Social Media Use and Friendship Closeness in Adolescents' Daily Lives: An Experience Sampling Study

Supplementary Materials

Correlations Between Activities Per Platform

	Between-person correlations				Within-person correlations			
Instagram	1	2			1	2		
1. Viewing posts/stories of others								
2. Reading direct messages	0.86				0.58			
3. Sending direct messages	0.86	0.98			0.56	0.79		

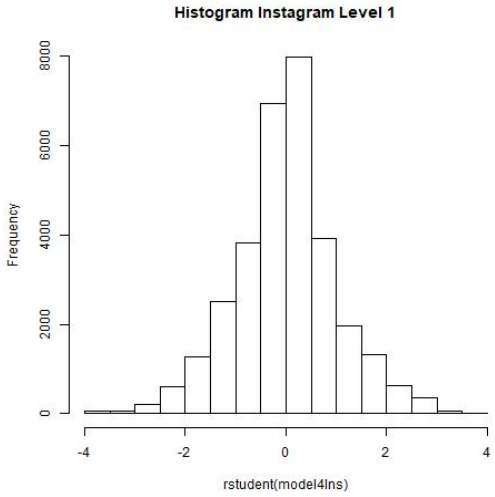
	Between-person correlations	Within-person correlations
WhatsApp	Sending direct messages	Sending direct messages
Reading direct messages	0.98	0.83

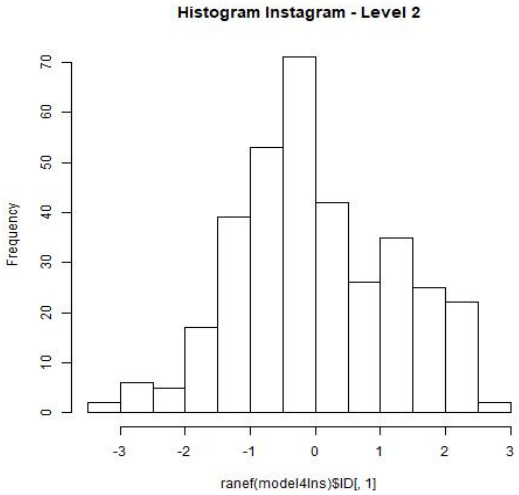
	Between-person correlations				Within-person correlations			
Snapchat	1	2	3	4	1	2	3	4
1. Viewing stories of others								
2. Viewing snaps	0.97				0.76			
3. Reading direct messages	0.95	0.93			0.69	0.67		
4. Sending snaps	0.96	0.99	0.94		0.72	0.81	0.70	
5. Sending direct messages	0.95	0.92	1.00	0.94	0.68	0.65	0.84	0.69

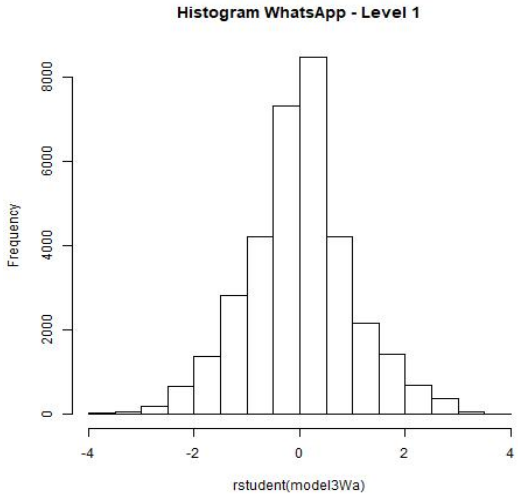
Note. All correlations were signficant ($p < .001$)

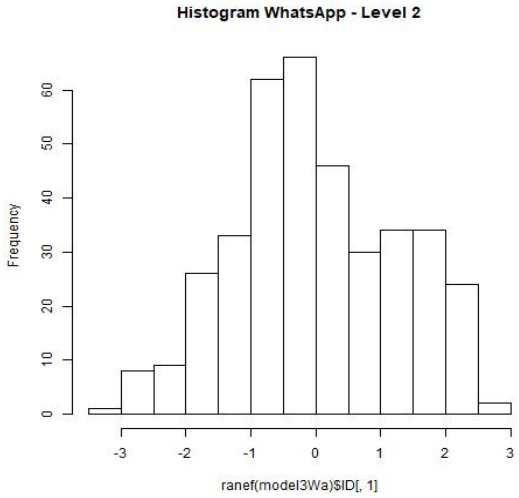
Assumption check (1) Histograms of Residuals

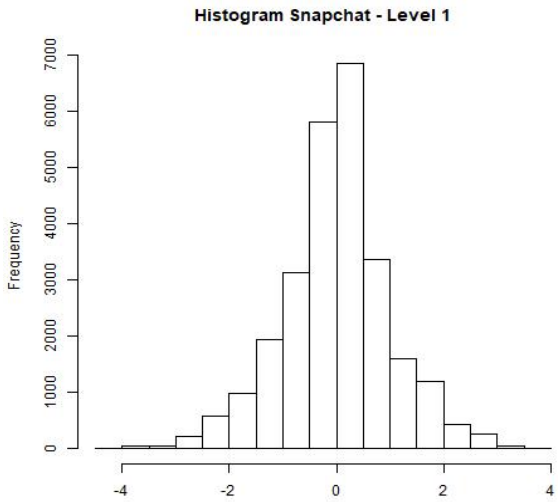
Histograms indicate that residuals were fairly normally distributed at both levels.

