

Supplemental Material – Unreviewed (SOM-U)

Supplemental Methods

Approach to Measurement

Timepoint selection. Time points for measures to be included in our study were selected with the goals of matching the time period of the longitudinal associations (age 4 through age 15), balancing intervals between observations, and maintaining measurement consistency given the measures available at each assessment.

Informant selection. No more than one parent served as an informant on a given questionnaire for a given variable at any particular time period in order to reduce dependencies among informants. Preference was given to maternal reports when available as these data were less likely to be missing.

Measure selection. To identify relevant measures of the study variables at each of the requisite timepoints, we used a systematic search and selection process through the study documentation. We first developed broadly inclusive search terms for each variable in consultation with the Medical Subject Headings (MeSH) thesaurus by entering each variable as a MeSH search term and evaluating the resulting descriptors and neighboring terms and concepts for relevance to the variable of interest. Relevant terms identified through this process were added to the search term for each variable (see Table S1).

Table S1

Search Terms Used to Identify Relevant Measures from the SECCYD Documentation

Variable	Search Term
Academic achievement	achievement aptitude dropout learning literacy motivation "educational status" "gpa"
Emotion regulation	allostatic anxiety depression emotion fear forgive frustrat pleasure psychotherapy "affective" "affect" "anger" "rage" "stress"
Personality	assertiveness attitude empathy extraversion individuality individuation intelligence introversion leadership moral negativism optimism perfectionism personality pessimism temperamen "ego"
Problem behavior	aggression alcohol bullying compuls crim delusion drinking depersonalization problem gambling impuls risk self-injur self-harm self-mutil smoking substance tobacco violence "behavioral symptoms" "problem behavior" "underage drinking" "child reactive disorders"
Self-control	“regulation” self-control” temperance
Social support	attachment confidence interpersonal reliance trust
Social skills	cooperation empathy friend interpersonal shy "social skills"

Note. The term “social trust” was used in the initial search and later replaced with “social support” to provide a better match to the resulting terms and measures.

Next, these MeSH-informed search terms were submitted to a full-text optical character recognition search of the compiled study documentation, including the user guides, codebooks, questionnaires, assessment charts, annotated lists of research instruments, and manuals of operation for each assessment period. This documentation formed a combined total of 4,792 pages of searchable text. Full and partial matches to each search term were identified from within this document, which effectively returned any instrument, item, or coded variable or subscale that contained a term related to the variables of interest. Matching terms were evaluated as candidates for the associated variable based on the following criteria: conceptual relevance to the

construct of interest, observations available at focal time points, and moderate to high (i.e., $>.7$) internal reliability when reported.

The above-described measure selection and eligibility determination process resulted in a list of 77 candidate measures spanning all variables and timepoints. Alphanumeric variable labels and data files corresponding to each candidate measure were used to compute pairwise correlations among all candidate measures for a given variable at a given time point. Only measures that demonstrated significant correlations with all other retained measures were kept, with the number of retained measures maximized; these measures were then z-scored and averaged to form composites.

Supplemental Results

Multilevel Model Specification

We began with an empty means, random intercept model in order to partition the variance across levels. All models assume errors are independently and normally distributed with a mean of zero and common variance σ^2 within individuals at Level 1, and multivariate normally distributed with a mean of zero and a full covariance matrix τ . The intraclass correlation computed from the empty means model, $ICC = \tau_{00}/(\tau_{00} + \sigma^2) = (65.18/65.18 + 39.96)$, indicated approximately 62% of the variance in problem behaviors exists between-persons (see Table S2), which we later modeled as a function of individual differences at Level-2.

Table S2

Results of Empty Means Random Intercept Model for Problem Behavior

<i>Fixed Effect</i>	Coefficient	SE	<i>z</i>	<i>p</i>
Mean Age 15 Problem Behaviors, β_{00}	52.57	.37	142.85	<.001
Mean Change, β_{10}	-0.55	.03	-21.40	<.001
<i>Random Effect</i>	Variance	SE	95% CI	
Age 15 Problem Behaviors, r_{0i}	65.18	3.49	58.68, 72.40	
Level-1 error, e_{it}	39.96	1.10	37.88, 42.17	

Note. All models assume errors are independently and normally distributed with a mean of zero and common variance σ^2 within individuals at Level 1, and multivariate normally distributed with a mean of zero and a full covariance matrix τ . Time was zero-centered around age 15.

Visual examination of the raw mean trajectory in problem behaviors over time indicated a slightly decreasing, roughly linear fit to the data. We therefore tested the fit of an unconditional linear growth model to identify the appropriate model for time before conducting any hypothesis-testing with our individual differences predictors. Time was represented continuously and zero-centered around age 15, yielding an intercept π_{0i} representing the problem behaviors of person i in adolescence. This model indicated significant variance in both the fixed intercept and slope estimates (see Table S3), so we allowed individual intercepts and slopes to vary randomly between individuals in all subsequent models.

