Know when to fold 'em

Larbi Alaoui and Christian Fons-Rosen

Universitat Pompeu Fabra

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- But words like stubbornness, obstinacy and bullheadedness all have a much more negative connotation.
- **Upside** of not giving up... **downside** of not letting go.

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- Use the individual's own ex-ante preferences, or plan of action, as the metric.
- Compare it to actual ex-post behavior.
- Measure grit (Duckworth scale).
- Hypothesis: Grittier subjects find it harder to let go when losing, and are therefore more likely to overplay.

Motivation

- Conduct an experiment using a game of chance (shutting down ability component).
- Setting where the temptation to go below the established plan (and losing more) is well-defined and can be drawn out in a short experiment.
- Consistent with our hypothesis, grittier subjects are more likely to overplay.

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- Tenacity (stubbornness) captures the aspect of not letting go.
- Hence, tenacity alone, not diligence should capture overplaying.
- Our findings are consistent with this view: only tenacity drives overplaying in the regressions.

External validity of decomposition

- External validity: two different datasets, with measures of educational performance.
- Diligence always positive indicator of education, tenacity usually positive but more ambiguous.
- One dataset includes conscientiousness, which correlates with both tenacity and diligence.
- Results may carry through to conscientiousness to some extent (future research).

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- Consistent with our hypothesis, grittier subjects overplay more, using the individual's own ex-ante preferences as the benchmark.
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- Find that only tenacity explains overplaying.
- New categorization predicts other outcome measures in our experiment and in two different datasets.
- Diligence always positive, tenacity more ambiguous.
- Our mechanism can be used to think of different sides of tenacity in other settings (e.g. disposition effect, settings with loss aversion).
- Experimental design itself: useful domain of potential dynamic inconsistency in a short experiment (at least 30% of subjects overplay).

Game of chance: roulette game

- Main game: a simplified roulette wheel.
- First ask the subjects for the plan of action:

  If they had 2000 tokens (20 euros), what is the minimum limit (and maximum) that they wouldn't surpass.

Game of chance: roulette game

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- http://experimentalgames.upf.edu/roulette/

Grit Questions

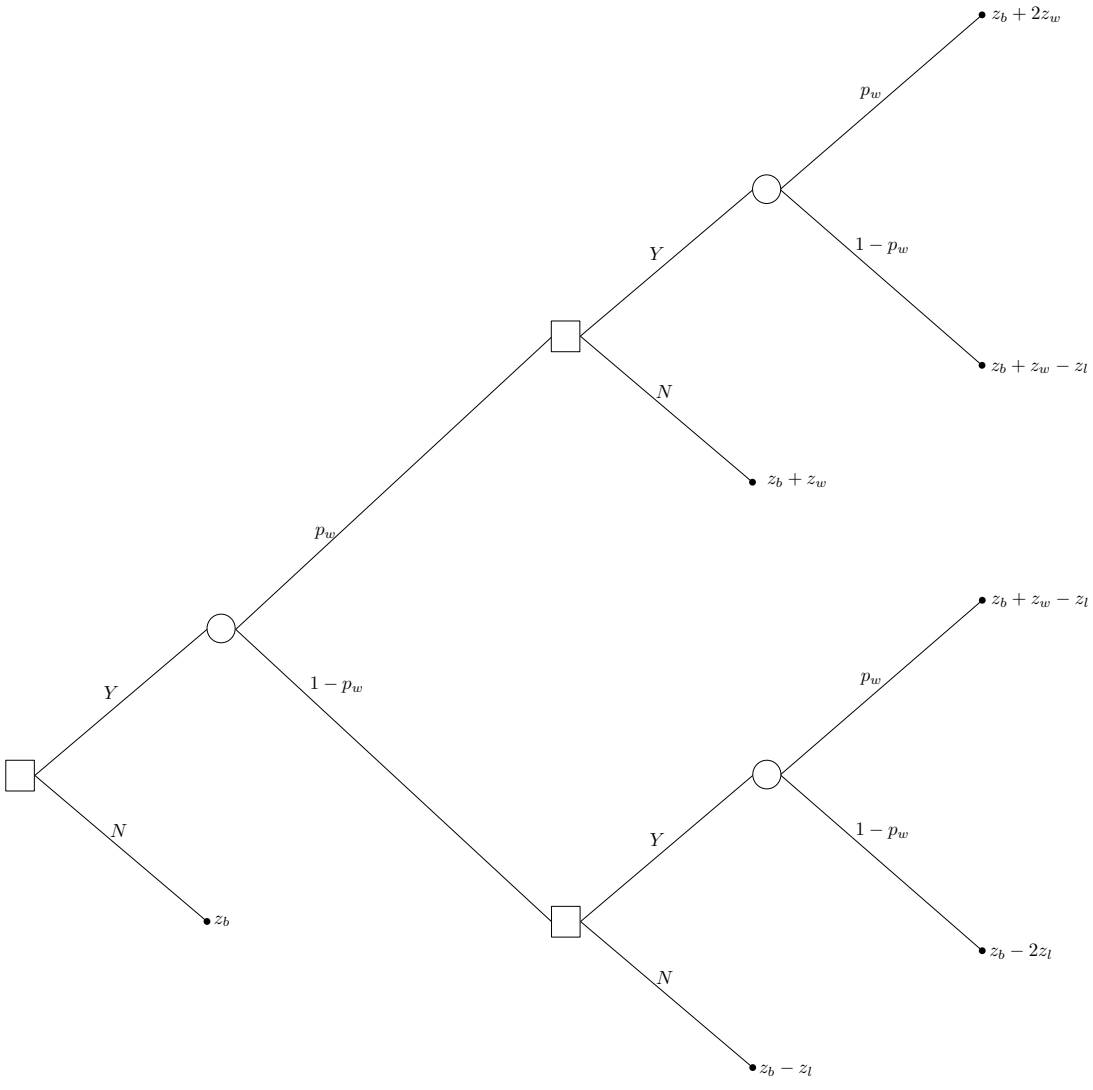
- Sample tenacity questions:

