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Data Science in Action

Does Aging Make Us Grittier? Disentangling the Age and Generation Effect on Passion and Perseverance

Shane Sanders[1,*], Nuwan Indika Millagaha Gedara[2,3], Bhavneet Walia[4], Christopher Boudreaux[5], and Merril Silverstein[6]

[1]*Professor of Sports Economics & Analytics, Falk College of Sport & Human Dynamics, Syracuse University; 316 MacNaughton Hall Syracuse University, Syracuse, NY 13244, USA*
[2]*Research Associate of Data Science, Kansas State University Olathe, Olathe, KS 66061-1304; 1DATA Consortium, www.1DATA.life, USA*
[3]*Department of Business Economics, University of Colombo, Sri Lanka*
[4]*Assistant Professor of Public Health, Falk College of Sport & Human Dynamics, Syracuse University, USA*
[5]*Associate Professor of Economics, College of Business, Florida Atlantic University, USA*
[6]*Marjorie Cantor Endowed Professor in Aging, Aging Studies Institute; Professor of Sociology and Human Development & Family Science, Maxwell School of Public Policy & Falk College of Sport & Human Dynamics, Syracuse University, USA*

Abstract

Defined as *perseverance and passion for long term goals*, *grit* represents an important psychological skill toward goal-attainment in academic and less-stylized settings. An outstanding issue of primary importance is whether age affects grit, *ceteris paribus*. The 12-item Grit-O Scale and the 8-item Grit-S Scale—from which grit scores are calculated—have not existed for a long period of time. Therefore, Duckworth (2016, p. 37) states in her book, *Grit: The Power and Passion of Perseverance*, that "we need a different kind of study" to distinguish between rival explanations that either generational cohort or age are more important in explaining variation in grit across individuals. Despite this clear data constraint, we obtain a glimpse into the future in the present study by using a within and between generational cohort age difference-in-difference approach. By specifying *generation* as a categorical variable and *age-in-generation* as a count variable in the same regression specifications, we are able to account for the effects of variation in age and generation simultaneously, while avoiding problems of multicollinearity that would hinder post-regression statistical inference. We conclude robust, significant evidence that the negative-parabolic shape of the grit-age profile is driven by generational variation and not by age variation. Our findings suggest that, absent a grit-mindset intervention, individual-level *grit* may be persistent over time.

Keywords *achievement; aging; difference-in-difference; grit; personality*

1 Introduction

Beginning with seminal studies by Duckworth et al. (2007) and Duckworth and Quinn (2009), a growing body of research has identified *grit*—defined as "perseverance and passion for long term goals" (Duckworth et al. 2007)—as an important psychological skill toward goal-attainment in

*Corresponding author. Email: sdsander@syr.edu.

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academic and less-stylized settings (see, e.g., Eskreis-Winkler et al. 2014, Duckworth 2016, or Crede et al. 2017 for later work). Grit captures the ability to persist in something passionately and persevere in the face of obstacles. Research has demonstrated that grit is distinct from other key goal-attainment psychological inputs such as IQ (see, e.g., Duckworth 2016).

Research on this psychological skill has recently expanded from psychology into the behavioral economics literature, given the effect of grit upon human capital formation, distribution of human capital levels across a population, and downstream outcome variables (e.g., economic output and income inequality). Alan et al. (2019), for example, find that grit is not simply a goal-attainment trait. Rather, it has properties of a psychological skill. Specifically, they find that individual-level grit survey scores change significantly following an early math learning intervention intended to teach individuals to be "gritty." In another behavioral economic study of grit, Mooradian et al. (2016) find that grit is positively related to entrepreneurial success, while Bettinger et al. (2018) and Kraft (2019) further show that grit and related psychological skills can be learned. Hence, grit can be viewed as a foundational skill capable of germinating other, more output-oriented, skills downstream. At the same time, there is strong evidence that grit, unlike some personality characteristics, is a malleable personality characteristic across the individual life cycle (Duckworth 2016).