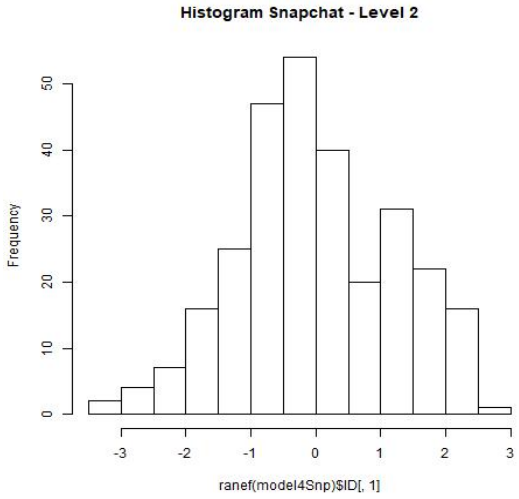








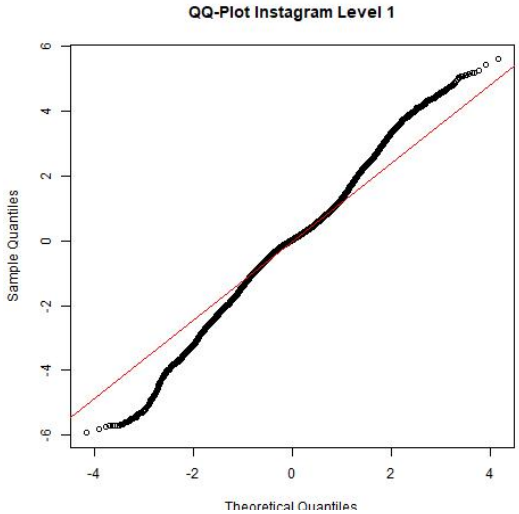


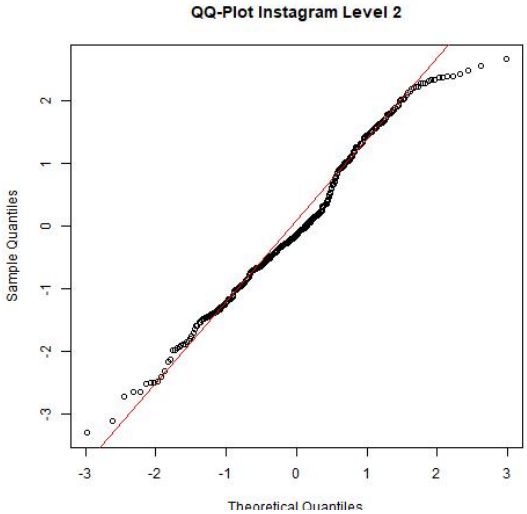


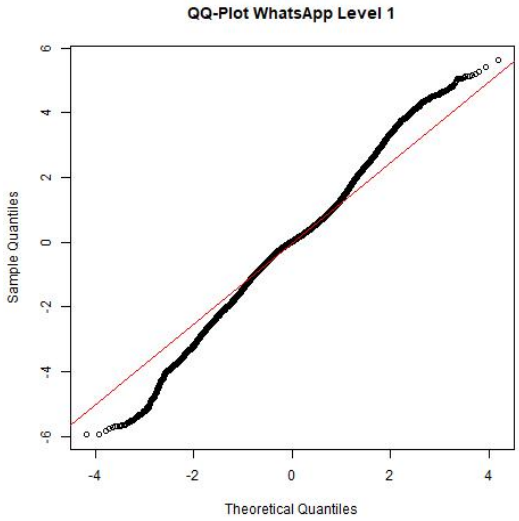
Note. The preregistered plots with the predicted values against the residuals are not presented as these were less meaningful and hard to interpret due to the categorical predictors.

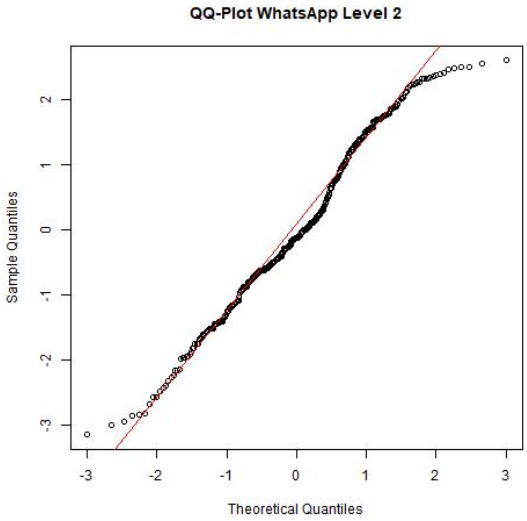
Assumption checks (2) QQ-Plots

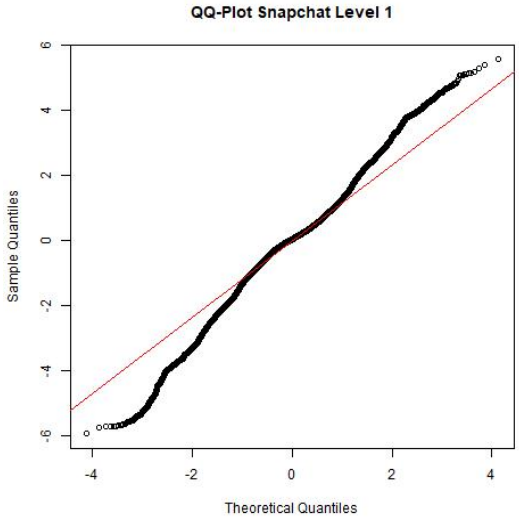
QQ-plots indicate that the residuals were faily normally distributed at both levels

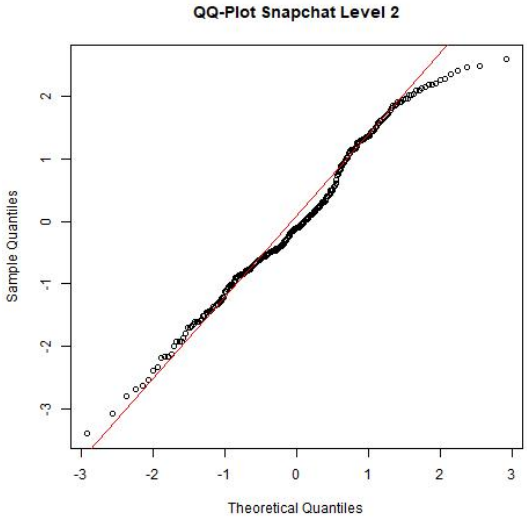












Intra-Class Correlations

		ICCs 3-level models		
		Instagram	WhatsApp	Snapchat
Level 2	ID	0.407	0.411	0.394
Level 3	Class	0.002	0.002	0.011

	ICCs 2-level models		
	Instagram	WhatsApp	Snapchat
Level 2	0.409	0.412	0.404

		Variance 3-level models		
		Instagram	WhatsApp	Snapchat
Level 1	Occassions	2.295	2.352	2.227
Level 2	ID	1.582	1.643	1.494
Level 3	Class	0.008	0.006	0.027

Conclusion: As preregistered, we estimated 2-level models instead of 3-level models as the variance at classroom level wass smaller than .10.