  To what extent do you agree with the following statement:
  - Setbacks don't discourage me.
  - I finish whatever I begin.

- Sample diligence questions:

  To what extent do you agree with the following statement:
  - I am diligent.
  - I am a hard worker.

Model: graphical illustration

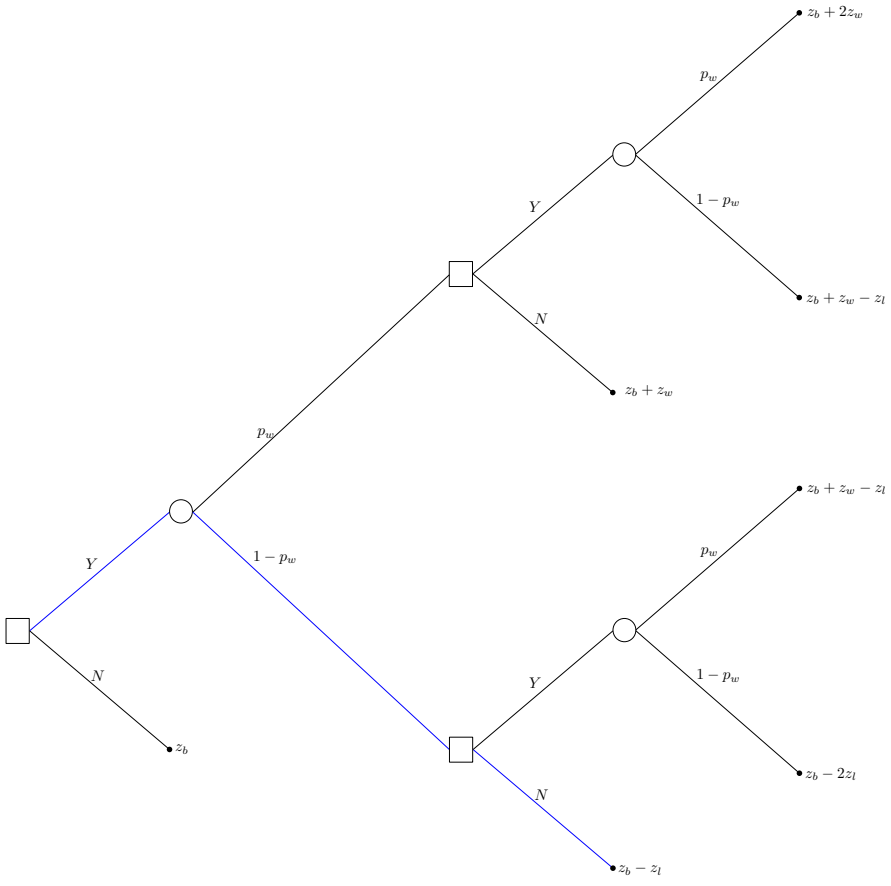


Model: key assumptions

- Suppose grit consists of tenacity and diligence, $G = (T, D)$.
- **Assumptions: Tenacity and Failure**
  (1) When the agent is losing and decides between playing more and stopping, with some probability $q_f(T) \in [0, 1]$ he incurs a cost of failing $c_f > 0$.

