyijari, N., & Shaik, S. A. (2016). Smartphone addiction among university students in Riyadh, Saudi Arabia. *Saudi Medical Journal*, *37*(6), 675–683. doi:10.15537/smj.2016.6.14430

Arora, T., Broglia, E., Thomas, G. N., & Taheri, S. (2014). Associations between specific technologies and adolescent sleep quantity, sleep quality, and parasomnias. *Sleep Medicine*, *15*(2), 240–247. doi:10.1016/j.sleep.2013.08.799

Arrona-Palacios, A. (2017). High and low use of electronic media during nighttime before going to sleep: a comparative study between adolescents attending a morning or afternoon school shift. *Journal of Adolescence*, *61*, 152–163. doi:10.1016/j.adolescence.2017.10.009

Bailin, A., Milanaik, R., & Adesman, A. (2014). Health implications of new age technologies for adolescents: a review of the research. *Current Opinion in Pediatrics*, *26*(5), 605–619. doi:10.1097/MOP.0000000000000140

Bartel, K. A., Gradisar, M., & Williamson, P. (2015). Protective and risk factors for adolescent sleep: a meta-analytic review. *Sleep Medicine Reviews*, *21*, 72–85. doi:10.1016/j.smrv.2014.08.002

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. doi:10.1037/0022-3514.51.6.1173

Bandura, A. (2001). *Social cognitive theory of mass communication.* Media Psychology, *3*(3): 265-299.

Bruni, O., Sette, S., Fontanesi, L., Baiocco, R., Laghi, F., & Baumgartner, E. (2015). Technology use and sleep quality in preadolescence and adolescence. *Journal of Clinical Sleep Medicine*, *11*(12), 1433–1441. doi:10.5664/jcsm.5282

Centraal Bureau voor de Statistiek. Retrieved June 2018, from http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=83429ned&D1=0-31&D2=0,7,15-16&D3=0&D4=l&HDR=T&STB=G1,G2,G3&VW=T

De-Sola Gutiérrez, J., Rodriguez de Fonseca, F., & Rubio, G. (2016). Cell-phone addiction: a review. *Frontiers in Psychiatry*, *7,* 1-15. doi:10.3389/fpsyt.2016.00175

Dewald, J. F., Meijer, A. M., Oort, F. J., Kerkhof, G. A., & Bögels, S. M. (2010). The influence of sleep quality, sleep duration and sleepiness on school performance in children and

adolescents: a meta-analytic review. *Sleep Medicine Reviews*, *14*(3), 179–189. doi:10.1016/j.smrv.2009.10.004

Englander, F., Terregrossa, R. A., & Wang, Z. (2010). Internet use among college students: tool or toy? *Educational Review*, *62*(1), 85–96. doi:10.1080/00131910903519793

Fobian, A. D., Avis, K., & Schwebel, D. C. (2016). Impact of media use on adolescent sleep efficiency. *Journal of Developmental and Behavioral Pediatrics: JDBP*, *37*(1), 9–14. doi:10.1097/DBP.0000000000000239

George, M. J., & Odgers, C. L. (2015). Seven fears and the science of how mobile technologies may be influencing adolescents in the digital age. *Perspectives on Psychological Science*, *10*(6), 832–851. doi:10.1177/1745691615596788

González, M. R., Gasco, J., & Llopis, J. (2016). Facebook and academic performance: a positive outcome. *Anthropologist*, *23*(1,2), 59–67. doi:10.1080/09720073.2016.11891924

Gradisar, M., Wolfson, A. R., Harvey, A. G., Hale, L., Rosenberg, R., & Czeisler, C. A. (2013). The sleep and technology use of Americans: findings from the National Sleep Foundation's 2011 sleep in America poll. *Journal of Clinical Sleep Medicine*, *9*(12), 1291–1299. doi:10.5664/jcsm.3272

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep Medicine Reviews*, *21*, 50–58. doi:10.1016/j.smrv.2014.07.007

Huang, H. (2014). *Social media generation in urban China: a study of social media use and addiction among adolescents*. Springer: Heidelberg.

Harbard, E., Allen, N. B., Trinder, J., & Bei, B. (2016). What's keeping teenagers up? Prebedtime behaviors and actigraphy-assessed sleep over school and vacation. *Journal of Adolescent Health*, *58*(4), 426–432. doi:10.1016/j.jadohealth.2015.12.011

Hew, K. F. (2011). Students' and teachers' use of Facebook. *Computers in Human Behavior*, *27*(2), 662–676. doi:10.1016/j.chb.2010.11.020

Lam, L. T. (2014). Internet gaming addiction, problematic use of the internet, and sleep problems: a systematic review. *Current Psychiatry Reports*, *16*(4), 444. doi:10.1007/s11920-014-0444-1

LeBourgeois, M. K., Hale, L., Chang, A.-M., Akacem, L. D., Montgomery-Downs, H. E., & Buston, O. M. (2017). Digital media and sleep in childhood and adolescence abstract. *Pediatrics*, *140*(S2), S92-S96. doi:10.1542/ peds.2016-1758J

Levenson, J. C., Shensa, A., Sidani, J. E., Colditz, J. B., & Primack, B. A. (2016). The association between social media use and sleep disturbance among young adults. *Preventive Medicine*, *85*, 36–41. doi:10.1016/j.ypmed.2016.01.001

Li, J., Lepp, A., & Barkley, J. E. (2015). Locus of control and cell phone use: Implications for sleep quality, academic performance, and subjective well-being. *Computers in Human Behavior*, *52*, 450–457. doi:10.1016/j.chb.2015.06.021

Liu, D., Kirschner, P. A., & Karpinski, A. C. (2017). A meta-analysis of the relationship of academic performance and Social Network Site use among adolescents and young adults. *Computers in Human Behavior*, *77*, 148–157. doi:10.1016/j.chb.2017.08.039

Magee, C. A., Lee, J. K., & Vella, S. A. (2014). Bidirectional relationships between sleep duration and screen time in early childhood. *JAMA Pediatrics*, *168*(5), 465–470. doi:10.1001/jamapediatrics.2013.4183

Madden, M., Lenhart, A., Duggan, M., Cortesi, S., & Gasser, U. (2013). Teens and technology. *Washington, DC: Pew Research Center's Internet & American Life Project, 2013*, 1–19.

