

Supplemental Materials for

**Problematic Use of the Internet among Adolescents: A Four-Wave Longitudinal Study of
Trajectories, Predictors and Outcomes**

Authors' note:

We developed these materials to provide additional technical information and to keep the main
manuscript focused.

Family socioeconomic status (SES) measurement

In this study, measurement of SES followed previous studies (Li et al 2017; Yang, Tian, van Oudenhoven, Hofstra, & Wang, 2010). Specifically, family SES was assessed by parental educational level and current occupations. Paternal and maternal educational levels included five response categories: elementary school, junior high school, senior high school (including occupational middle school), up-to-3-year college/university, and 4-or-more-year college/university. Occupational level included three categories: no, part-time, and full-time jobs. These two indicators were all treated as ordinal scales. A composite SES score was then created by standardizing educational and occupational levels (Z-score) and adding the standardized scores (Janicki-Deverts et al., 2007).

Table S1. Correlations of the variables at Wave 1.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Age W1	--													
2. Sex W1	-.06	--												
3. Family socioeconomic status W1	-.11**	-.01	--											
4. Child maltreatment W1	.11**	-.12**	-.03	--										
5. Inter-parental conflicts W1	.04	.02	.01	.42**	--									
6. Problematic use of the internet W1	-.14**	-.05	-.04	.24**	.29**	--								
7. Depression W1	.04	.07*	-.09**	.56**	.30**	.34**	--							
8. Anxiety W1	.01	.08**	-.04	.51**	.33**	.38**	.81**	--						
9. Parent-child relationship W1	-.08**	.04	.07*	-.52**	-.24**	-.20**	-.53**	-.46**	--					
10. Peer relationship W1	-.04	.16**	.06*	-.55**	-.22**	-.27**	-.56**	-.45**	.55**	--				
11. Teacher-student relationship W1	-.02	.07*	.03	-.55**	-.27**	-.34**	-.61**	-.53**	.59**	.66**	--			
12. Behavioral engagement W1	-.08**	.17**	.04	-.56**	-.24**	-.27**	-.46**	-.38**	.43**	.54**	.55**	--		

13. Emotional engagement W1	-.10**	.07*	.02	-.54**	-.20**	-.18**	-.53**	-.40**	.47**	.54**	.60**	.65**	--	
14. Cognitive engagement W1	-.08**	.08**	.01	-.45**	-.14**	-.15**	-.43**	-.33**	.44**	.48**	.51**	.62**	.81**	--
<i>M</i>	15.82	.55	-.01	38.51	10.56	45.39	36.91	32.05	66.74	93.45	87.97	16.97	17.00	17.39
<i>SD</i>	.61	.50	1.50	13.78	4.24	15.41	9.96	8.26	15.96	15.34	14.61	2.62	2.90	3.39

Note. W1= Wave1. * $p < .05$, ** $p < .01$ (two-tailed).

Table S2. Correlations of the variables at Wave 2.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Age W1	--													
2. Sex W1	-.06	--												
3. Family socioeconomic status W1	-.11**	-.01	--											
4. Child maltreatment W1	.11**	-.12**	-.03	--										
5. Inter-parental conflicts W1	.04	.02	.01	.42**	--									
6. Problematic use of the internet W2	-.13**	-.02	-.01	.19**	.18**	--								
7. Depression W2	-.06*	.04	-.03	.32**	.22**	.39**	--							
8. Anxiety W2	-.08**	.04	-.02	.30**	.24**	.47**	.80**	--						
9. Parent-child relationship W2	.03	.00	.06	-.29**	-.15**	-.18**	-.47**	-.36**	--					
10. Peer relationship W2	.06*	.19**	.03	-.36**	-.18**	-.31**	-.53**	-.42**	.55**	--				
11. Teacher-student relationship W2	.06*	.09**	.03	-.31**	-.20**	-.34**	-.58**	-.48**	.55**	.64**	--			
12. Behavioral engagement W2	-.00	.19**	-.01	-.30**	-.18**	-.28**	-.44**	-.38**	.37**	.52**	.51**	--		

13. Emotional engagement W2	-.00	.12**	.04	-.31**	-.15**	-.27**	-.56**	-.45**	.49**	.55**	.60**	.62**	--	
14. Cognitive engagement W2	.02	.09**	.02	-.30**	-.16**	-.21**	-.44**	-.34**	.47**	.48**	.51**	.56**	.78**	--
<i>M</i>	15.82	.55	-.01	38.51	10.56	45.11	37.02	32.60	67.78	93.91	86.62	16.86	16.81	17.48
<i>SD</i>	.61	.50	1.50	13.78	4.24	15.71	10.44	9.23	16.12	15.29	15.62	2.85	2.92	3.33

Note. W2= Wave2. * $p < .05$, ** $p < .01$ (two-tailed).