  (2) Probability q_f is higher for higher tenacity.
- Reference for losing: being below z_b.

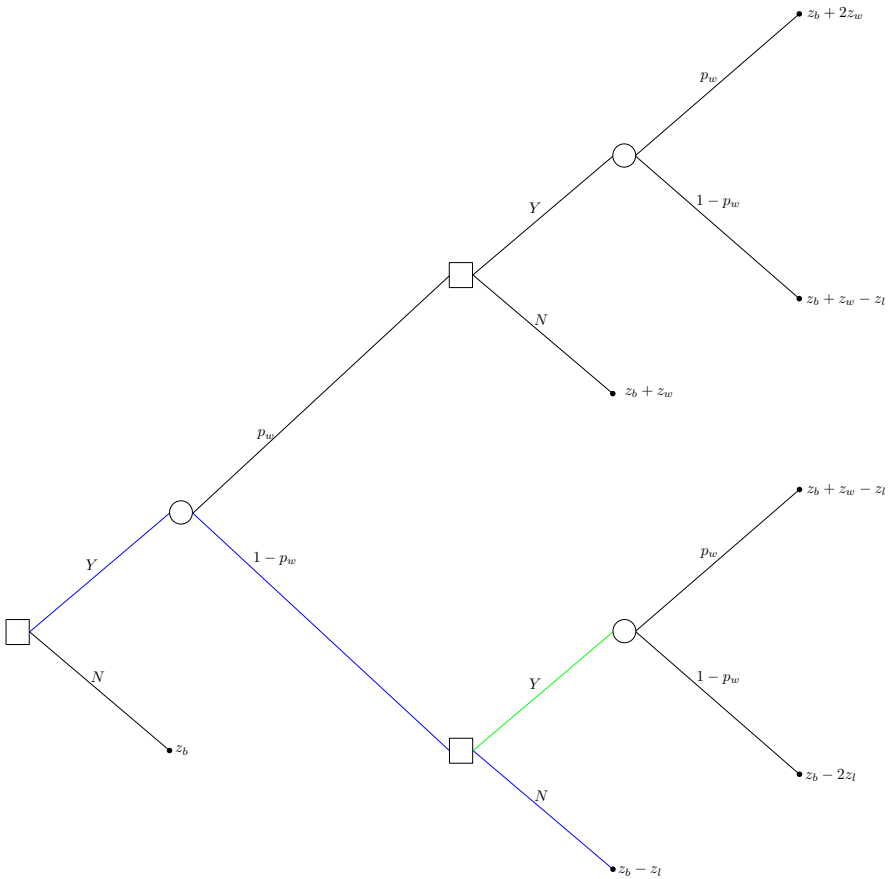
Model: graphical illustration



After the first loss:

- Plan of action: stop (N)

Model: graphical illustration



After the first loss:

- Plan of action: stop (N)
- Behavior: higher T, higher likelihood to continue (Y).

Model: main predictions for the experiment

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  (1) The probability of overplaying increases in the Tenacity Index.

  (2) This probability does not change in the Diligence Index, except through its possible correlation with the Tenacity Index.

  (3) This probability increases in the Grit Index.

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- Note:
  - Potential relation between higher tenacity and higher disposition effect or loss aversion.
  - In settings similar to ours, this mechanism bring out tenacity's **downside**. In others, it can lead to tenacity's **upside**.

Descriptive Statistics

Table: Descriptive statistics - Correlations with Grit, Tenacity and Diligence

Variable	Correlation with:		
	Grit Index	Tenacity Index	Diligence Index
Overplaying	.29	.33	.16
Plan of Action	.06	.07	.02
Locus Index	-.19	-.19	-.14
Age	.16	.16	.11
Female	.07	.07	.04
Technical Degree	.08	.00	.17
Self-esteem	.32	.24	.33
Procrastination	-.45	-.35	-.45
Temptation	-.36	-.30	-.34