Multi-Level Models Instagram Use

	Intercept only model			Reference Model				Instagram use model				Random effects model Instagram use		
Number of observations	31658			31658				31658				31658		
Number of participants	345			345				345				345		
	b	*SE*	*p*	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β	*b*	*SE*	*p*
Intercept	4.495	0.068	<.001	4.495	0.068	<.001	3.567	4.495	0.068	<.001	3.567	4.495	0.068	<.001
Fixed Effects														
Within-person (Level 1)														
Weekday vs. Weekend day$_{t\,0}$				0.286	0.020	<.001	0.189	0.286	0.020	<.001	0.189	0.284	0.020	<.001
Notification number of the day$_{t\,0}$				-0.062	0.005	<.001	-0.070	-0.059	0.005	<.001	-0.067	-0.059	0.005	<.001
Instagram use *vs.* no use$_{t\,0*}$								-0.087	0.020	<.001	-0.058	-0.063	0.032	0.050
Between-person (Level 2)														
Average Instagram use								0.419	0.276	0.129	0.082	0.418	0.276	0.129
Random Effects														
Within-person (Level 1)														
σ^2 Residual	2.295	0.018	<.001	2.267	0.018	<.001		2.265	0.018	<.001		2.230	0.018	<.001
Between-person (Level 2)														
σ^2 Residual (intercept)	1.588	0.123	<.001	1.588	0.123	<.001		1.577	0.122	<.001		1.577	0.122	<.001
σ^2 Instagram use												1.195	0.027	<.001
Fit indices														
Deviance	117558.574			117177.432				117155.828				116959.252		
Likelihood Ratio Test				χ2(2) = 381.142		0.000		χ2(2) = 21.604		0.000		χ2(2) = 196.576		0.000
AIC	117564.574			117187.432				117169.827				117042.153		
BIC	117589.662			117229.246				117228.367				117016.729		

Note. The following variables were dummy coded: Weekday vs. weekend day (0 = Weekend day; 1 = Weekday), Instagram use (0 = no use of Instagram; 1 = use of Instagram). Significant Likelihood Ratio Tests are marked in yellow, significant positive effects are marked in green, and significant negative effects in red.

Conclusion: (1) Instagram use was negatively related to friendship closness at the within-person level; (2) The likelihood ratio test pointed at significant heterogeneity in the within-person association of Instagram use with friendship closeness.

Multi-Level Models Instagram Use With & Without Friends

	Instagram use with vs. without friends model				Random effects model Instagram use with vs. without friends		
Number of observations	31658				31658		
Number of participants	345				345		
	b	*SE*	*p*	β	*b*	*SE*	*p*
Intercept	4.495	0.067	<.001	3.567	4.495	0.067	<.001
Fixed Effects							
Within-person (Level 1)							
Weekday vs. Weekend day$_{t\,0}$	0.287	0.020	<.001	0.189	0.279	0.020	<.001
Notification number of the day$_{t\,0}$	-0.059	0.005	<.001	-0.067	-0.057	0.005	<.001
Instagram use *with* friends*vs.* no use$_{t\,0*}$	-0.104	0.024	<.001	-0.069	-0.083	0.039	0.036
Instagram use *without* friends vs. no use$_{t\,0*}$	-0.072	0.023	0.002	-0.047	-0.040	0.033	0.224
Between-person (Level 2)							
Average Instagram use *with* friends	0.970	0.318	0.002	0.171	0.970	0.318	0.002
Average Instagram use *without* friends	-0.345	0.355	0.332	-0.055	-0.345	0.355	0.331
Random Effects							
Within-person (Level 1)							
σ^2 Residual	2.265	0.018	<.001		2.202	0.018	<.001
Between-person (Level 2)							
σ^2 Residual (intercept)	1.527	0.118	<.001		1.528	0.118	<.001
σ^2 Instagram use *with* friends					0.289	0.039	<.001
σ^2 Slope Instagram use *without* friends					0.154	0.026	<.001
Fit indices							
Deviance	117143.262				116794.922		
Likelihood Ratio Test	χ2(2) = 12.566		0.001		χ2(2) = 348.340		0.000
AIC	117161.262				116816.923		
BIC	117236.527				116908.913		

Note. The following variables were dummy coded: Weekday vs. weekend day (0 = Weekend day; 1 = Weekday), Instagram use *with* friends (0 = no use of Instagram with friends; 1 = use of Instagram with friends), Instagram use *without* friends (0 = no Instagram use without friends; 1 = Instagram use without friends). Significant Likelihood Ratio Tests are marked in yellow, significant positive effects are marked in green, and significant negative effects in red.

Conclusion: (1) Instagram use with and without friends were negatively related to friendship closness at the within-person level; (2) Instagram use with friends was positively related to friendship closeness at the between-person level; (3) The likelihood ratio test pointed at significant heterogeneity in the within-person association of Instagram use with friendship closeness.

Multi-Level Random Effects Model Instagram Use With & Without Friends - Moderation by Gender

	Random effects model Instagram use with friends + Gender		
Number of observations	31534		
Number of participants	344		
	b	*SE*	*p*
Intercept	4.492	0.068	<.001
Fixed Effects			
Within-person (Level 1)			
Weekday vs. Weekend day$_{t\,0}$	0.280	0.020	<.001
Notification number of the day$_{t\,0}$	-0.057	0.005	<.001
Instagram use *with* friends *vs.* no use$_{t\,0*}$	-0.086	0.040	0.030
Instagram use *without* friends vs. no use$_{t\,0*}$	-0.041	0.033	0.218
Instagram use *with* friends * Gender	0.094	0.081	0.246
Instagram use *without* friends * Gender	0.048	0.067	0.471
Between-person (Level 2)			
Average Instagram use *with* friends	0.843	0.324	0.009
Average Instagram use *without* friends	-0.451	0.373	0.226
Gender	0.179	0.139	0.199
Average Instagram use *with* friends * Gender	-0.199	0.657	0.762
Average Instagram use *without* friends * Gender	-1.007	0.717	0.160
Random Effects			
Within-person (Level 1)			
σ^2 Residual	2.209	0.018	<.001
Between-person (Level 2)			
σ^2 Residual (intercept)	1.516	0.118	<.001
σ^2 Slope Instagram use *with* friends	0.288	0.039	<.001
σ^2 Slope Instagram use *without* friends	0.145	0.026	<.001
Fit indices			
AIC	116459.262		
BIC	116593.003		

Conclusion: There were not any significant main effects or interactions including gender.