Table S3. Correlations of the variables at Wave 3.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Age W1	--													
2. SEX W1	-.06	--												
3. Family socioeconomic status W1	-.11**	-.01	--											
4. Child maltreatment W1	.11**	-.12**	-.03	--										
5. Inter-parental conflicts W1	.04	.02	.01	.42**	--									
6. Problematic use of the internet W3	-.13**	-.05	.06	.17**	.15**	--								
7. Depression W3	-.03	-.02	.02	.33**	.20**	.43**	--							
8. Anxiety W3	-.03	.01	.02	.30**	.19**	.48**	.82**	--						
9. Parent-child relationship W3	.01	.07*	.05	-.35**	-.14**	-.17**	-.54**	-.41**	--					
10. Peer relationship W3	-.03	.21**	.01	-.36**	-.14**	-.27**	-.61**	-.49**	.67**	--				
11. Teacher-student relationship W3	.02	.15**	.04	-.30**	-.14**	-.37**	-.63**	-.52**	.61**	.73**	--			
12. Behavioral engagement W3	-.06	.22**	.00	-.31**	-.11**	-.31**	-.54**	-.45**	.55**	.64**	.62**	--		

13. Emotional engagement W3	.01	.17**	.02	-.31**	-.14**	-.28**	-.59**	-.50**	.61**	.66**	.65**	.68**	--	
14. Cognitive engagement W3	-.00	.17**	-.01	-.29**	-.16**	-.19**	-.48**	-.38**	.58**	.58**	.54**	.60**	.85**	--
<i>M</i>	15.82	.55	-.01	38.51	10.56	45.48	38.21	33.01	65.08	90.76	83.95	16.17	16.23	16.82
<i>SD</i>	.61	.50	1.50	13.78	4.24	16.79	10.98	9.48	18.09	16.46	16.12	3.06	3.11	3.85

Note. W3= Wave 3. * $p < .05$, ** $p < .01$ (two-tailed).

Table S4. Correlations of the variables at Wave 4.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Age W1	--													
2. Sex W 1	-.06	--												
3. Family socioeconomic status W1	-.11**	-.01	--											
4. Child maltreatment W1	.11**	-.12**	-.03	--										
5. Inter-parental conflicts W1	.04	.02	.01	.42**	--									
6. Problematic use of the internet W4	-.18**	-.07*	.03	.19**	.18**	--								
7. Depression W4	-.05	-.06	.02	.31**	.23**	.40**	--							
8. Anxiety W4	-.09**	-.05	.03	.28**	.20**	.52**	.79**	--						
9. Parent-child relationship W4	-.00	.02	.06	-.32**	-.20**	-.14**	-.51**	-.36**	--					
10. Peer relationship W4	.02	.22**	.04	-.31**	-.15**	-.28**	-.63**	-.46**	.64**	--				
11. Teacher-student relationship W4	.05	.14**	.06	-.32**	-.19**	-.36**	-.65**	-.50**	.61**	.77**	--			
12. Behavioral engagement W4	-.04	.21**	.01	-.31**	-.15**	-.27**	-.55**	-.45**	.45**	.64**	.61**	--		

13. Emotional engagement W4	-.03	.14**	.02	-.31**	-.18**	-.22**	-.56**	-.42**	.55**	.66**	.64**	.69**	--	
14. Cognitive engagement W4	-.02	.11**	.00	-.30**	-.18**	-.17**	-.46**	-.34**	.56**	.59**	.57**	.64**	.85**	--
<i>M</i>	15.82	.55	-.01	38.51	10.56	44.33	37.61	32.59	65.65	90.87	84.37	16.23	16.21	16.75
<i>SD</i>	.61	.50	1.50	13.78	4.24	17.21	10.95	9.19	18.01	16.94	16.15	3.07	3.09	3.86

Note. W4= Wave 4. * $p < .05$, ** $p < .01$ (two-tailed).

Table S5. Means and growth parameters for each latent PUI development trajectories.