Results: baseline regressions

Table: Baseline regressions

Dep.Var.: Overplaying	(1)	(2)	(3)	(4)	(5)
Grit Index	0.259***	0.248***	0.237***	0.248***	0.260***
	(0.072)	(0.070)	(0.071)	(0.070)	(0.071)
Plan of Action		0.067***	0.068***	0.072***	0.074***
		(0.013)	(0.013)	(0.014)	(0.014)
ln(Age)			0.236	0.154	0.076
			(0.274)	(0.267)	(0.262)
D(Female)				-0.124	-0.156*
				(0.080)	(0.082)
Technical Degree					-0.095
					(0.080)
Observations	138	138	138	138	138
R-squared	0.087	0.145	0.150	0.165	0.174

Results: tenacity and diligence split

Table: Splitting Grit Index into tenacity and diligence

Dep. Var.: Overplaying	(1)	(2)	(3) Technical	(4) Non-technical	(5) Female	(6) Male	(7) >100
Tenacity Index	0.298***	0.278***	0.237**	0.371***	0.280***	0.313***	0.227***
	(0.074)	(0.068)	(0.091)	(0.096)	(0.095)	(0.096)	(0.073)
Diligence Index	-0.028	-0.011	-0.033	-0.058	0.042	-0.107	-0.017
	(0.073)	(0.071)	(0.108)	(0.098)	(0.092)	(0.104)	(0.075)
Plan of Action		0.071***	0.057***	0.093***	0.068**	0.063***	0.077***
		(0.013)	(0.015)	(0.030)	(0.030)	(0.018)	(0.013)
ln(Age)		0.086	-0.494	0.637**	-0.357	0.519*	0.104
		(0.274)	(0.437)	(0.261)	(0.390)	(0.277)	(0.265)
D(Female)		-0.150*					-0.180**
		(0.081)					(0.082)
Technical Degree		-0.068					-0.088
		(0.083)					(0.084)
Observations	138	138	71	67	80	58	128
R-squared	0.112	0.192	0.136	0.280	0.167	0.250	0.186

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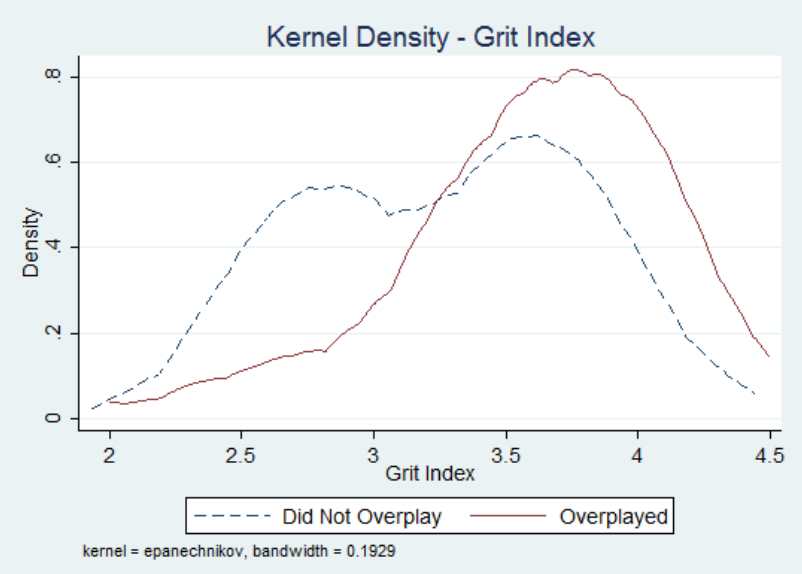

