

Online Supplement for:

The Far-Reaching Effects of Believing People Can Change:

Implicit Theories of Personality Shape

Stress, Health, and Achievement During Adolescence

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Overview

This online supplement contains the following information:

- Procedural details for the Cyberball experience of social exclusion (see Figure S1).
- Exact survey items asked for all studies.
- Detail about the intervention procedures and content.
- Descriptions of the measures and results for students' responses to a hypothetical conflict, administered on Study 2's end-of-year survey to assess long-term effects of the intervention on interpretations of social adversity.
- Exploratory analyses of additional LIWC categories in Study 3.
- Tables S1 and S2, which report non-significant differences between experimental conditions at baseline.
- Tables S3 – S5, which report OLS regression results with and without covariates for Studies 1-3, respectively.
- Figures S2-S3: Covariate-adjusted and raw means for intervention effect on grades.

Detail on Methods Used in Studies 1, 2, and 3

Procedure. For this survey (and for all self-report data collected for this paper), data were collected simultaneously for an intact class but cardboard dividers were placed around computer stations to provide privacy.

Experience of social exclusion. Students were asked to come to the computer lab to purportedly test out and provide opinions about a new visualization task developed by university researchers. As noted in the manuscript, the “Cyberball” paradigm was a method to elicit temporary social stress— (Williams & Jarvis, 2006). The stress appraisal questions followed the first two questions on the post-Cyberball survey; the first question asked respondents how many

times they were thrown the ball, as a manipulation check (over 98% of respondents wrote that they received the ball only a few times, i.e., less than 5) and the second question (to bolster the credibility of the task) asked respondents to write a few words describing what they “visualized” during the game of Cyberball.

In order to code suspicion that the Cyberball experience was not real, we asked students to write a note to send to their Cyberball partners. This question had a second purpose of allowing for a manipulation check to ensure that, on average, the ostracism was functioning as intended. We found that the large proportions wrote responses consistent with ostracism. Here are some examples: “Nice joke, making sure I don't get the ball! Don't worry, I'm not sad or mad... just laughing inside...;” “you could of passed to ball to me !;” “Why didn't you guys pass me the ball i wanted to play to;” “i dont think it was fair that i didnt get to play. they threw the ball to me maybe 3 times and that was it. i also think that thye did it on purpose to make somebody else feel left out;” or “pass the ball.”

The manuscript states that immediately following the exclusion experience, participants were told that there was a computer glitch that caused them to be excluded, and then participants played a second time, during which they were fully included. A screenshot from the “glitch” pop-up is presented in Figure S1.

Measures.

Implicit theories of personality. The four items used in previous research to assess adolescents’ implicit theories of personality (Yeager et al., 2011) were: “Bullies and victims are types of people who really can’t be changed;” “There are two kinds of people: Bullies and their victims,” “You can’t change people who are jerks in schools,” “Some people are just jerks, and

not much can be done to change them” (1 = *Strongly disagree*, 2 = *Disagree*, 3 = *Mostly disagree*, 4 = *Mostly agree*, 5 = *Agree*, 6 = *Strongly agree*).

Global psychological stress. The 10-item Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) is a commonly-used and well-validated measure of global stress, defined as the general sense that the demands in one’s environment are greater than one’s ability to cope with them. It asks participant to rate their responses to this set of questions:

- In the last month, how often have you been upset because of something that happened unexpectedly?
- In the last month, how often have you felt that you were unable to control the important things in your life?
- In the last month, how often have you felt "stressed"?
- In the last month, how often have you felt confident about your ability to handle your personal problems? (R)
- In the last month, how often have you felt that things were going your way? (R)
- In the last month, how often have you found that you could not cope with all the things that you had to do?
- In the last month, how often have you been able to control irritations in your life? (R)
- In the last month, how often have you felt that you were on top of things? (R)
- In the last month, how often have you been angered because of things that were outside your control?
- In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Responses are given on a five-point scale (1 = *Never*, 2 = *Almost never*, 3 = *Sometimes*, 4 =

Fairly often, 5 = *Very often*). Following standard practice (Cohen et al., 1983), responses to these items were summed.

Physical Health. Participants indicated whether they had or had not experienced symptoms of physical illness that might have prevented them from engaging in their daily work. Specifically, they were prompted “During the past 4 weeks, have you had any of the following problems with your school work or other regular daily activities because you felt sick, tired, or in pain?” and then they said “Yes” or “No” to three items about how their health affected their schoolwork. These items were summed (1 = *Yes*, 0 = *No*) to create a composite.