Multi-Level Models WhatsApp Use

	Intercept only model			Reference Model				WhatsApp use model				Random Effects Model WhatsApp use		
Number of observations	34068			34068				34068				34068		
Number of participants	375			375				375				375		
	b	*SE*	*p*	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β	*b*	*SE*	*p*
Intercept	4.474	0.067	<.001	4.474	0.067	<.001	3.485	4.474	0.068	<.001	3.485	4.474	0.067	<.001
Fixed Effects														
Within-person (Level 1)														
Weekday vs. Weekend day$_{t\,0}$				0.299	0.019	<.001	0.195	0.299	0.019	<.001	0.195	0.297	0.019	<.001
Notification number of the day$_{t\,0}$				-0.064	0.005	<.001	-0.072	-0.063	0.005	<.001	-0.071	-0.064	0.005	<.001
WhatsApp use *vs.* no use$_{t\,0*}$								-0.041	0.019	0.030	-0.027	-0.027	0.028	0.336
Between-person (Level 2)														
Average WhatsApp use								0.542	0.269	0.044	0.104	0.542	0.269	0.044
Random Effects														
Within-person (Level 1)														
σ^2 Residual	2.352	0.018	<.001	2.322	0.018	<.001		2.321	0.018	<.001		2.296	0.018	<.001
Between-person (Level 2)														
σ^2 Residual (intercept)	1.647	0.123	<.001	1.648	0.123	<.001		1.630	0.121	<.001		1.630	0.121	<.001
σ^2 Slope WhatsApp use												0.137	0.021	<.001
Fit indices														
Deviance	127362.370			126927.430				126918.690				126801.452		
Likelihood Ratio Test				χ2(2) = 434.940		0.000		χ2(2) = 8.740		0.006		χ2(2) = 125.978		0.000
AIC	127368.370			126937.431				126932.689				126817.452		
BIC	127393.678			126979.611				126991.742				126884.941		

Note . The following variables were dummy coded: Weekday vs. weekend day (0 = Weekend day; 1 = Weekday), WhatsApp use (0 = no use of WhatsApp; 1 = use of WhatsApp). Significant Likelihood Ratio Tests are marked in yellow, significant positive effects are marked in green, and significant negative effects in red.

Conclusion: (1) WhatsApp use was negatively related to friendship closness at the within-person level, but positively related to friendship closeness at the between-person level; (2) The likelihood ratio test pointed at significant heterogeneity in the within-person associations of WhatsApp use with friendship closeness.

Multi-level Models WhatsApp Use With & Without Friends

	WhatsApp use with friends model			
Number of observations	34068			
Number of participants	375			
	b	*SE*	*p*	β
Intercept	4.474	0.067	<.001	3.485
Fixed Effects				
Within-person (Level 1)				
Weekday vs. Weekend day$_{t\,0}$	0.300	0.019	<.001	0.195
Notification number of the day$_{t\,0}$	-0.063	0.005	<.001	-0.071
WhatsApp use *with* friends*vs.* no use$_{t\,0*}$	-0.057	0.034	0.090	-0.037
WhatsApp use *without* friends vs. no use$_{t\,0*}$	-0.038	0.020	0.053	-0.025
Between-person (Level 2)				
Average WhatsApp use *with* friends	0.525	0.348	0.131	0.082
Average WhatsApp use *without* friends	0.555	0.319	0.082	0.095
Random Effects				
Within-person (Level 1)				
σ^2 Residual	2.321	0.018	<.001	
Between-person (Level 2)				
σ^2 Residual (intercept)	1.630	0.121	<.001	
Fit indices				
Deviance	126918.370			
Likelihood Ratio Test	$\chi2(2)$ = 0.320 0.426			
AIC	126936.370			
BIC	127012.295			

Note. The following variables were dummy coded: Weekday vs. weekend day (0 = Weekend day; 1 = Weekday), WhatsApp use with friends (0 = no use of WhatsApp with friends; 1 = use of WhatsApp with friends), WhatsApp use without friends (0 = no WhatsApp use without friends; 1 = WhatsApp use without friends). Significant Likelihood Ratio Tests are marked in yellow, significant positive effects are marked in green, and significant negative effects in red.

Conclusion: The within-person and between-person effects of WhatsApp use With and Without friends did not depend on whether WhatsApp was used with friends or without friends.

Multi-level Random Effects Models WhatsApp Use - Moderation by Gender

	Random effects model WhatsApp use + Gender		
Number of observations	33944		
Number of participants	374		
	b	*SE*	*p*
Intercept	4.484	0.067	<.001
Fixed Effects			
Within-person (Level 1)			
Weekday vs. Weekend day$_{t\,0}$	0.298	0.019	<.001
Notification number of the day$_{t\,0}$	-0.065	0.005	<.001
WhatsApp use vs. no uset0*	-0.028	0.028	0.311
WhatsApp use * Gender	0.128	0.056	0.023
Between-person (Level 2)			
Average WhatsApp use	0.467	0.276	0.090
Gender	0.229	0.134	0.087
Average WhatsApp use * Gender	-0.292	0.541	0.590
Random Effects			
Within-person (Level 1)			
σ^2 Residual	2.303	0.018	<.001
Between-person (Level 2)			
σ^2 Residual (intercept)	1.620	0.121	<.001
σ2 Slope WhatsApp use	0.134	0.021	<.001
Fit indices			
AIC	126449.763		
BIC	126542.520		

Note. The following variables were dummy coded: Weekday vs. weekend day (0 = Weekend day; 1 = Weekday), WhatsApp use (0 = no use of WhatsApp; 1 = use of WhatsApp); Gender (0 = Boy; 1 = Girl). Significant positive effects are marked in green, and significant negative effects in red.

Conclusion: We found a significant cross-level interaction between WhatsApp use and gender. Simple effect analysis showed that the effect of WhatsApp use on friendship closeness was significantly negative for boys (b = -.098, p = .040) but non significant for girls (b = .024, p = .465).

Multi-Level Models Snapchat Use

	Intercept only model			Reference Model				Snapchat use model			
Number of observations	26479			26479				26479			
Number of participants	285			285				285			
	b	*SE*	*p*	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β
Intercept	4.559	0.073	<.001	4.559	0.073	<.001	3.707	4.559	0.073	<.001	3.707
Fixed Effects											
Within-person (Level 1)											
Weekday vs. Weekend day$_{t\,0}$				0.275	0.021	<.001	0.184	0.275	0.021	<.001	0.184
Notification number of the day$_{t\,0}$				-0.051	0.005	<.001	-0.059	-0.051	0.005	<.001	-0.059
Snapchat use *vs.* no use$_{t\,0*}$								-0.002	0.023	0.940	-0.001
Between-person (Level 2)											
Average Snapchat use								0.157	0.269	0.559	0.035
Random Effects											
Within-person (Level 1)											
σ^2 Residual	2.227	0.019	<.001	2.204	0.019	<.001		2.204	0.019	<.001	
Between-person (Level 2)											
σ^2 Residual (intercept)	1.512	0.129	<.001	1.513	0.129	<.001		1.511	0.129	<.001	
σ^2 Slope Snapchat use											
Fit indices											
Deviance	97528.822			97252.288				97251.940			
Likelihood Ratio Test				χ2(2) =	276.534	0.000		χ2(2) =	0.348	0.420	
AIC	97528.823			97262.288				97265.941			
BIC	97553.375			97303.208				97323.229			

Note. The following variables were dummy coded: Weekday vs. weekend day (0 = Weekend day; 1 = Weekday), Snapchat use (0 = no use of Snapchat; 1 = use of Snapchat). Significant Likelihood Ratio Tests are marked in yellow, significant positive effects are marked in green, and significant negative effects in red.