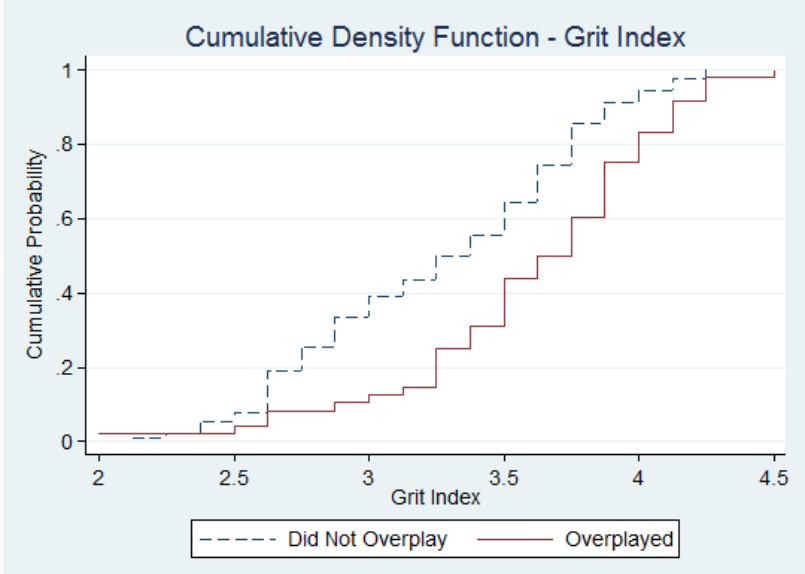

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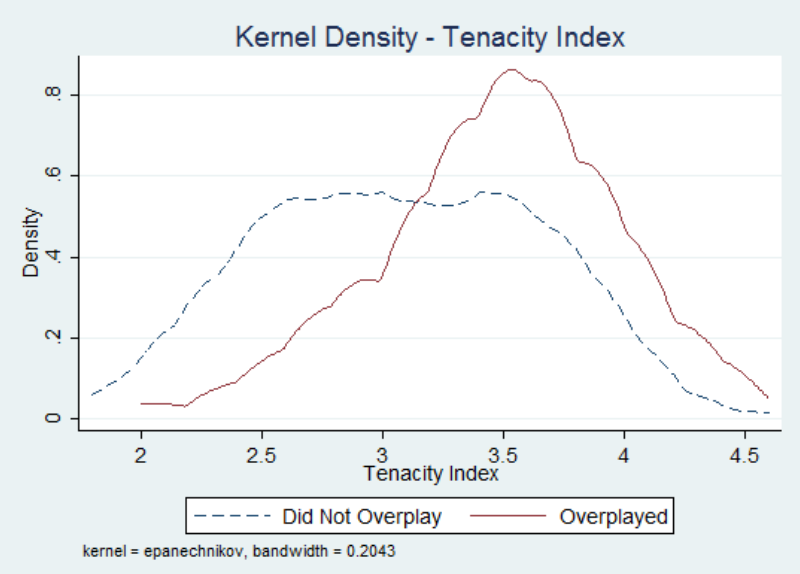

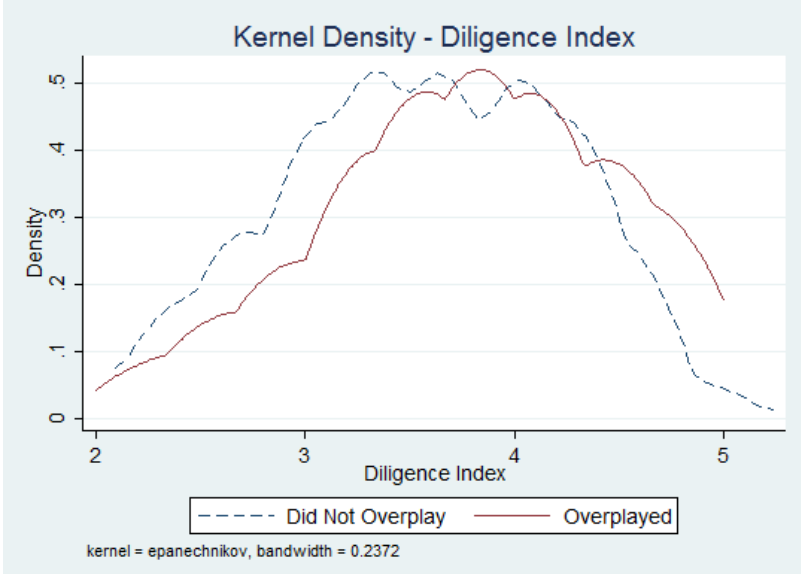

Results: procrastination and temptation

- Consider the relation between the tenacity and diligence split and self-reported procrastination and temptation.
- A hypothesis on the role of tenacity would require additional assumptions.
- Conjecture that diligence associates with less temptation and procrastination problems.

Results: procrastination and temptation

Table: Post-questions on procrastination and temptation

Dep.Var.:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Procrastination				Temptation			
Grit Index	-0.660***				-0.570***			
	(0.141)				(0.130)			
Tenacity Index		-0.497***		-0.217		-0.454***		-0.249
		(0.150)		(0.184)		(0.131)		(0.162)
Diligence Index			-0.525***	-0.427***			-0.425***	-0.311**
			(0.096)	(0.128)			(0.110)	(0.136)
Observations	118	118	118	118	118	118	118	118
R-squared	0.198	0.125	0.201	0.218	0.129	0.091	0.115	0.134

Summary of Experimental Results

- Grittier subjects more likely to overplay.
- Decomposing grit into tenacity and diligence, only tenacity captures overplaying, consistent with our hypothesis.
- Looking at (self-reported) procrastination and temptation:
  - diligence relates to less procrastination and temptation
  - tenacity more ambiguous.