An outstanding issue of primary importance in the grit literature is whether grit changes with aging, *ceteris paribus*. Duckworth and Quinn (2009) find that the relationship between age and Grit-S scores is positive and statistically significant *in cross-sectional data*. Yet, as the same authors mention, one may draw two conclusions from this result. First, individuals become grittier over time as they age, which is consistent with evidence that interests stabilize over time (Swanson, 1999) and with evidence that psychological maturity increases over one's life course (Roberts, Walton, & Viechtbauer 2006). Second, changes in culture (i.e., generational cohort effects) account for how grit increases with age. This second possibility is also consistent with evidence that birth cohort differences have been documented for several personality traits (Twenge, 2006). Given that the 12-item Grit-O Scale (Duckworth et al. 2007) and the 8-item Grit-S Scale (Duckworth and Quinn 2009)—from which grit scores are calculated—have not existed for a long period of time, Duckworth (2016) states that "we need a different kind of study" to distinguish between rival explanations that either generational cohort or age are more important in explaining variation in grit across individuals. Of course, Duckworth is correct in asserting that cross-sectional grit scale data is not ideal for this purpose. Rather, a panel data is best-suited to estimate the effect of age conditional upon generational cohort baselines. Duckworth (2016) further states that an ideally long panel data measuring grit scores has not yet had time to germinate.

Despite this clear data constraint, we use a within and between generational cohort age difference-in-difference approach to address this outstanding limitation. By specifying *generation* as a categorical variable and *age-in-generation* as a count variable in the same regression specifications, we are able to account for the effects of variation in age and generation simultaneously, while avoiding problems of multicollinearity that would hinder post-regression statistical inference. The *age-in-generation* variable works as follows: At the time of the observation, a subject is t years old *in generation* if her age minus the minimum age in her generational cohort at that time is t years. Other than the final generational cohort, which is naturally truncated, generations are 15 to 25 years in length. Therefore, the present approach allows for substantial age-related variation, while also conditioning on generational variation.

There is evidence from the previous literature that malleable personality traits can vary systematically with generational cohort (Twenge 2006; 2008; Twenge and Foster 2010), where

generational cohort influences individual personalities as a component of the individual's shared environment (e.g., through popular culture). Further, there is evidence that malleable personality traits can vary within-individual across the life cycle (Mroczek and Spiro 2003; Mroczek, Spiro, and Griffin 2006), where standard life events that are not generation-specific (e.g., beginning college, commencing one's career) are found to drive some of these age-related changes.

2 Data Summary and Visualizations

The socio-demographic characteristics of the participants in the cross-sectional study are summarized in Table 1. Data were obtained from the seminal work of Duckworth et al. (2007), who study grit variation among individuals in settings that feature intense competition or substantial attrition (e.g., Ivy League grade competition, U.S. Military Academy retention, National Spelling Bee ranking). Participants in the study consisted of 4268 adults with a mean age of 25.40 years. Millennials represented the majority of the population, and the Silent Generation had the smallest representation of any generational cohort in the data. Females represented 0.6511 proportion of observations, and the race category "Indigenous Australian, Native American, or White" represented the modal such category (0.6202). "High School" represented the modal educational category (0.4318).

We use the seminal and now standard generational cohort birth year ranges established in Howe and Strauss (1992; 2000) and canonized by subsequent research on generational cohort characteristics. Generational birth year ranges are summarized in Table 2 as follows.

Note that generational cohorts typically possess a wide age range within, which is an important characteristic for the present study. Herein, we use the cross-sectional Grit-O calculated in Duckworth et al. (2007) and subsequently provided as open-source data. Survey responses were recorded from April 2004 to October 2005 such that age and generational cohort are almost perfectly collinear in the data. For example, a 20-year-old observed in the data will always be a Millennial. Transforming the *age* at the time of survey variable to *age-in-generation* at time of survey (i.e., maximum birth year in generational cohort minus individual's birth year) allows us to isolate the respective effects of *age* and *generation* upon *grit*. As standard generational cohorts are broad in terms of the time dimension, we obtain substantial variation in *age-in-generation* while also conditioning upon *generation*. Below, we summarize birth year and generational characteristics of the survey data.