Conclusion: Snapchat use was unrelated related to friendship closness at the within-person and between-person level.

Multi-Level Models Snapchat Use With and Without Friends

	Snapchat use with friends model				Random effects Model Snapchat with friends		
Number of observations	26479				26479		
Number of participants	285				285		
	b	*SE*	*p*	β	*b*	*SE*	*p*
Intercept	4.559	0.073	<.001	3.706	4.559	0.073	<.001
Fixed Effects							
Within-person (Level 1)							
Weekday vs. Weekend day$_{t\,0}$	0.275	0.021	<.001	0.185	0.271	0.021	<.001
Notification number of the day$_{t\,0}$	-0.052	0.005	<.001	-0.060	-0.053	0.005	<.001
Snapchat use *with* friends*vs.* no use$_{t\,0*}$	0.014	0.028	0.616	0.009	0.055	0.04	0.162
Snapchat use *without* friends vs. no use$_{t\,0*}$	-0.013	0.025	0.614	-0.009	0.01	0.036	0.783
Between-person (Level 2)							
Average Snapchat use *with* friends	0.416	0.292	0.154	0.090	-0.440	0.381	0.249
Average Snapchat use *without* friends	-0.440	0.381	0.249	-0.073	0.416	0.292	0.154
Random Effects							
Within-person (Level 1)							
σ^2 Residual	2.204	0.019	<.001		2.161	0.019	<.001
Between-person (Level 2)							
σ^2 Residual (intercept)	1.486	0.127	<.001		1.487	0.127	<.001
σ^2 Snapchat use *with* friends					0.166	0.033	<.001
σ^2 Slope Snapchat use *without* friends					0.145	0.027	<.001
Fit indices							
Deviance	97246.214				97086.034		
Likelihood Ratio Test	χ2(2) =	5.726	0.029		χ2(2) =	160.180	0.000
AIC	97264.214				97108.034		
BIC	97337.871				97198.059		

Note. The following variables were dummy coded: Weekday vs. weekend day (0 = Weekend day; 1 = Weekday), Snapchat use with friends (0 = no use of Snapchat with friends; 1 = use of Snapchat with friends), Snapchat use without friends (0 = no Snapchat use without friends; 1 = Snapchat use without friends). Significant Likelihood Ratio Tests are marked in yellow, significant positive effects are marked in green, and significant negative effects in red.

Conclusion: The likelihood ratio tests pointed at significant heterogeneity in the within-person associations of friendship closeness with Snapchat use with friends and Snapchat use without friends

Multi-Level Random Effects Model Snapchat Use With and Without Friends - Moderation by Gender

	Random effects model Snapchat use with friends + Gender		
Number of observations	26355		
Number of participants	284		
	b	*SE*	*p*
Intercept	4.567	0.073	<.001
Fixed Effects			
Within-person (Level 1)			
Weekday vs. Weekend $day_{t\,0}$	0.272	0.021	<.001
Notifciation number of the $day_{t\,0}$	-0.053	0.005	<.001
Snapchat use *with* friends vs. no uset0*	0.055	0.040	0.163
Snapchat use *without* friends vs. no uset0*	0.011	0.036	0.760
Snapchat use *with* friends * Gender	-0.055	0.085	0.513
Snapchat use *without* friends * Gender	0.093	0.075	0.212
Between-person (Level 2)			
Average Snapchat use *with* friends	0.378	0.293	0.198
Average Snapchat use *without* friends	-0.406	0.395	0.304
Gender	0.239	0.153	0.118
Average Snapchat use *with* friends * Gender	-0.622	0.598	0.299
Average Snapchat use *without* friends * Gender	-0.278	0.772	0.718
Random Effects			
Within-person (Level 1)			
σ^2 Residual	2.169	0.019	<.001
Between-person (Level 2)			
σ^2 Residual (intercept)	1.473	0.126	<.001
σ2 Slope Snapchat use *with* friends	0.164	0.032	<.001
σ2 Slope Snapchat use *without* friends	0.144	0.027	<.001
Fit indices			
AIC	96752.733		
BIC	96883.603		

Conclusion: In the Snapchat use with & without friends model, there were not any significant main effects or interactions including gender.

Sensitivity Analysis (1) - Multi-level Models Three Platforms Combined

We estimated a model in which all three platforms were included together, among a subsample of 274 adolescents who used all three platforms. Just like in our main analyses, we found that Instagram use *with* and *without* friends were negatively related to momentary experiences of friendship closeness at the within-person level, b = -.137, p <.001, β = -.092 and *b* = -.107, *p* <.001, β = -.072. Again, Instagram use *with* friends was positively related to average levels of friendship closeness at the between-person level, *b* = 2.054, *p* =.005, β = +.375. The within-person and between-person effects of general WhatsApp use were no longer significant. In contrast to our main analyses, we found a positive within-person effect of Snapchat use with friends on momentary levels of friendship closeness, *b* = +.062, *p* = .048, β = +.042. This suggests that after controlling for the negative within-person effects of Instagram use, adolescents felt closer after using Snapchat *with* friends in the past hour as compared to not using Snapchat. Taken together, the results of this sensitivity analysis suggest that the effects were most robust for Instagram.

Sensitivity Analysis (1) - Multi-level Models Three Platforms Combined

	Intercept Only Model			Reference model				Social media use model			
Number of observations	25564			25564				25564			
Number of participants	274			274				274			
	b	*SE*	*p*	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β
Intercept	4.576	0.075	<.001	4.576	0.075	<.001	3.695	4.576	0.075	<.001	3.695
Fixed Effects											
Within-person (Level 1)											
Weekday vs. Weekend day$_{t\,0}$				0.271	0.022	<.001	0.183	0.271	0.022	<.001	0.183
Notification number of the day$_{t\,0}$				-0.052	0.005	<.001	-0.061	-0.050	0.005	<.001	-0.058
Instagram use vs. no use$_{t\,0*}$								-0.119	0.026	<.001	-0.080
WhatsApp use *vs. no use* $_{t\,0*}$								0.033	0.026	0.206	0.023
Snapchat use vs. no use$_{t\,0*}$								0.046	0.026	0.074	0.031
Between-person (Level 2)											
Average Instagram								1.034	0.695	0.137	0.201
Average WhatsApp								-0.479	0.730	0.512	-0.093
Average Snapchat use								-0.156	0.391	0.690	-0.034
Random Effects											
Within-person (Level 1)											
σ^2 Residual	2.194	0.02	<.001	2.171	0.019	<.001		2.169	0.019	<.001	
Between-person (Level 2)											
σ^2 Residual (intercept)	1.534	0.133	<.001	1.534	0.133	<.001		1.515	0.132	<.001	
Fit indices											
Deviance	93772.706			93508.198				93483.480			
Likelihood Ratio Test				$\chi2(2) =$	264.508	0.000		$\chi2(2) =$	24.718	0.001	
AIC	93778.706			93518.198				93505.48			
BIC	93803.153			93558.942				93595.119			

Conclusion: After including all three platforms together in one models, findings were most robust for Instagram.