Detail on the Experimental Intervention

The structure and content of the incremental theory of personality intervention was modeled on the six-session workshop tested and described by Yeager et al. (2013). In the third week of school, students were told that university researchers would be coming into their classroom to ask for their help in improving some messages to deliver to next year’s high school freshmen. On the day of the intervention, researchers told students that because they were currently going through the transition to high school, they were in the best position to provide guidance to next year’s students about what that is like. Researchers then told students about something called a “growth mindset” that they hoped to teach to next year’s students and that they, the students, could help by first reading scientific information about the growth mindset and then writing a note explaining how someone could use the mindset. Next, researchers handed out envelopes containing a paper copy of either an experimental intervention or a control activity (in Study 2) or took students to the school’s computer lab (in Study 3). Experimental and control exercises were formatted identically (similar clip art, font, and amount of text on a page) so that students would not suspect that another person was completing a different writing

exercise. Both exercises discussed “the growth mindset” and the ability for growth and change, again to minimize the possibility that students would suspect that they had completed different activities. Importantly, the Algebra teachers were kept blind to study hypotheses, message content and students’ experimental conditions, and other teachers (whose grades were also part of the dependent variable) were not informed that students had participated in the experiment (and hence were also blind to condition and message content).

As noted in the manuscript, the experimental activity first presented scientific information in support of the idea that people have the potential to change. This involved reading a scientific article showing that people’s behaviors are controlled by “thoughts and feelings in their brains,” and that such pathways in the brain can be changed. To provide students with a reason to read the article, the intervention stated:

Below is an article reproduced from a popular magazine called *Psychology Today*, and it was published this year. It summarizes some scientific research on the “growth mindset.” We need your help picking out the most important points for students like you. Your assignment is to read the article and then summarize the three most important things that a student like you would need to know in order to use the growth mindset.

To build interest, the article began with a brief anecdote (based on what a teen who participated in our pilot studies said) about a person who ran into an old friend from high school, who talked how the growth mindset was helpful during freshman year. The teen in the anecdote said:

Not everybody is stuck on one personality; over time, people can change through practice and when their brain makes new connections.

Next, the article summarized what researchers say about the science underlying the “Growth Mindset.” For instance, the article began as follows:

People's personalities live in their brains, and the brain can be changed.

I first read the research of Dr. Daniel Lawrence from Stanford University. I learned that people don't do things because of some label that people use to describe them. They do things because of the thoughts and feelings that they have—thoughts and feelings that live in the brain, and that can be changed.

When you have a thought or a feeling, the pathways of neurons in your brain send signals to other parts of your brain that lead you to do a behavior. By changing these pathways, you can actually change and improve how you behave after challenges and setbacks.

Everyone's brain is a "work in progress!"

The article then went on to summarize the findings of actual research studies that documented people's ability to change.

After participants read and summarized the content in this article, they were asked to help communicate these ideas to future students, after reading the comments that previous students had made about them. That is, first the document told participants that researchers had recently completed a survey on campus about the growth mindset, and they were asked to read three example quotes that upperclassmen had written. Each of these quotes involved a disclosure of a time the upperclassman felt excluded or left out, followed by statements that during that time they remembered that people can change—both they and the people who are doing bad things to them. For instance, one quote about the first month of high school (taken from an actual interview with a student when piloting the intervention) stated:

Some people in school began treating their friends, including me, in a way that showed we weren't as close or we were belittled or not important anymore. We are excluded and ignored. This morning I was walking by and all the person could do was act as if I

weren't there. Seeing them and they just look you in the face without a hi or smile used to make me feel invisible...

But I realized that it's probably not about me... Maybe they are acting different because they are going through some drama that's making them act this way. They could be insecure so they need to make themselves feel better by making me feel bad. People do things because of their thoughts and feelings, not because they have a trait that makes them good or bad. And thoughts and feelings change all the time.

Next, participants were asked to write their own version of such a narrative, drawing on the examples they had just read and on their own experiences in high school or middle school, to share with future ninth graders. As in the Yeager et al. (2013) intervention, the design of this final activity drew on a long line of research on persuasion, particularly the "saying-is-believing" or "self-persuasion" technique (E. Aronson, 1999). Using this method, even brief encounters with a novel message have resulted in long-term changes in important behaviors (e.g., E. Aronson, 1999; J. Aronson et al., 2002; Walton & Cohen, 2011). Note that students' notes were in fact shared with future students.

The control group activity was parallel but focused on malleability in a non-relevant but important domain (athletic ability), to, as noted in the paper, eliminate the possibility that simple optimism about the potential for growth in any domain might account for our results. Analogous to the experimental intervention, this activity involved reading a scientific summary of evidence that athletic talent is malleable, followed by quotes from upperclassmen endorsing it, and then a self-persuasion exercise in which participants wrote mentoring notes to a future student echoing that sentiment. Hence, both conditions involved information that peers endorsed a growth message and a prosocial activity of sharing that information to help others; in this way, the only

difference between conditions was whether the intervention addressed the malleability of personality. Hence, our optimistic, positive control group provided a good test of our hypothesis.