We observe in Figures 1 and 2 a good range of data in terms of *birth year* and a large sample of data for each of the last four generational cohorts. Given its sample size, the Silent Generation will be largely silent in the study, as in life. We next consider the *Grit-O Scale* histogram in Figure 3.

Grit-O Scores are based on a five-point scale that represents the average of a 12-item survey that was seminal in measuring grit. See Duckworth et al. (2007) for more information on *Grit-O Scores*. We observe from Figure 3 that grit scores are roughly bell-shaped and symmetric but with some spikes toward the distribution's center. The average *grit* score in the sample is 2.57, which ranges from a minimum of 0 and a maximum of 4.17. Consistent with the *grit* score's bell-shaped distribution, the standard deviation is small relative to the mean (SD = 0.44). Figures 4a-b consider variation in grit by *age* and *generation*.

Figure 4a suggests that the uncontrolled relationship between *grit* and *age* is quadratic (negative-parabolic) in the cross-section. That is, *grit* follows a rising-then-falling pattern in *age* within the cross-section. Figure 4b shows a very similar variation in the average *grit* score

Table 1: Sample description.

Variable	Mean	Std. Dev.	Min	Max
Grit	2.5708	0.4430	0	4.17
Age	25.407	11.361	13	78
Generational Cohort				
New Silent Generation or Gen Z	0.3503	0.4771	0	1
Millennials or Gen Y	0.5155	0.4998	0	1
Thirteeners or Gen X	0.1022	0.3029	0	1
Baby Boomers	0.0314	0.1744	0	1
Silent Generation	0.0007	0.0265	0	1
Gender				
Male	0.3411	0.4741	0	1
Female	0.6511	0.4767	0	1
Other	0.0067	0.0807	0	1
Race				
Asian	0.1837	0.3873	0	1
Arab	0.0164	0.1270	0	1
Black	0.0590	0.2357	0	1
Indigenous Australian, Native American, or White	0.6202	0.4854	0	1
Other	0.1113	0.3145	0	1
Education				
Less than high school	0.1446	0.3517	0	1
High school	0.4318	0.4954	0	1
University degree	0.2748	0.4465	0	1
Graduate degree	0.1408	0.3479	0	1

N = 4,268 observations.

Table 2: Generational age ranges.

Generation Name	Birth Year Range
G.I. Generation	[1900,1924]
Silent Generation	[1925,1945]
Baby Boomers	[1946,1964]
Thirteeners or Generation X	[1965,1979]
Millennials or Generation Y	[1980,2000]
New Silent Generation or Generation Z	>2000

and distributional location by *generation*. Given that the cross-sectional data was observed within a close time-period, we expect such correspondence. The empirical strategy to follow will attempt to disentangle the near-equivalent patterns of these plots. Are these patterns driven by continuous age effects, level effects driven by generational cohort breaks, or both? In Figures 5a-b, we consider scatter plots that present *generation* sub-sample trends in the simple relationship between *grit* and *age*.