Meijman, T. F., de Vries-Griever, A. H. G., de Vries, G., & Kampman, R. (1988). The evaluation of the Groningen Sleep Quality Scale. Groningen: *Heijmans Bulletins*, HB 88-13-EX.

Minges, K. E., & Redeker, N. S. (2016). Delayed school start times and adolescent sleep: a systematic review of the experimental evidence. *Sleep Medicine Reviews*, *28*, 82–91. doi:10.1016/j.smrv.2015.06.002

Pieters, D., De Valck, E., Vandekerckhove, M., Pirrera, S., Wuyts, J., Exadaktylos, V., Haex, B., Michiels, N., Verbraecken, J., & Cluydts, R. (2014). Effects of pre-sleep media use on sleep/wake patterns and daytime functioning among adolescents: the moderating role of parental control. *Behavioral Sleep Medicine*, *12*(6), 427–443. doi:10.1080/15402002.2012.694381

Power, S., Taylor, C., & Horton, K. (2017). Sleepless in school? The social dimensions of young people's bedtime rest and routines. *Journal of Youth Studies*, *20*(8), 945–958. doi:10.1080/13676261.2016.1273522

Reid Chassiakos, Y., Radesky, J., Christakis, D., Moreno, M. A., & Cross, C. (2016). Children and adolescents and digital media. *Pediatrics*, *138*(5). doi:10.1542/peds.2016-2593

Roberts, D. F., & Foehr, U. G. (2008). Trends in Media Use. *The Future of Children, 18*(1), 11–37. doi:10.1353/foc.0.0000

Schweizer, A., Berchtold, A., Barrense-Dias, Y., Akre, C., & Suris, J. C. (2017). Adolescents with a smartphone sleep less than their peers. *European Journal of Pediatrics*, *176*(1), 131–136. doi:10.1007/s00431-016-2823-6

Shochat, T., Cohen-Zion, M., & Tzischinsky, O. (2014). Functional consequences of inadequate sleep in adolescents: a systematic review. *Sleep Medicine Reviews*, *18*(1), 75–87. doi:10.1016/j.smrv.2013.03.005

Scholte, E. M., & van der Ploeg, J. D. (2010). *ADHD-vragenlijst AVL*. Houten: Bohn Stafleu van Loghum.

Titova, O. E., Hogenkamp, P. S., Jacobsson, J. A., Feldman, I., Schiöth, H. B., & Benedict, C. (2015). Associations of self-reported sleep disturbance and duration with academic failure in community-dwelling Swedish adolescents: sleep and academic performance at school. *Sleep Medicine*, *16*(1), 87–93. doi:10.1016/j.sleep.2014.09.004

Touitou, Y., Touitou, D., & Reinberg, A. (2016). Disruption of adolescents' circadian clock: the vicious circle of media use, exposure to light at night, sleep loss and risk behaviors. *Journal of Physiology Paris*, *110*(4), 467–479. doi:10.1016/j.jphysparis.2017.05.001

Tsai, M.-H., Hsu, J.-F., & Huang, Y.-S. (2016). Sleep problems in children with Attention Deficit/Hyperactivity Disorder: current status of knowledge and appropriate management. *Current Psychiatry Reports*, *18*(8), 76. doi:10.1007/s11920-016-0711-4

Uncapher, M. R., Lin., L., Rosen, L. D., Kirkorian, L. H., Baron, N. S., Bailey, K., Cantor, J., Strayer, D. L., Parsons, T. D., & Wagner, A. D. (2017). Media multitasking and cognitive, psychological, neural, and learning differences. *Pediatrics, 140*(S62), S62-S66.

Van Der Schuur, W. A., Baumgartner, S. E., Sumter, S. R., & Valkenburg, P. M. (2015). The consequences of media multitasking for youth: A review. *Computers in Human Behavior*, *53*, 204–215. doi:10.1016/j.chb.2015.06.035

Van den Eijnden, R. J. J. M., Lemmens, J. S., & Valkenburg, P. M. (2016). The Social Media Disorder Scale: validity and psychometric properties. Computers in Human Behavior, 61, 478–487. doi:10.1016/j.chb.2016.03.038

Wahlstrom, K. L., & Owens, J. A. (2017). School start time effects on adolescent learning and academic performance, emotional health and behaviour. *Current Opinion in Psychiatry*, *30*(6), 485–490. doi:10.1097/YCO.0000000000000368

Wang, B., Yao, N., Zhou, X., Liu, J., & Lv, Z. (2017). The association between attention deficit/hyperactivity disorder and internet addiction: a systematic review and meta-analysis. *BMC Psychiatry,* 1–12. doi:10.1186/s12888-017-1408-x

Wheaton, A. G., Chapman, D. P., & Croft, J. B. (2016). School start times, sleep, behavioral, health, and academic outcomes: a review of the literature. *Journal of School Health*, *86*(5), 363–381. doi:10.1111/josh.12388