Effect of the Intervention on Year-End Interpretations of Social Adversity in Study 2

Measure. Study 2 also examined whether the intervention created an internalized change in how students interpreted social adversities. As an initial test of this idea we measured year-end interpretations of a hypothetical conflict. Analyses of other responses to this scenario using this data—but not these exact dependent variables—are reported in another manuscript (Yeager, Miu, Powers, & Dweck, 2013). On the year-end survey, participants first read this scenario:

Imagine that you were walking in a crowded hallway at school and everybody was rushing to get to the next class so they wouldn't be late. While you were looking the other way, you and another student bumped into each other (pretty hard), so it hurt your shoulder and you dropped the books that you were carrying. The other student paused briefly, looked at you quickly, and then turned away and hurried to class.

Previous research has found that an entity theory is related to characterological attributions about the peer in a conflict and to hatred of that peer, and that each of these can predict more extreme responses to a conflict, such as vengeance (Yeager et al., 2011). Therefore, in the present research, to assess long-term effects of the incremental theory intervention on interpretations of social adversity, two items then measured characterological attributions about the peer (specifically, how much the adolescent thought “They are bad people” and “They are nice people” [reverse-scored]) and one item assessed how much they would feel the emotion of “hatred.” Each item was rated on a seven-point scale (1 = *Not at all*, 2 = *A little*, 3 = *Somewhat*, 4 = *A moderate amount*, 5 = *A lot*, 6 = *A great deal*, 7 = *An extreme amount*). Responses were combined into a composite by taking their unweighted average. Self-reported

stress and anxiety following this hypothetical scenario was not measured, unfortunately, but these attributional and emotional measures provide a sense of whether the intervention changed students' enduring interpretations of social adversity. (This measure was not administered on the Study 3 year-end survey).

Results. In Study 2, on the end-of-year survey, adolescents receiving the incremental theory intervention showed less harsh interpretations of a peer conflict (i.e., lower scores on the attribution and emotional composite), Control $M = 3.29$, $SD = 0.92$, Experimental $M = 2.82$, $SD = 0.87$, $t(76) = -2.45$, $p = .02$, $d = .36$, suggesting their interpretations of social adversity continued to be altered at the end of the year.

Exploratory Analyses of Additional LIWC Categories in Study 3

Here we report exploratory analyses of additional LIWC categories (Pennebaker, Booth, & Francis, 2007). First, we examined the use of *discrepant thinking* (e.g., *would*, *could*, *should*) as an index of whether adolescents wrote self-descriptions that dwelled on how their current self was not ideal—an index of a lack of satisfaction with the self. An example of a self-description that included discrepant words was “I'm not exactly sure, I'm not friends with the majority of people. Matter of fact, most people would consider me an acquaintance and I prefer to keep it that way” or “They think nobody cares and we all want too fail... because we all assume an education isn't needed.” Overall very few students used discrepant thinking in their self-descriptions in May (*should*, *would could*); however, those that did were marginally significantly more likely to be in the control condition than the incremental theory intervention condition (7% vs. 1%), $\chi^2(1) = 3.38$, $p = .07$. There were no significant differences at baseline, $\chi^2(1) = 0.09$, $p = .76$. A number of studies have demonstrated the correlation of discrepant thinking with stress-related health problems, such as poorer immune functioning (for a review, see Pennebaker,

Mehl, & Niederhoffer, 2003). Indeed, in the present study discrepant words used in self-descriptions in May significantly predicted greater global stress in May, $r = .20, p = .01$. Thus a potentially useful avenue for future research could be to replicate this finding and extend it, perhaps using more extensive samples of student writing than the brief prompt utilized here.

Next, the incremental theory manipulation seems to have affected linguistic categories for which there are not immediately apparent theoretical interpretations. Treated individuals were marginally significantly more likely to use *impersonal pronouns* (*it, it's, those*) (37% vs. 23%), $\chi^2(1) = 2.94, p = .09$, and the *present tense* (*is, does, hear*) (64% vs. 77%), $\chi^2(1) = 2.64, p = .10$. Incremental theory participants were also significantly more likely to use words that referred to their bodies or to their *health* (*clinic, flu, pill*) (0% vs. 8%), $\chi^2(1) = 5.50, p = .02$. For all of the remaining LIWC categories, there were no significant long-term differences. Because these findings were not predicted and several did not reach the conventional threshold for statistical significance, they should be interpreted cautiously.