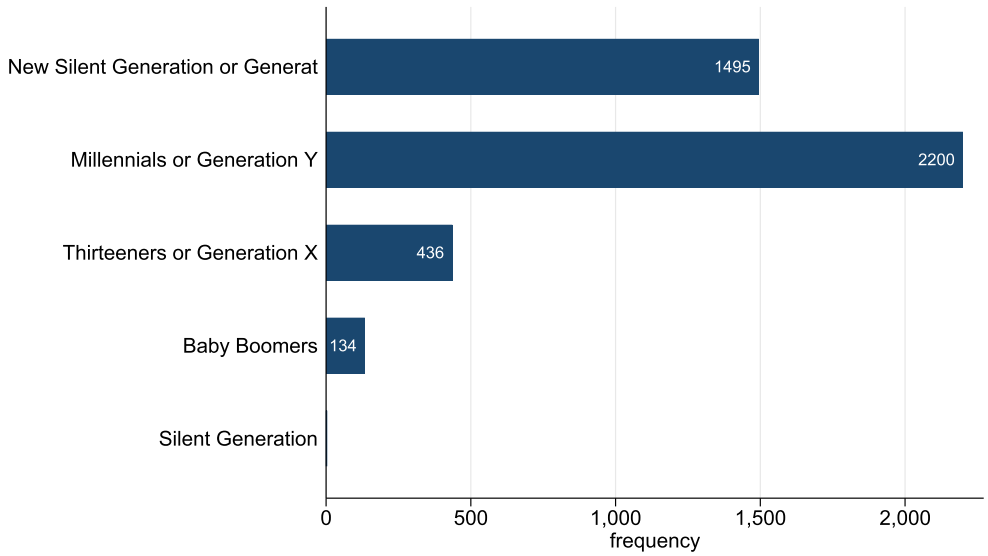

Figure 1: Tabulation of Grit-O survey respondents by generation.

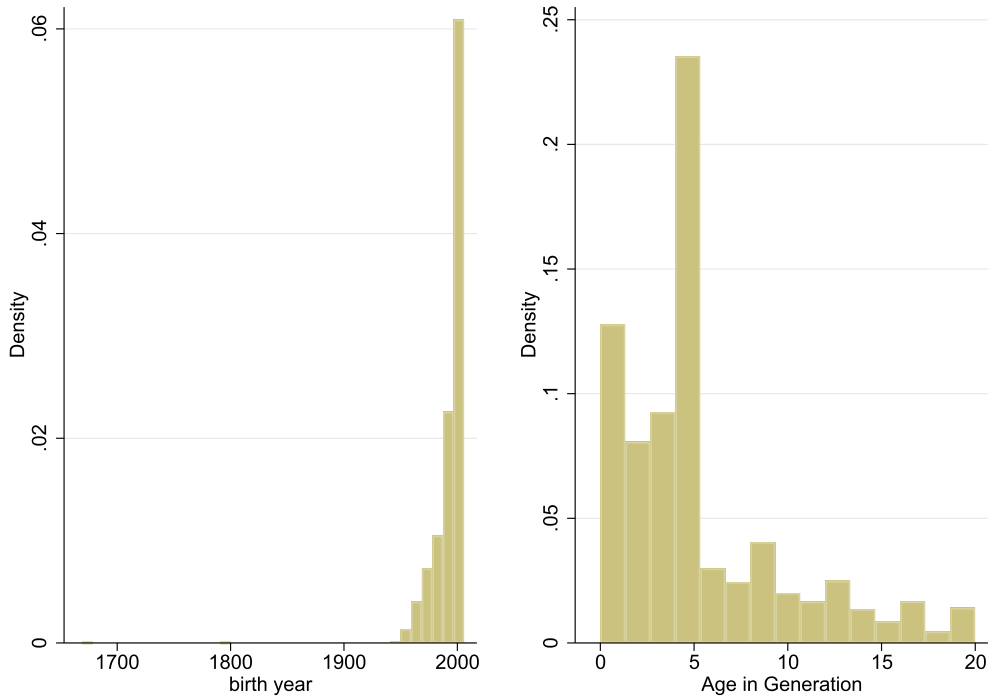

Figure 2: Birth year and age in generation histograms.

*Bins for the age in generation histogram are larger to make histograms continuous.