Table S3

Results of Unconditional Random Linear Time Model for Adolescent Problem Behavior

<i>Fixed Effect</i>	Coefficient	SE	<i>z</i>	<i>p</i>
Mean Age 15 Problem Behaviors, β_{00}	52.58	.36	144.82	<.001
Mean Change, β_{10}	-0.55	.03	-17.99	<.001
<i>Random Effect</i>	Variance	SE	95% CI	
Age 15 Problem Behaviors, r_{0i}	74.64	5.93	63.88, 87.21	
Mean Change, r_{1i}	0.39	0.04	0.31, 0.48	
Level-1 error, e_{it}	31.23	1.05	29.24, 33.36	

Note. All models assume errors are independently and normally distributed with a mean of zero and common variance σ^2 within individuals at Level 1, and multivariate normally distributed with a mean of zero and a full covariance matrix τ . Time was zero-centered around age 15.

Having identified an appropriate model for time, we used the following generic intercepts-as-outcomes model to conduct our hypothesis-testing and model comparisons, adding our predictor variables (delay of gratification, self control, and social support) at level-2 in various combinations:

Level 1 (within individuals):

$$Problem\ Behavior_{ti} = \pi_{0i} + \pi_{1i}time_t + e_{ti}$$

Level 2 (between individuals):

$$\pi_{0i} = \beta_{00} + \beta_{01}[PredictorVariableI]_i + \mu_{0i}$$

$$\pi_{1i} = \beta_{10} + \mu_{1i}$$

We focused on explaining variance in the intercept rather than the slope in an effort to balance best fit against parsimony in model building, and given our primary interest in explaining variance in adolescent outcomes while controlling for individual developmental trajectories, as opposed to explaining the particular shape or rate of change. Coefficients for fixed and random effects of all models used for hypothesis-testing are shown in Table S4. All variables were entered in the model un-centered; delay of gratification was dummy-coded such that the intercept represents the reference group (non-delayers), and social support and self-control, being standardized composites, were already centered around a grand mean of 0 with a standard deviation of 1. All models were identical at Level-1 and in the equation for the slope on time at Level-2, and preliminary analyses indicated no significant two-way or three-way interactions among these variables in the equation for the intercept.

Table S4

Fixed and Random Effects Results for Multilevel Models of Adolescent Problem Behavior

	(1) Delay of Gratification				(2) Social Support				(3) Self Control			
<i>Fixed Effect</i>	Coeff.	SE	z	p	Coeff.	SE	z	p	Coeff.	SE	z	p
Int., β_{00}	53.5	0.5	107.38	<.001	52.5	0.32	160.91	<.001	52.47	0.35	152.1	<.001
β_{01}	-1.77	0.59	-3	0.003	-7.08	0.29	-24.58	<.001	-5.93	0.35	-16.75	<.001
Change, β_{10}	-0.55	0.03	-17.02	<.001	-0.55	0.03	-18.06	<.001	-0.55	0.03	-18.03	<.001
<i>Random Effect</i>	Var.	SE	95% CI		Var.	SE	95% CI		Var.	SE	95% CI	
r_{0i}	72.68	6.15	61.57	85.8	50.61	4.85	41.96	61.06	62.43	5.4	52.71	73.97
r_{1i}	0.39	0.05	0.31	0.49	0.39	0.04	0.31	0.48	0.38	0.04	0.31	0.48
e_{ti}	31.18	1.11	29.08	33.44	31.19	1.05	29.2	33.32	31.28	1.05	29.28	33.42
	(4) Delay + Social Support				(5) Delay + Self Control				(6) Delay + Social Support + Self Control			
<i>Fixed Effect</i>	Coeff.	SE	z	p	Coeff.	SE	z	p	Coeff.	SE	z	p
Int., β_{00}	52.68	0.43	122.09	<.001	52.45	0.47	112.69	<.001	52.32	0.43	122.4	<.001
Delayer	-0.2	0.47	-0.43	0.667	0.15	0.53	0.28	0.779	0.43	0.46	0.92	0.359
SocialSupport	-7.18	0.32	-22.58	<.001	--	--	--	--	-5.87	0.36	-16.52	<.001
SelfControl	--	--	--	--	-6.1	0.39	-15.67	<.001	-2.9	0.39	-7.43	<.001
Change, β_{10}	-0.55	0.03	-17.03	<.001	-0.55	0.03	-17.02	<.001	-0.55	0.03	-17.03	<.001
<i>Random Effect</i>	Var.	SE	95% CI		Var.	SE	95% CI		Var.	SE	95% CI	
r_{0i}	52.08	5.16	42.89	63.26	61.84	5.66	51.69	73.98	50.8	5.11	41.71	61.88
r_{1i}	0.39	0.05	0.31	0.49	0.39	0.05	0.31	0.49	0.39	0.05	0.31	0.49
e_{ti}	31.13	1.11	29.03	33.38	31.2	1.11	29.1	33.46	31.14	1.1	29.05	33.39

Note. All models assume errors are independently and normally distributed with a mean of zero and common variance σ^2 within individuals at Level 1, and multivariate normally distributed with a mean of zero and a full covariance matrix τ . Time was zero-centered around age 15. Level 2 variables were entered in the model uncentered; delay of gratification was dummy-coded such that the intercept represents the reference group (non-delayers), and social support and self-control, being standardized composites, were already centered around a grand mean of 0 with a standard deviation of 1.