Table 1S. Effectiveness of Random Assignment in Study 2: Non-Significant Pre-intervention Differences Between Conditions

Preintervention variable	Control <i>M</i>	Experimental <i>M</i>	Test statistic	p =
% Female	46%	54%	$\chi^2(1) = 0.46$	.50
% White	54%	41%	$\chi^2(1) = 2.65$	.27
% Latino	5%	14%	$\chi^2(1) = 1.69$	.19
% Mother has a college degree	72%	73%	$\chi^2(1) = 4.71$	.45
% English is the primary language spoken in the home	67%	63%	$\chi^2(1) = 0.09$	.77
Average 8th grade achievement ¹	2.82	2.83	$t(76) = 0.07$	.94
Entity theory of personality	2.56	2.8	$t(76) = -1.03$	.31
Frequency of peer exclusion / victimization ⁴	2.16	1.95	$t(76) = 1.02$	.31
<i>N</i>	37	41		

Note: ¹ To gain precision, preintervention achievement is an average of grade 8 Math/English grade point average and Math/English California Standards Test scores (the latter was re-scaled to have same mean and standard deviation as grade 8 grade point average).

Table 2S. Effectiveness of Random Assignment in Study 3: Non-Significant Pre-intervention Differences Between Conditions

Preintervention variable	Control <i>M</i>	Experimental <i>M</i>	Test statistic	p =
% Female	51%	47%	$\chi^2(1) = 0.16$	.69
% White	5%	10%	$\chi^2(1) = 1.27$	.25
% Latino	79%	79%	$\chi^2(1) = .005$	.94
% English is the primary language spoken in the home	40%	38%	$\chi^2(1) = 0.04$	.83
Average 8th grade achievement ¹	1.82	1.82	$t(153) = 0.08$	.94
Among baseline entity theorists (>3.5 on entity theory scale)	1.68	1.70	$t(45) = .13$	.90
Among baseline incremental theorists (≤ 3.5 on entity theory scale)	1.92	1.93	$t(102) = 0.16$	.88
Entity theory of personality	3.13	3.12	$t(149) = -0.17$	.87
Frequency of peer exclusion / victimization ⁴	1.55	1.6	$t(150) = 0.46$	.64
<i>N</i>	83	84		

Note: Mother's education was not measured in this study and so we could not assess differences across experimental groups. ¹ To gain precision, preintervention achievement is an average of grade 8 Math/English grade point average and Math/English California Standards Test scores (the latter was re-scaled to have same mean and standard deviation as grade 8 grade point average).

Table S3. Study 1 Results: Regression Models Predicting Outcomes, With and Without Covariates.

Predictor	Negative reactions to social exclusion (September)				Global psychological stress (May)				Physical illness (May)			
	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =
Intercept	-0.721 [-1.295 -0.147]	.01	-0.217 [-0.963 0.529]	.57	1.833 [1.470 2.195]	.00	2.546 [1.965 3.127]	.00	0.132 [-0.395 0.658]	.62	0.221 [-0.650 1.093]	.62
Entity theory of personality measure (September)	0.253 [0.050 0.456]	.02	0.220 [0.004 0.401]	.01	0.306 [0.179 0.433]	.00	0.302 [0.158 0.408]	.00	0.291 [0.091 0.491]	.01	0.306 [0.122 0.522]	.00
Latino			-0.166 [-0.550 0.218]	.39			0.05 [-0.261 0.361]	.75			-0.045 [-0.564 0.474]	.86
White			0.046 [-0.284 0.377]	.78			-0.017 [-0.269 0.234]	.89			-0.032 [-0.420 0.356]	.87
Sex			-0.252 [-0.576 0.073]	.13			-0.428 [-0.669 -0.186]	.00			-0.091 [-0.481 0.299]	.65
Adjusted R ²	0.048		0.029		0.117		0.154		0.044		0.034	
AIC	386.963		385.218		335.594		325.636		465.17		466.791	
<i>N</i>	153		150		145		144		146		145	

Note: *b* = unstandardized regression coefficient. All models also control for baseline values of outcome variables.

Table S4. Study 2 Results: Regression Models Predicting Outcomes, With and Without Covariates.