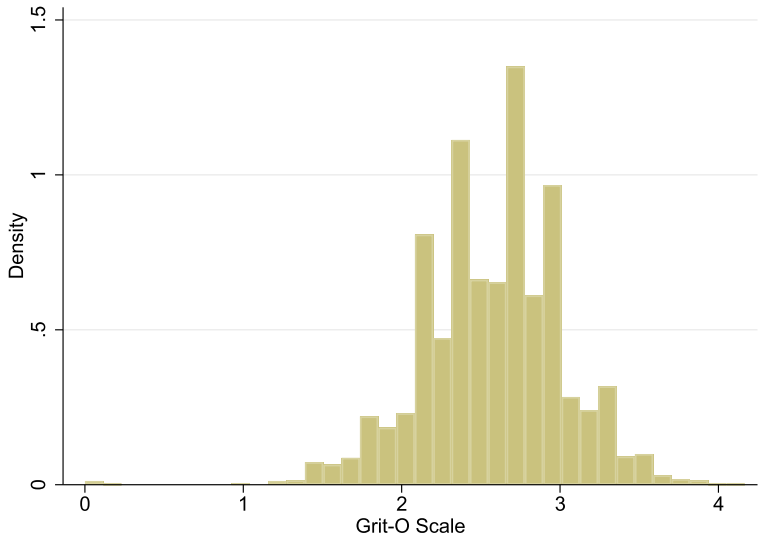

Figure 3: Grit-O scale histogram.

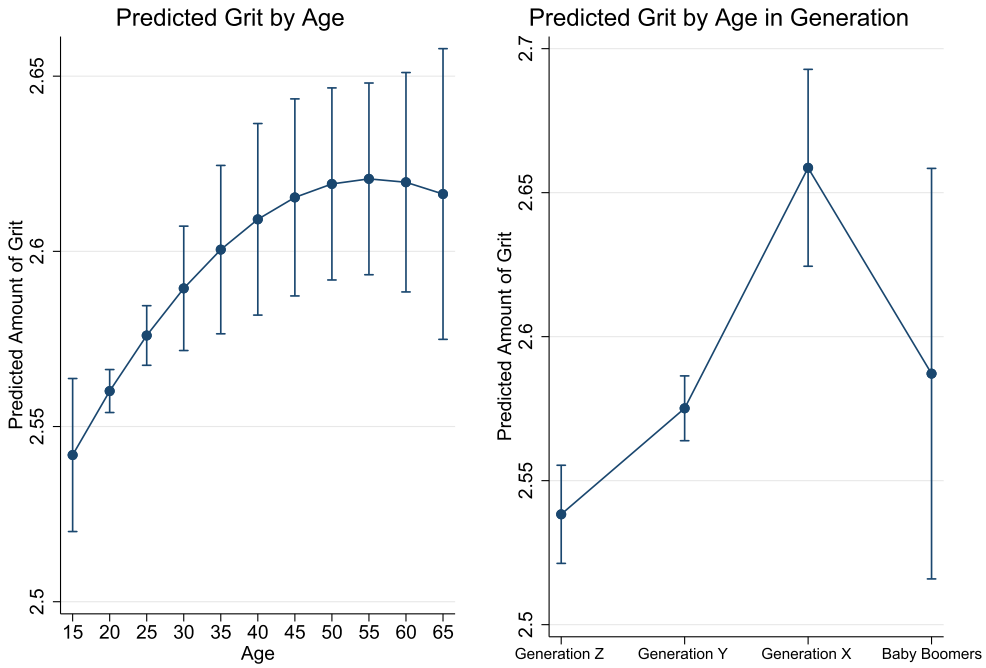

Figure 4: Predicted grit by age and generation.

Figure 5 presents within-generation trend lines between *grit* and *age* and between-*generation* average level effects upon *grit*. The plot demonstrates that the isolated effects of *generation* and *age* upon *grit* may not be as clear-cut as were the combined effects in Figures 4a-b. In Figure 5, we do not observe a clear within-generation age effect, but we observe some degree of level change in average grit score between generations. We will consider these isolated effects further in the next section.