Time points	Profile 1 (Low Decreasing) <i>N</i> =520	Profile2 (Moderate Increasing) <i>N</i> =538	Profile 3 (High Increasing) <i>N</i> =91	
Mean				Group differences
Baseline	38.66 (40.33)	50.40 (49.45)	54.23 (51.00)	1 < 2 = 3
6 months	36.55 (36.38)	51.17 (50.66)	57.64 (60.37)	1 < 2 < 3
12 months	36.05 (32.44)	50.50 (51.87)	65.39 (69.74)	1 < 2 < 3
18 months	28.04 (28.49)	53.27 (53.08)	80.08 (79.10)	1 < 2 < 3
Growth parameters				
Intercept	40.33*** (.62)	49.45*** (.67)	51.00*** (2.13)	
Linear slope	-3.94*** (.21)	1.21*** (.23)	9.37*** (1.15)	

Note: For mean, the values outside brackets are observed mean, value in brackets are estimated mean. For growth parameters, the values outside brackets are mean, value in brackets are standard error.

*** $p < .001$ (two-tailed)

Table S6. Estimated differences and Cohen's d in family predictors and adolescent adjustment outcomes between each latent PUI development trajectories.

		Time point	HI Vs. LD <i>Est. Diff (Cohen's d)</i>	MI Vs. LD <i>Est. Diff (Cohen's d)</i>	HI Vs. MI <i>Est. Diff (Cohen's d)</i>
Predictors					
	childhood maltreatment	Baseline	8.24 (.50)	3.17 (.23)	5.07 (.30)
	Parental conflicts	Baseline	1.74 (.35)	1.23 (.28)	.51 (.10)
Outcomes					
		Baseline	-6.39 (-.34)	-4.14 (-.25)	-2.26 (-.13)
	Parent-child relationship	6 months	-5.12 (-.28)	-5.38 (-.31)	.26 (.01)
		12 months	-6.56 (-.31)	-6.67 (-.32)	.11 (.01)
		18 months	-6.15 (-.29)	-6.50 (-.31)	.34 (.02)
Social relationship					
	Teacher-student relationship	Baseline	-9.95 (-.64)	-6.77 (-.45)	-3.18 (-.21)
		6 months	-10.99 (-.65)	-8.32 (-.51)	-2.67 (-.17)

Mental health	Peer relationship	12 months	-15.55 (-.91)	-9.32 (-.51)	-6.23 (-.42)
		18 months	-16.64 (-1.03)	-11.91(-.66)	-4.73 (-.36)
		Baseline	-8.31 (-.49)	-5.78 (-.36)	-2.53 (-.16)
		6 months	-9.73 (-.59)	-7.17 (-.45)	-2.56 (-.16)
		12 months	-11.53 (-.62)	-8.14 (-.44)	-3.39 (-.20)
		18 months	-14.97 (-.85)	-9.83 (-.51)	-5.14 (-.36)
	Depression	Baseline	5.88 (.55)	4.75 (.46)	1.13 (.10)
		6 months	8.08 (.75)	5.94 (.55)	2.14 (.47)
		12 months	10.75 (.91)	6.85 (.56)	3.90 (.35)
		18 months	13.68 (1.24)	7.19 (.60)	6.49 (.64)
	Anxiety	Baseline	5.76 (.61)	3.68 (.44)	2.08 (.21)

School engagements	Self-esteem	6 months	8.41 (.83)	5.15 (.55)	3.26 (.31)
		12 months	10.95 (.97)	5.90 (.58)	5.05 (.44)
		18 months	15.40 (1.49)	6.54 (.71)	8.86 (.83)
		Baseline	-3.75 (-.59)	2.37 (.22)	-1.38 (-.22)
		6 months	-4.35 (-.67)	2.98 (.22)	-1.37 (-.22)
		12 months	-5.71 (-.90)	3.35 (.44)	-2.36 (-.44)
		18 months	-6.60 (-1.10)	4.04 (.52)	-2.57 (-.52)
		Baseline	-1.34 (-.45)	-.69 (-.25)	-.65 (-.22)
	Behavioral engagement	6 months	-1.60 (-.53)	-1.01 (-.33)	-.59 (-.20)
		12 months	-2.30 (-.69)	-1.39 (-.40)	-.91 (-.30)
		18 months	-2.65(-.82)	-1.46 (-.42)	-1.20 (-.40)

Emotional engagement	Baseline	-1.30 (-.39)	-.70 (-.23)	-.60 (-.18)
	6 months	-2.19 (-.66)	-1.09 (-.36)	-1.09 (-.32)
	12 months	-2.71 (-.74)	-1.35 (-.39)	-1.36 (-.39)
	18 months	-2.55 (-.75)	-1.08 (-.30)	-1.46 (-.48)
Cognitive engagement	Baseline	-1.17 (-.30)	-.70 (-.20)	-.47(-.12)
	6 months	-1.49 (-.39)	-1.26 (-.36)	-.23 (-.06)
	12 months	-2.08 (-.45)	-1.41 (-.32)	-.67 (-.15)
	18 months	-1.97 (-.45)	-1.38 (-.31)	-.58 (-.15)