Sensitivity Analysis (1) - Multi-level Models Three Platforms Combined

	Social media use with friends model			
Number of observations	25564			
Number of participants	274			
	b	*SE*	*p*	β
Intercept	4.576	0.073	<.001	3.692
Fixed Effects				
Within-person (Level 1)				
Weekday vs. Weekend day$_{t\,0}$	0.272	0.022	<.001	0.183
Notification number of the day$_{t\,0}$	-0.050	0.005	<.001	-0.034
Instagram use *with* friends vs. no use$_{t\,0*}$	-0.137	0.032	<.001	-0.092
Instagram use *without* friends vs. no use$_{t\,0*}$	-0.107	0.029	<.001	-0.072
WhatsApp use *with* friends vs. no use$_{t\,0*}$	0.030	0.043	0.484	0.020
WhatsApp use *without* friends vs. no use$_{t\,0*}$	0.041	0.027	0.125	0.028
Snapchat *with* friends vs. no use$_{t\,0*}$	0.062	0.031	0.048	0.042
Snapchat use *without* friends vs. no use$_{t\,0*}$	0.023	0.028	0.412	0.015
Between-person (Level 2)				
Average Instagram use *with* friends	2.054	0.735	0.005	0.375
Average Instagram use *without* friends	0.465	0.732	0.525	0.074
Average WhatsApp use *with* friends	-1.517	0.805	0.060	-0.270
Average WhatsApp use *without* friends	-0.463	0.736	0.530	-0.085
Average Snapchat use *with* friends	0.206	0.398	0.605	0.044
Average Snapchat use *without* friends	-0.385	0.591	0.515	-0.064
Random Effects				
Within-person (Level 1)				
σ^2 Residual	2.169	0.019	<.001	
Between-person (Level 2)				
σ^2 Residual (intercept)	1.424	0.124	<.001	
Fit indices				
Deviance	93464.680			
Likelihood Ratio Test	$\chi2(2)$ =	19.240	0.004	
AIC	93498.679			
BIC	93637.211			

Conclusion: After including all three platforms together in one models, findings were most robust for Instagram.

Sensitivity Analysis (2) - Potentially Untrustworthy Answer Patterns

We examined whether our findings were robust by controlling for potential untrustworthy answer patterns. We conducted several validation checks to examine whether participants' answers were trustworthy according to the following pre-registered criteria (for a detailed description, see OSF https://edu.nl/63xaf): (1) consistency of participants' within-person response patterns, (2) no outliers, (3) no unserious responses (e.g., gross comments) to open comments. Based on our pre-determined criteria (https://edu.nl/63xaf), we considered the answers of eight participants as potentially untrustworthy as they violated criterion 1 and 2 (n = 4) or criterion 1 and 3 (n = 4) (for the syntax, see https://osf.io/ac7he/?view_only=89572d503b4a44edbbc318e983b2d388). In total, three out of eight participants scored more than two standard deviations below the mean on friendship closeness.

As sensitivity analysis, we conducted the final multi-level analyses again without these eight participants. Like our main analyses, these sensitivity analyses revealed negative within-person associations of Instagram use (with & without friends) and WhatsApp use with friendship closeness (see next page). At the between-person level, we again found a positive association between Instagram use with friends and friendship closeness. However, in contrast to our main analyses, the positive between-person association of WhatsApp use changed from significant ($\beta = .104$, $p = .044$) into marginally significant ($\beta = .100$, $p = .056$). As these effect sizes are relatively similar, this may be due to a reduction of power. Again, the effects were most robust for Instagram.

Sensitivity Analysis (2) - Potentially Untrustworthy Answer Patterns

SUMMARY OF MAIN FINDINGS INCLUDING PARTICIPANTS WITH SUSPICIOUS ANSWER PATTERNS

	Instagram (Model 4)				Snapchat (Model 4)				WhatsApp (Model 3)				
	345 participants				285 participants				*N* = 375 participants				
	31658 observations				26479 observations				34068 observations				
Within	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β	**Within**	*b*	*SE*	*p*	β
Platform use with friends	-0.104	0.024	<.001	-0.069	0.014	0.028	0.616	0.009	Platform use	-0.041	0.019	0.030	-0.027
Platform use without friends	-0.072	0.023	0.002	-0.047	-0.013	0.025	0.614	-0.009					
Between									**Between**				
Platform use with friends	0.970	0.318	0.002	0.171	0.416	0.292	0.154	0.090	Platform use	0.542	0.269	0.044	0.104
Platform use without friends	-0.345	0.355	0.332	-0.055	-0.440	0.381	0.249	-0.073					

SUMMARY OF MAIN FINDINGS EXCLUDING PARTICIPANTS WITH SUSPICIOUS ANSWER PATTERNS

	Instagram (Model 4)				Snapchat (Model 4)				WhatsApp (Model 3)				
	340 participants and				280 participants				367 participants				
	31286 observations				26107 observations				33499 observations				
Within	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β	**Within**	*b*	*SE*	*p*	β
Platform use with friends	-0.102	0.024	<.001	-0.067	0.015	0.028	0.594	0.010	Platform use	-0.043	0.019	0.027	-0.028
Platform use without friends	-0.075	0.023	0.001	-0.050	-0.017	0.025	0.503	-0.011					
Between									**Between**				
Platform use with friends	0.935	0.317	0.003	0.167	0.441	0.291	0.129	0.004	Platform use	0.511	0.268	0.057	0.100
Platform use without friends	-0.283	0.359	0.431	-0.056	-0.316	0.385	0.411	-0.005					

Conclusion: After excluding participants with potentially suspicious answer patterns from the analyses, the between person effects of WhatsApp use and Snapchat use with friends changed from significant to marginally significant. Findings were most robust for Instagram.