Predictor	Negative reactions to social exclusion (September)				Global psychological stress (May)				Physical illness (May)			
	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =
Intercept	0.267 [-0.037 0.570]	.08	0.411 [-0.037 0.859]	.07	3.205 [3.003 3.408]	.00	3.249 [2.954 3.544]	.00	1.757 [1.330 2.183]	.00	1.876 [1.317 2.435]	.00
Incremental theory of personality intervention (September)	-0.488 [-0.919 -0.056]	.03	-0.502 [-0.949 -0.055]	.03	-0.342 [-0.635 -0.049]	.02	-0.37 [-0.660 -0.081]	.01	-0.562 [-1.127 0.004]	.05	-0.576 [-1.141 -0.011]	.04
Latino			-0.366 [-1.072 0.341]	.31			0.043 [-0.538 0.623]	.88			0.271 [-0.638 1.180]	.55
White			-0.354 [-0.826 0.117]	.14			-0.171 [-0.481 0.139]	.28			-0.218 [-0.786 0.350]	.45
Sex			0.115 [-0.313 0.544]	.59			0.092 [-0.200 0.385]	.53			-0.1 [-0.657 0.457]	.72
Adjusted R2	0.05		0.044		0.052		0.033		0.036		0.005	
AIC	209.291		209.08		160.434		163.499		261.764		263.267	
<i>N</i>	75		74		78		77		78		77	

Note: *b* = unstandardized regression coefficient. Baseline values for outcomes variables were unavailable in this study and so models could control for them.

Table S5. Study 3 Results: Regression Models Predicting Outcomes, With and Without Covariates.

Predictor	Negative reactions to social exclusion (September)				Global psychological stress (May)				Physical illness (May)			
	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =	<i>b</i> [95% CI]	p =
Intercept	0.077 [-0.142 0.295]	.49	0.912 [0.059 1.766]	.04	2.91 [2.756 3.064]	.00	3.646 [3.078 4.214]	.00	1.427 [1.155 1.698]	.00	2.384 [1.318 3.451]	.00
Incremental theory of personality intervention (September)	-0.297 [-0.607 0.012]	.06	-0.317 [-0.626 -0.008]	.05	-0.228 [-0.436 -0.021]	.03	-0.231 [-0.444 -0.018]	.03	-0.536 [-0.901 -0.171]	.00	-0.454 [-0.828 -0.081]	.01
Latino			-0.148 [-0.467 0.171]	.36			0.078 [-0.220 0.376]	.61			0.055 [-0.422 0.532]	.82
White			-0.383 [-1.001 0.235]	.22			-0.328 [-0.542 -0.114]	.00			-0.444 [-0.815 -0.073]	.02
Sex			-0.291 [-0.601 0.018]	.07			0.308 [-0.155 0.771]	.19			0.695 [-0.050 1.440]	.07
Adjusted R ²	0.02		0.034		0.025		0.074		0.047		0.059	
AIC	328.517		328.673		281.513		265.204		460.994		467.685	
<i>N</i>	125		125		144		135		148		147	

Note: *b* = unstandardized regression coefficient. All models also control for baseline values of outcome variables.

Figure S1. Screenshot From Cyberball “Glitch” Message, Designed to Alleviate the Immediate Negative Affect of the Exclusion Experience.