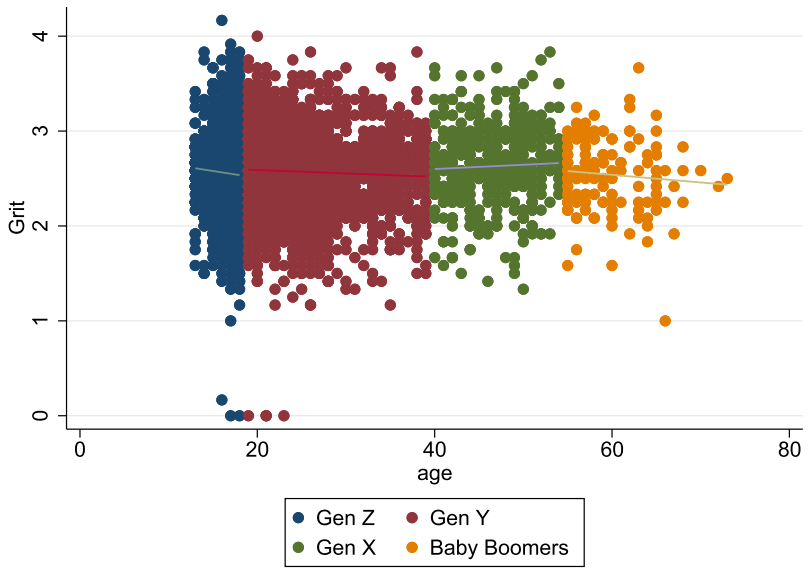

Figure 5: Sub-sample trends (by *generation*) in simple relationship between *grit* and *age*.

3 Model

Before specifying the model, we measure the extent of the obvious multicollinearity problem associated with specifying *age* and *generation* in the same model. In a fully-specified model featuring *generation* indicator variables and *age*, the variance inflation factor for *age* is 23.70. If we replace *age* with *age-in-generation* in an otherwise identical model, the age-related VIF reduces to 2.76. Specification of *age-in-generation* in place of *age* preserves age-related variation as an explanatory variable in our estimation while treating multicollinearity.

To further disentangle *age* and *generation* effects on *grit*, we use *Grit-O Score* data available from Duckworth et al. (2007). Our dependent variable, *grit*, is based on a five-point scale that represents the average of a 12-item survey demonstrated to be seminal in measuring *grit*. Higher numbers indicate more *grit* and lower numbers indicate less *grit*. Our explanatory variables of interest include *age, generation*, and *age-in-generation*. We also include a quadratic term for *age* and, alternatively, *age-in-generation* to account for possible non-linear effects. Further note that we do not include age and generation in the same specifications due to issues of multicollinearity. Moreover, age and age-in-generation are not included in the same specifications. We capture jointly conditional age and generational variation effects by including age-in-generation and generation, without age, in the same specifications. We also include subject *gender*, *race*, and *education* as control variables that may influence *grit*. *Female* is binary-coded (1 = female; 0 = male). *Race* includes the following categories: *Arab*, *black*, *indigenous Australian*, *Native American*, *Asian*, and *white*. *Education* includes the following categories: less than high school, high school, university degree, or graduate degree. We use these variables to estimate the following model:

$$\text{Grit}_{ij} = \beta_0 + \beta_1 \text{Age}_{ij} + \sum_{k=1}^{K} X'_{kij}\delta_k + \beta_2 \nu_j + \varepsilon_{ij} \tag{1}$$

$$\text{Grit}_{ij} = \beta_0 + \sum_{k=1}^{K} X'_{kij}\delta_k + \beta_1 \nu_j + \varepsilon_{ij} \tag{2}$$

$$\text{Grit}_{ij} = \beta_0 + \beta_1 \text{Age in Gen}_{ij} + \sum_{k=1}^{K} X'_{kij}\delta_k + \beta_2 \nu_j + \varepsilon_{ij} \quad (3)$$

$$\text{Grit}_{ij} = \beta_0 + \beta_1 \text{Age}_{ij} + \beta_2 \text{Age}_{ij}^2 + \sum_{k=1}^{K} X'_{kij}\delta_k + \beta_3 \nu_j + \varepsilon_{ij} \quad (4)$$