Sensitivity Analysis (3) - Discrepancy Social Media Use With Close Friends vs. Social media use variable

In addition to the preregistered sensitivity analyses, we also estimated a model in which we omitted occasions with discrepancies between social media use with friends and general social media use (i.e., occasions on which adolescents used a platform with friends, even though they spent 0 minutes using that platform). In the original model, these occassions were included, after recoding the response on the social media use variable from 0 into 1. The discrepancy between the social media use with friends items and general social media use items occurred in 2%, 3%, and 10% of the occasions for

SUMMARY OF MAIN FINDINGS INCLUDING ALL OBSERVATIONS

	Instagram (Model 4)				Snapchat (Model 4)					WhatsApp (Model 3)			
	345 participants				285 participants					375 participants			
	31658 observations				26479 observations					34068 observations			
Within	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β	**Within**	*b*	*SE*	*p*	β
Platform use with friends	-0.104	0.024	<.001	-0.069	0.014	0.028	0.616	0.009	Platform use	-0.041	0.019	0.030	-0.027
Platform use without friends	-0.072	0.023	0.002	-0.047	-0.013	0.025	0.614	-0.009					
Between									**Between**				
Platform use with friends	0.970	0.318	0.002	0.171	0.416	0.292	0.154	0.090	Platform use	0.542	0.269	0.044	0.104
Platform use without friends	-0.345	0.355	0.332	-0.055	-0.440	0.381	0.249	-0.073					

SUMMARY OF MAIN FINDINGS EXCLUDING DISCREPANT OBSERVATIONS

	Instagram (Model 4)				Snapchat (Model 4)					WhatsApp (Model 3)			
	345 participants				26479 observations					375 participants			
	28633 observations				25742 observations					33381 observations			
Within	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β	**Within**	*b*	*SE*	*p*	β
Platform use with friends	-0.100	0.028	<.001	-0.066	0.012	0.029	0.678	0.008	Platform use	-0.040	0.019	0.037	-0.026
Platform use without friends	-0.065	0.024	0.006	-0.043	-0.014	0.025	0.585	-0.009					
Between									**Between**				
Platform use with friends	0.872	0.313	0.005	0.150	0.456	0.293	0.119	0.098	Platform use	0.529	0.266	0.047	0.103
Platform use without friends	-0.594	0.340	0.080	-0.095	-0.454	0.378	0.230	-0.075					

Exploratory DSEM Analayses

As pre-registered, we examined whether the within-person effects of Instagram use without friends and WhatsApp use remained significant after controlling for the carry-over effect of friendship closeness two hours prior each assessment. We estimated fixed effects autoregressive multi-level models within the Dynamic Structural Equation Model (DSEM) framework in MPlus 8. These models enabled us to control for the autoregressive effect of friendship quality in the previous hour (t-1). By default, DSEM uses Bayesian Markov Chain Monte Carlo (MCMC) for model estimation.

We followed our preregistered plan of analyses and first ran DSEM models with a maximum of 5,000 iterations and a thinning factor of 2. Based on problems with model convergence and our experience with estimating DSEM models for another manuscript of the larger project, we improved the model setup by increasing the time interval from 1 to 2 hours (McNeish & Hamaker, 2019). The Instagram, WhatsApp and Snapchat models converged well after 200 iterations, with PSRs smaller than 1.03. To exclude the possibility that the PSR value of 200 iterations was close to 1 by chance (Schultzberg & Muthén, 2018), we also ran models with 5,000 iterations. The trace plots for each parameter looked like fat caterpillars (Hamaker, Asparouhov, Brose, Schmiedek, & Muthén, 2018), indicating that convergence was successful. These models converged successful and their results did not deviate from the models with 5,000 iterations (see SJ t/m SL). We considered effects as significant if the 95% CIs for the effect of Instagram/WhatsApp use on friendship closeness did not contain 0.

To examine heterogeneity in within-person effects of Instagram/WhatsApp/Snapchat use with friendship closeness, we also estimated DSEM models with random slopes for the autoregressive effect of friendship closeness and within-person effects of social media use (see SK t/m SM). All estimated random effects were significant. Finally, as preregistered, we also tried to estimate models with correlations between random effects, but these models did not convergence well after 50,000 iterations, as trace plots did not look like flat caterpillars. This suggests that models with correlations between random slopes are too complex.

References:

McNeish, D., & Hamaker, E. L. (2019). A primer on two-level dynamic structural equation models for intensive longitudinal data in Mplus. Psychological methods. https://doi.org/10.1037/met0000250

Hamaker, E. L., Asparouhov, T., Brose, A., Schmiedek, F., & Muthén, B. (2018). At the frontiers of modeling intensive longitudinal data: Dynamic structural equation models for the affective measurements from the COGITO study. *Multivariate Behavioral Research, 53* (6), 820-841. doi:10.1080/00273171.2018.1446819

Summary of Main Findings DSEM Models Instagram

	Instagram (DSEM Fixed)				Instagram (DSEM Random)			
Fixed effects	*b*	*p*	95% CI	β	*b*	*p*	95% CI	β
Within-person (Level 1)								
Friendship Closeness t-1	0.27	<.001	[.246 , .294]	0.270	0.264	<.001	[.238 , .287]	0.264
Instagram use *with* friends*vs.* no use$_{t\,0*}$	-0.088	<.001	[-.133 , -.042]	-0.024	-0.073	0.029	[-.149 , .002]	-0.018
Instagram use *without* friends vs. no use$_{t\,0*}$	-0.054	0.009	[-.096 , -.010]	-0.015	-0.037	0.120	[-.097 , .025]	-0.010
Between-person (Level 2)								
Average Instagram use *with* friends	1.073	<.001	[.401 , 1.741]	0.182	1.062	0.001	[.412 , .1.739]	0.180
Average Instagram use *without* friends	-0.287	0.225	[-1.037 , .471]	-0.044	-0.291	0.216	[-1.053 , .478]	-0.044
Random effects								
Within-person (Level 1)								
σ^2 Residual	1.966	<.001	[1.935 , 1.998]		1.922	<.001	[1.890 , 1.953]	
Between-person (Level 2)								
σ^2 Residual (Intercept)	1.595	<.001	[1.374 , 1.872]		1.596	<.001	[1.367 , 1.866]	
σ^2 Residual (Friendship Closeness t-1)	0.033	<.001	[.026 , .041]		0.033	<.001	[.026 , .040]	
σ^2 Residual (Instagram use *with* friends)					0.246	<.001	[.184 , .325]	
σ^2 Residual (Instagram use *without* friends)					0.105	<.001	[.065 , .155]	

Conclusion: The negative within-person effects of Instagram use with and *without* friends on friendship closeness remained signficant after controlling for the autoregressive effect of friendship

Conclusion: Confidence intervals of the random effects pointed at significant heterogeneity in the within-person effects of Instagram use with and without friends on friendship closeness.