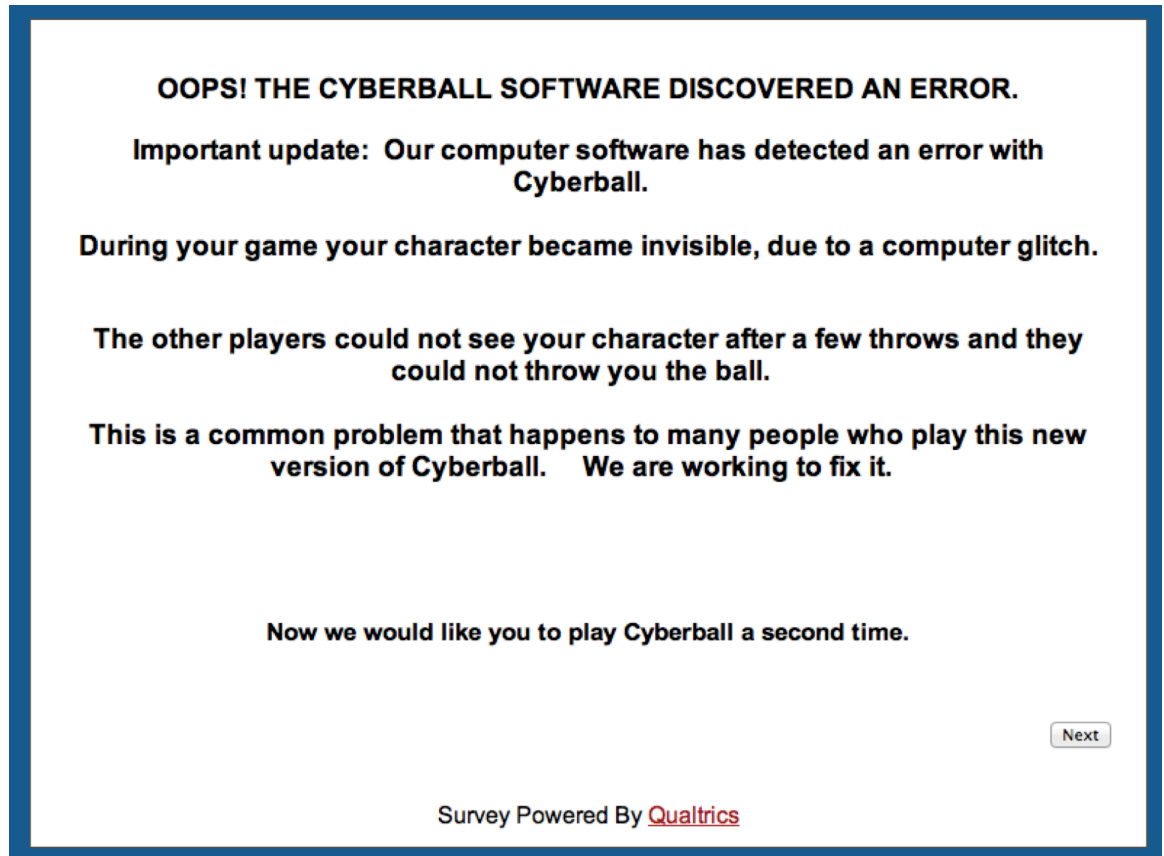


Figure S2. Intervention Effect on Grades in Study 2: Covariate-adjusted Means, Effect Sizes (Cohen’s *d*), and *p*-values. Note: statistical tests are from separate regression models at each measurement occasion controlling for covariates noted in the text.