$$\text{Grit}_{ij} = \beta_0 + \beta_1 \text{Age in Gen}_{ij} + \beta_2 \text{Age in Gen}_{ij}^2 + \sum_{k=1}^{K} X'_{kij}\delta_k + \beta_3 \nu_j + \varepsilon_{ij} \quad (5)$$

where $Grit_{ij}$ is the *Grit-O Score* for individual i in country j. Age_i and Age_i^2 capture an individual's *age* and its quadratic, respectively. *Age in* Gen_i and *Age in* Gen_i^2 capture an individual's *age-in-generation* and its quadratic, respectively. X_{ki} includes k control variables for each individual. In our model, k=15 control variables for the categories of *gender, race, education*, and *generation* mentioned above; ν_j is the country-specific fixed effect. β and δ are parameters to be estimated, and ε_i is the error term. Lastly, we use heteroscedastic-consistent standard errors that are robust clustered at the country-level. The empirical strategy is a type of difference-in-difference approach that takes advantage of age variation within generational cohorts (i.e., that is independent of one's generational cohort) to disentangle the effects of generational cohort and age. In this cross-sectional data, it is the case that age and generational cohort are correlated between cohort but not within cohort.

4 Results

Table 2 reports results from the regression models. In column 1, we include the set of control variables and *age*, where we observe a significant, positive relationship between *age* and *grit*. In Column 2, we replace *age* with *generation* and observe that Millennials and Generation X members have significantly more *grit*, on average, than do Generation Z members. Column 3 adds the explanatory variable *age-in-generation* alongside generation dummies and control variables. Conditional upon *generation*, *age-in-generation* has no statistically significant effect on *grit*, suggesting that *within-generation age* variation does not influence *grit*. While the effect of *age* loses significance conditional on *generation*, the effect of *generation* maintains significance when conditioned upon age in Model (3). The *generation* results from Column (2)—but not the age results of Column (1)—hold robustly in Column (3). The results of Column (3) provide evidence that variation in *generation* and not variation in *age* is causing the observed trend between *grit* and *age*. We test further, however, for significance and robustness.

Column (4) augments the Column 1 model by including *age-squared* with *age* (without *generation* controls). Consistent with Figure 4a, we observe a negative-parabolic relationship in the quadratic model (4) results when not conditioning on *generation*. However, we observe only weak significance for the *age* variable coefficient and no significance for the *age-squared* variable coefficient. Lastly, Column (5) augments the Column 3 model by including *age-in-generation squared*, with *age*, conditional on *generation*. Conditional on *generation*, neither *age-in-generation* nor its quadratic has a statistically significant effect on *grit*. Moreover, the apparent relationship between *grit* and *age* in Figure 4a does not hold even qualitatively when we condition upon *generation* in the full model of Column (5). Yet, *generation* results maintain the same basic sign and significance characteristics in model (5) as in models (2) and (3). *Generation* is a significant predictor of *grit*, and these results are robust even when conditioning upon *age-in-*

Table 3: The effects of age and generation on grit.