Summary of Main Findings DSEM Models WhatsApp

	WhatsApp (DSEM Fixed)				WhatsApp (DSEM Random)			
Fixed effects	*b*	*p*	95% CI	β	*b*	*p*	95% CI	β
Within-person (Level 1)								
Friendship Closeness t-1	0.273	<.001	[.249 , .295]	0.273	0.271	<.001	[.247 , .293]	0.270
WhatsApp use vs. no use	-0.027	0.073	[-.065 , .009]	-0.008	-0.019	0.243	[-.070 , .033]	-0.005
Between-person (Level 2)								
WhatsApp use vs. no use	0.609	0.019	[.030 , 1.172]	0.113	0.601	0.02	[.038 , 1.148]	0.112
Random effects								
Within-person (Level 1)								
σ^2 Residual	2.019	<.001	[1.987 , 2.051]		2	<.001	[1.969 , 2.032]	
Between-person (Level 2)								
σ^2 Residual (Intercept)	1.698	<.001	[1.476 , 1.981]		1.697	<.001	[1.466 , 1.966]	
σ^2 Residual (Friendship Closeness t-1)	0.031	<.001	[.025 , .038]		0.031	<.001	[.025 , .038]	
σ^2 Residual (WhatsApp use)					0.114	<.001	[.081 , .155]	

Conclusion: The negative within-person effect of general WhatsApp use on friendship closeness was no longer signficant after controlling for the autoregressive effect of friendship

Conclusion: Confidence intervals of the random effect pointed at significant heterogeneity in the within-person effect of WhatsApp use on friendship closeness.

Summary of Main Findings DSEM Models Snapchat

	Snapchat (DSEM Fixed)				Snapchat (DSEM Random)			
Fixed effects	*b*	*p*	95% CI	β	*b*	*p*	95% CI	β
Within-person (Level 1)								
Friendship Closeness t-1	0.262	<.001	[.235 , .289]	0.261	0.256	<.001	[.230 , .283]	0.256
Snapchat use *with* friends vs. no uset0*	0.037	0.08	[-.014 , .092]	0.010	0.072	0.024	[.001 , .144]	0.018
Snapchat use *without* friends vs. no uset0*	0.017	0.25	[-.031 , .068]	0.005	0.032	0.175	[-.033 , .100]	0.008
Between-person (Level 2)								
Average Snapchat use *with* friends	0.473	0.062	[-.133 , 1.065]	0.099	0.476	0.063	[-.138 , 1.072]	0.101
Average Snapchat use *without* friends	-.409	.163	[-1.222 , .415]	-0.065	-.399	.173	[-1.201 , .413]	-0.064
Random effects								
Within-person (Level 1)								
σ^2 Residual	1.924	<.001	[1.890 , 1.957]		1.893	<.001	[1.860 , 1.927]	
Between-person (Level 2)								
σ^2 Residual (Intercept)	1.546	<.001	[1.308 , 1.838]		1.543	<.001	[1.312 , 1.835]	
σ^2 Residual (Friendship Closeness t-1)	0.033	<.001	[.027 , .042]		0.033	<.001	[.026 , .041]	
σ2 Residual (Snapchat use *with* friends)					0.127	<.001	[.076 , .193]	
σ2 Residual (Snapchat use *without* friends)					0.119	<.001	[.076 , .173]	

Conclusion: After controlling for the autoregressive effect of friendship closeness, we still did not find significant within-person effects of Snapchat use with and without friends on friendship closeness.

Conclusion: Confidence intervals of the random effects pointed at significant heterogeneity in the within-person effects of Snapchat use with and without friends on friendship closeness.

Supplement 14 - Results preregistered Model 4 vs. Final Model 4

SUMMARY OF MAIN FINDINGS PREREGISTERED MODELS

	Instagram (Model 4)				WhatsApp (Model 4)				Snapchat (Model 4)			
	345 participants				375 participants				285 participants			
	31658 observations				34068 observations				26479 observations			
Within	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β
Platform use with vs. without friends	-0.033	0.025	0.198	-0.021	-0.018	0.033	-0.560	-0.012	0.027	0.027	0.326	0.018
Platform use vs. no use	-0.072	0.023	0.002	-0.047	-0.038	0.020	0.053	-0.025	-0.013	0.025	0.614	-0.009
Between												
Platform use with vs. without friends	1.315	0.395	0.001	0.232	-0.030	0.393	0.939	-0.005	0.856	0.391	0.028	0.185
Platform use vs. no use	-0.345	0.355	0.332	-0.068	0.555	0.319	0.082	0.107	-0.440	0.381	0.249	-0.098
Fit indices												
Deviance	117143.262				126918.370				97246.214			
AIC	117161.262				126936.370				97264.214			
BIC	117236.527				127012.295				97337.871			

SUMMARY OF MAIN FINDINGS FINAL MODELS

	Instagram (Model 4)				WhatsApp (Model 4)				Snapchat (Model 4)			
	345 participants				375 participants				285 participants			
	31658 observations				34068 observations				26479 observations			
Within	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β	*b*	*SE*	*p*	β
Platform use with friends vs. no use	-0.104	0.024	<.001	-0.069	-0.057	0.034	0.090	-0.037	0.014	0.028	0.616	0.009
Platform use without friends vs. no use	-0.072	0.023	0.002	-0.047	-0.038	0.020	0.053	-0.025	-0.013	0.025	0.614	-0.009
Between												
Platform use with friends vs. no use	0.970	0.318	0.002	0.171	0.525	0.348	0.131	0.082	0.416	0.292	0.154	0.090
Platform use without friends vs. no use	-0.345	0.355	0.332	-0.055	0.555	0.319	0.082	0.095	-0.440	0.381	0.249	-0.073
Fit indices												
Deviance	117143.262				126918.370				97246.214			
AIC	117161.262				126936.370				97264.214			
BIC	117236.527				127012.295				97337.871			

For the ease of interpretation, we used an alternative specification of the preregistered model 4. Specifically, we estimated the effects of Instagram/WhatsApp/Snapchat use with friends and without friends (final model) instead of Instagram/WhatsApp/Snapchat use with friends and general Instagram/WhatsApp/Snapchat use (preregistered model). As this alternative specification of Model 4 resulted in an identical overall model fit as the preregistered Model 4, Model 3 remained nested in Model 4.