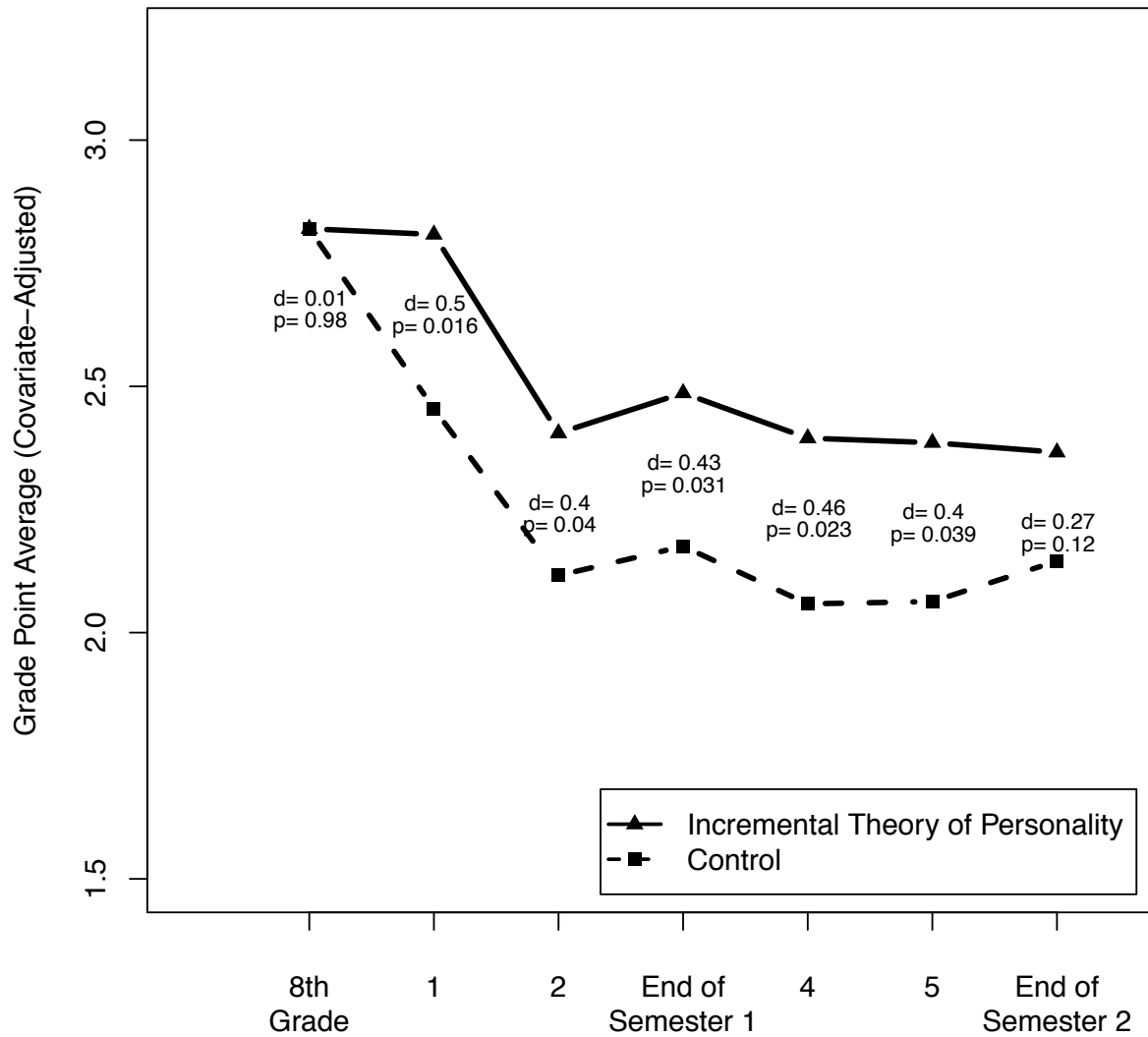


Figure S3. Intervention Effect on Grades in Study 2: Raw Means, Effect Sizes (Cohen’s *d*), and *p*-values. Note: Models with no covariates. Statistical tests are independent-sample t-tests at each measurement occasion.

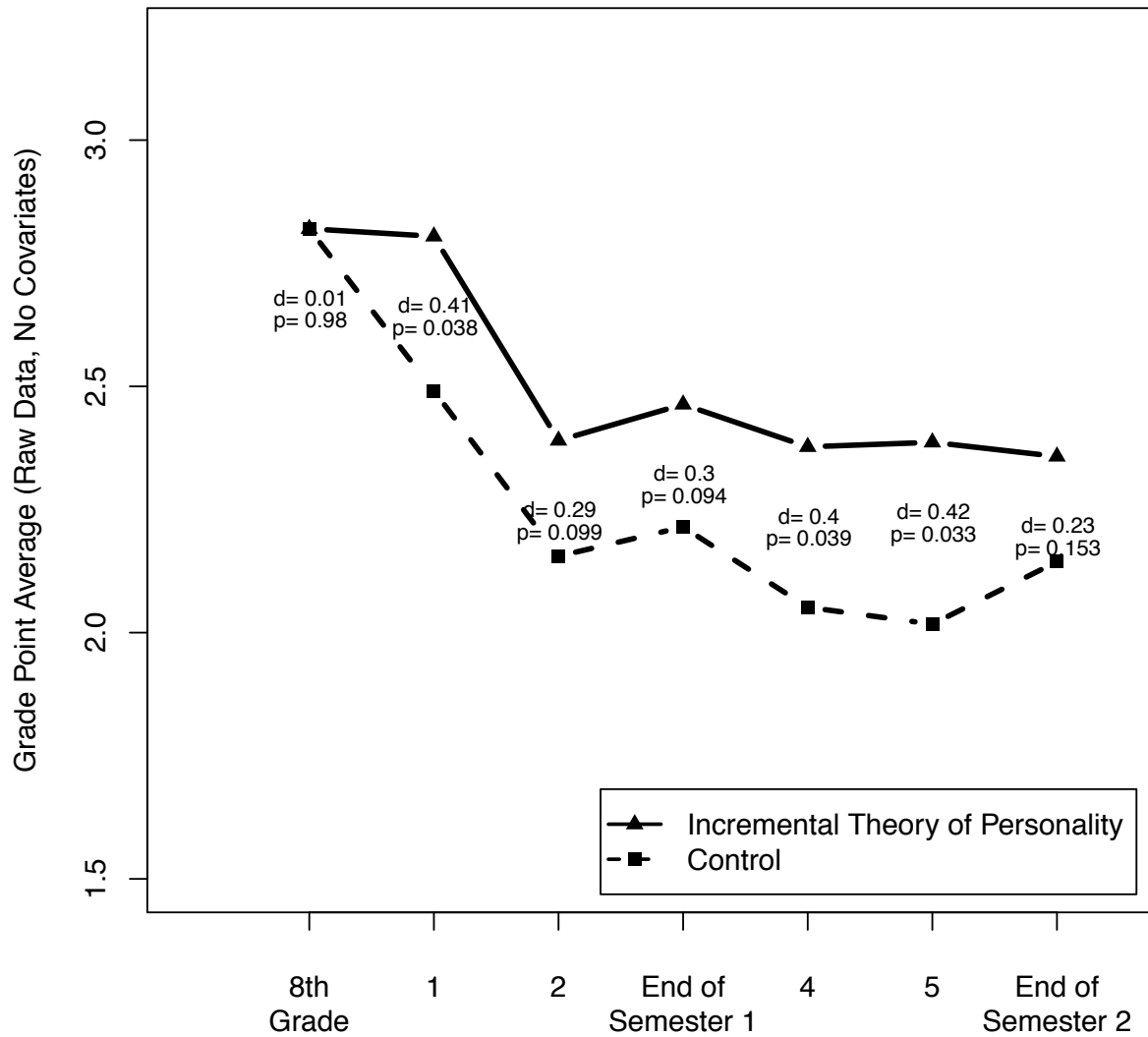


Figure S4. Effect of incremental theory of personality intervention on academic performance across the transition to high school, only among those with an entity theory at baseline (Study 3). Lines represent raw means for a given marking period, drawn with a loess smoothing curve. Eighth grade performance is a composite of grade point average and state test scores (with test scores re-scaled to have the same mean and standard deviation of the 8th grade point average). Only includes data from the sub-sample of 45 students with an entity theory at baseline.