	(1)	(2)	(3)	(4)	(5)
Female	-0.00573	-0.00531	-0.00582	-0.00506	-0.00628
	(0.691)	(0.720)	(0.683)	(0.726)	(0.659)
Race (baseline=Asian)					
Arab	-0.261***	-0.262***	-0.264***	-0.259***	-0.266***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Black	-0.0411*	-0.0431*	-0.0418	-0.0419*	-0.0423
	(0.100)	(0.088)	(0.112)	(0.100)	(0.103)
Indigenous Australian,	-0.0789***	-0.0789***	-0.0777***	-0.0787***	-0.0778***
Native American, or White	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other	-0.0552**	-0.0547**	-0.0540**	-0.0552**	-0.0539**
	(0.021)	(0.024)	(0.024)	(0.022)	(0.024)
Education (baseline= Less than high school)					
High school	0.00110	-0.00893	-0.00776	-0.00454	-0.00527
	(0.924)	(0.459)	(0.541)	(0.732)	(0.693)
University degree	-0.0365*	-0.0562***	-0.0527**	-0.0477*	-0.0475*
	(0.074)	(0.002)	(0.016)	(0.080)	(0.052)
Graduate degree	-0.0655***	-0.0830***	-0.0767***	-0.0775***	-0.0718***
	(0.001)	(0.000)	(0.001)	(0.002)	(0.004)
Generation (baseline=Generation Z)					
Millennials or Generation Y		0.0350**	0.0361**		0.0310*
		(0.020)	(0.013)		(0.051)
Thirteeners or Generation X		0.120***	0.120***		0.118***
		(0.000)	(0.000)		(0.000)
Baby Boomers		0.0445	0.0423		0.0379
		(0.288)	(0.330)		(0.398)
Silent Generation		-0.145	-0.151		-0.158
		(0.252)	(0.217)		(0.188)
Age	0.00183***			0.00534*	
	(0.001)			(0.088)	
Age^2				-0.0000485	
				(0.209)	
Age in Generation			-0.00130		-0.00531
			(0.551)		(0.301)
Age in $Generation^2$					0.000241
					(0.293)
Constant	2.610***	2.637***	2.641***	2.566***	2.650***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: Dependent Variable is Grit. Model estimated using OLS with country fixed effects included in all models. N=4,121 observations. Standard errors are robust to heteroscedasticity and clustered at country-level. p-values in parentheses (Two-tailed test) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

generation. Conversely, any significance in the relationship between *age* (*age-in-generation*) and *grit* washes out when conditioning upon *generation*.

The generational results suggest with substantial robustness that Generations Y and X have significantly higher grit that Generation Z. By flipping the reference group sequentially (results not included), we also observe that Generation X has a higher level of grit than does any other generation. This result is obtained for each specification that includes generational indicator variables at the 0.05 significance level. The result is consistent with past related research that shows Generation X to be marked by related characteristics such as self-reliance (e.g., relative to Generation Y; see Borges et al. 2006) and restraint from self-indulgence (e.g., relative to Baby Boomers; see Himmelman 2018) relative to other generational cohorts.

5 Conclusion

Our findings suggest that the effects of *generation*—not *age*—significantly influence *grit*. We thus conclude that the grit-age profile shape in cross-sectional *grit* score data is driven by generational characteristics and not by *age*. Our findings suggest that individual-level *grit* may be persistent over time. A 20-year-old with a *grit* score of three may expect to have a grit score near three at the age of 40. As generational cohorts move through life, however, we might expect the distribution of grit scores for 40 year-olds to change over time.

We can consider these results with the established empirical and theoretical results pertaining to age and generational cohort effects upon malleable personality traits, as considered in the introduction. These results suggest that shared cultural context and environment, as proxied by *generation*, are estimated to be important in grit formation. We conclude evidence that collective, social forces are important toward grit formation. However, there is no evidence from these results (and in these contexts) that standard, age-specific life events that are not generation-specific, as proxied by *age*, are important in grit formation. In the frame of the mindset literature, these preliminary results may seem bleak. We must remember, however, that observed subjects in the data were not subject to any sort of grit intervention. While grit may be malleable, none of the subjects forming the present data had been molded as yet in the one-shot data of Duckworth et al. (2007).

On another level, however, the *generation* results are perhaps more exciting in their potential: The experiences and exposures of a *generation* may cause wholesale changes in the distribution of grit scores. As such, aggregated interventions administered, e.g., through school grit-mindset education, may influence a generation toward scaled improvements in *grit* that are, at the same time, persistent. More research must be done to understand these potential implications.

Supplementary Material

For reproducibility, all data formatting and analysis scripts have been uploaded as Supplementary Materials and linked with the abstract of the article.

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