Note: HI=High Increasing; MI=Moderate Increasing; LD=Low Decreasing. *Est. Diff* = Estimated differences in means of outcome. Estimate the mean of the auxiliary variable the demographics factors were controlled. Cohen's d around .2 was interpreted as "small"; Cohen's d around .5 was interpreted as "medium"; Cohen's d around .8 was interpreted as "large"; Cohen's d around 1.2 was interpreted as "very large" (Sawilowsky, 2009). [Group size in Low Decreasing, Moderate Increasing, and High Increasing group are 520, 538, 91, respectively.](#)

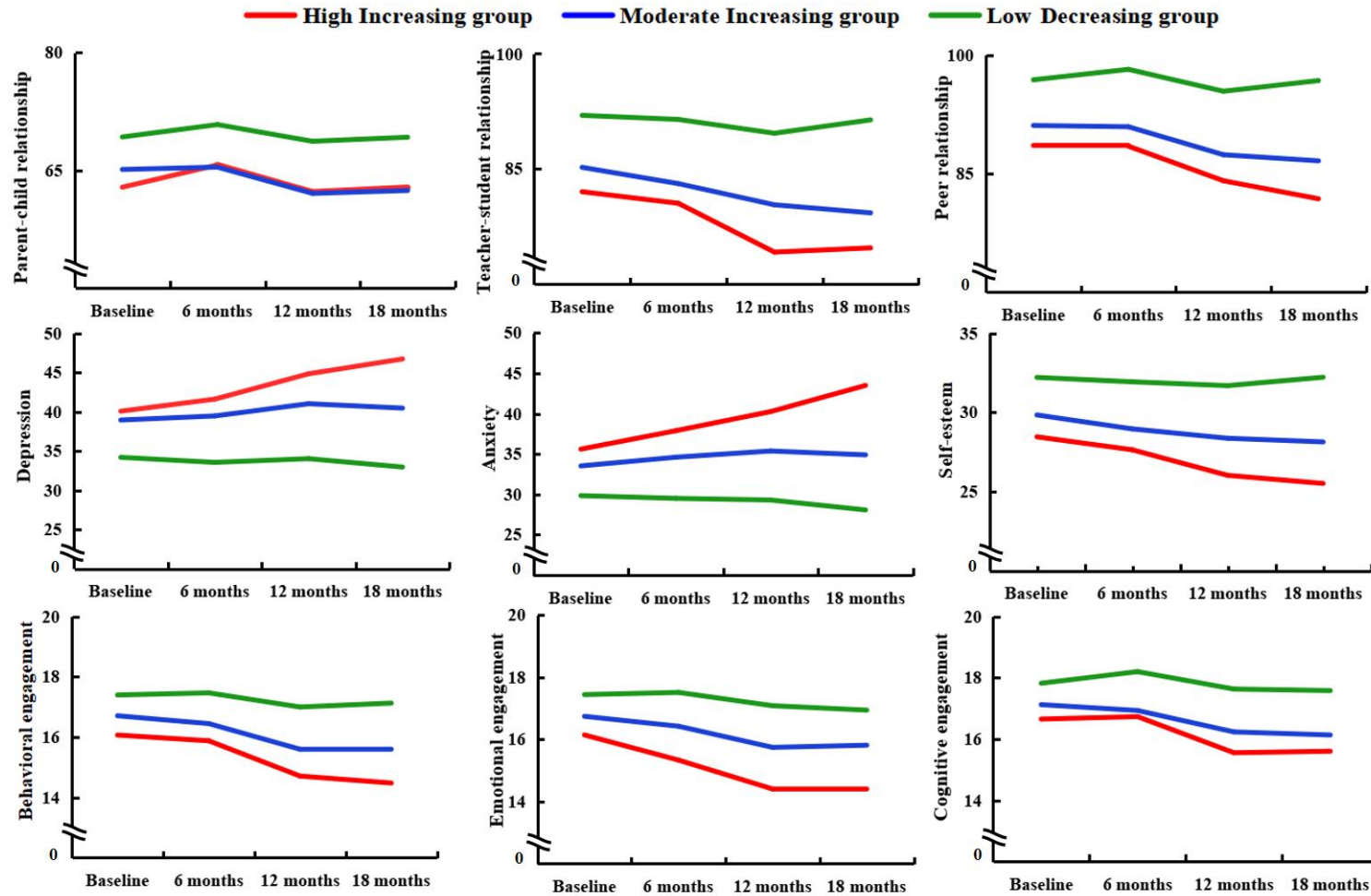


Figure S1. Development trend of the outcomes in the different PUI subgroups.

References

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