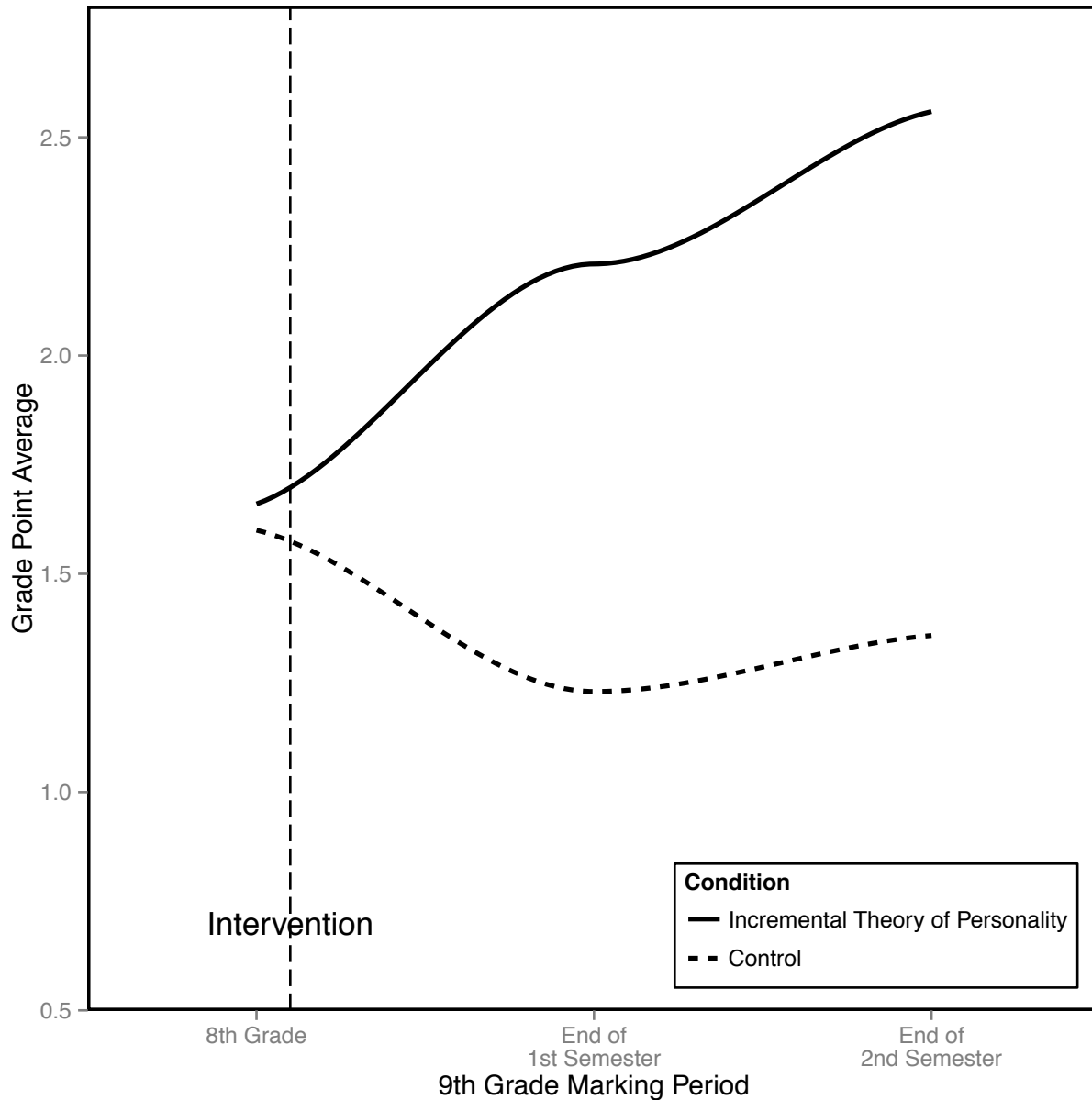


Figure S5. Intervention Effect on Grades in Study 3: Covariate-adjusted Means, Effect Sizes (Cohen’s *d*), and *p*-values. Note: statistical tests are from separate regression models at each measurement occasion controlling for covariates noted in the text. Only includes data from the sub-sample of 40 students with an entity theory at baseline and data on covariates.