External validity

- How does our novel decomposition of grit into tenacity and diligence fare with educational measures of performance?
- Use two different datasets:
  - ICPSR school survey: Part of the Measures of Effective Teaching (MET) Project, includes data between 2009 and 2011 across 6 US school districts
  - Online psychology survey

External validity 1 (ICPSR survey)

Table: ICPSR - Effect of Grit on Education

Dep. Var.:	(1)	(2)	(3)	(4)	(5)	(6)
Test Scores	ACT	ACT	SAT9	SAT9	Maths	Maths
Grit Index	1.641***		7.993***		0.166***	
	(0.175)		(0.774)		(0.009)	
Diligence Index		1.079***		3.746***		0.066***
		(0.167)		(0.718)		(0.008)
Tenacity Index		0.540***		4.244***		0.099***
		(0.193)		(0.795)		(0.009)
District FE	Y	Y	Y	Y	Y	Y
School FE	N	N	N	N	N	N
Gender Dummies	Y	Y	Y	Y	Y	Y
Age Control	Y	Y	Y	Y	Y	Y
Race Dummies	Y	Y	Y	Y	Y	Y
Additional Controls	Y	Y	Y	Y	Y	Y
Observations	4,551	4,551	4,625	4,625	14,465	14,465
R-squared	0.228	0.230	0.319	0.322	0.333	0.333

External validity 2 (online dataset)

Table: Online Survey - Relation between Grit and Conscientiousness

Dep. Var.: Conscientiousness	(1)	(2)	(3)	(4)	(5) US only	(6) US only
Grit Index	0.617***					
	(0.012)					
Diligence Index		0.382***	0.388***	0.377***	0.404***	0.386***
		(0.014)	(0.014)	(0.015)	(0.021)	(0.021)
Tenacity Index		0.235***	0.231***	0.228***	0.221***	0.222***
		(0.015)	(0.016)	(0.016)	(0.022)	(0.022)
ln(Age)				0.126***		0.119***
				(0.025)		(0.032)
Gender Dummies	N	N	N	Y	N	Y
Race Dummies	N	N	N	Y	N	Y
Urban Dummies	N	N	N	Y	N	Y
Country FE	N	N	Y	Y	N	N
Observations	3,988	3,988	3,951	3,951	2,014	2,014
R-squared	0.410	0.430	0.453	0.458	0.417	0.424

External validity 2 (online dataset)

Table: Online Survey - Effect of Grit/Conscientiousness on Education

Dep.Var.: Education	(1)	(2)	(3)	(4)	(5)	(6)
Conscientiousness Index	0.114***		0.102***	0.039*		0.027
	(0.025)		(0.025)	(0.021)		(0.021)
Grit Index	0.170***			0.078***		
	(0.024)			(0.019)		
Diligence Index		0.158***	0.118***		0.100***	0.089***
		(0.021)	(0.023)		(0.017)	(0.019)
Tenacity Index		0.083***	0.059**		0.004	-0.002
		(0.023)	(0.024)		(0.019)	(0.019)
Gender, Race, Urban FE	N	N	N	Y	Y	Y
Country FE	N	N	N	Y	Y	Y
Observations	3,988	3,988	3,988	3,951	3,951	3,951
R-squared	0.047	0.044	0.048	0.437	0.439	0.439

Next steps

- Understanding better the flipside of tenacity in other domains.

  Examples: CEOs, investors, firm managers, entrepreneurs, students.

- Social welfare.

- Link to the disposition effect and loss aversion.

- Link to overconfidence.

Grit: two distinct decompositions

	Perseverance	Consistency
Tenacity	*Setbacks don't discourage me.* *I finish whatever I begin.*	New ideas and projects sometimes distract me from previous ones. I have been obsessed with a certain idea or project for a short time but later lost interest. I often set a goal but later choose to pursue a different one.
Diligence	*I am diligent.* *I am a hard worker.*	I have difficulty maintaining my focus on projects that take more than a few months to complete.