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Grit, discounting, & time inconsistency

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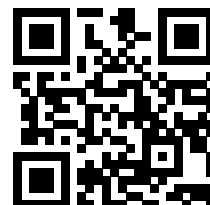
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Grit, Discounting, & Time Inconsistency

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Abstract

We study the association of the perseverance-of-effort (PoE) and the consistency-of-interests (CoI) components of the psychological measure of grit, with economic measures of impatience and decreasing impatience (time inconsistency), respectively, in the general population. We find that impatience is associated with grit through the PoE component. No association of time inconsistency with grit is found. Predicting participants' financial and health outcomes and behaviors, we find that both impatience and grit are predictive for both outcomes, but this is not the case for time inconsistency. Our findings suggest that it can be beneficial for empirical studies of intertemporal decisions to include both economic impatience and psychological grit measures.

JEL: D15, G51, I10

Keywords: Time preferences, time inconsistency, decreasing impatience, Grit, household finance, health.

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1 Introduction

The concept of *Grit* has attracted significant attention since it was first introduced by Duckworth et al. (2007). Grit is thought to measure an individual's perseverance and long-term goal orientation, and consists of two principal components: *Consistency of Interests* (CoI) and *Perseverance of Effort* (PoE) (see e.g., Datu et al., 2016; Duckworth et al., 2009; von Culin et al., 2014). Grit has been studied in a variety of contexts, and has been linked to such diverse topics as intelligence, happiness, educational attainment, health behavior, labor market outcomes, and financial decision-making (cf. Alan et al., 2019; Arco-Tirado et al., 2019; Cornaggia et al., 2020; Datu et al., 2021; Kannangara et al., 2018; Li et al., 2018; Reed 2014; Rutberg et al., 2020; Zisman et al., 2020). Grit appears to be increasing in early childhood (Sutter et al., 2022), and it has been suggested that active interventions increasing grit in children may lead to substantial economic benefits for individuals in the long run (Alan et al., 2019; Sutter, 2014). While the majority of studies highlight the positive effects of grit, Alaoui and Fons-Rosen (2021) demonstrate that gritty individuals may fall victim to their own disposition and continue a course of action beyond the point at which they would have – ex-ante – liked to stop.

The psychological concept of perseverance of effort is closely related to delayed gratification and patience, respectively impatience, which economists see as a manifestation of discounting, i.e., a measure of time preference. This observation suggests a fundamental link between grit and time preferences through the facet of perseverance-of-effort. While the study of time preferences started out by measuring discount rates as constant measures of impatience (Samuelson, 1937), more recent developments acknowledge that discounting and impatience do not have to be constant, but may be increasing or decreasing with time delay (e.g., Strotz, 1955; Loewenstein and Prelec, 1992; Bleichrodt et al., 2009; Rohde, 2019; and for a review: Cohen et al., 2020). Such non-constant discounting has theoretically been linked to time-inconsistent behavior and planning failure, and has been employed to explain a variety of behaviors and outcomes, including poor financial and health outcomes such as under-saving or obesity (e.g., Frederick et al., 2002; Meier and Sprenger, 2010; Sutter et al., 2013). Time inconsistency has a natural counterpart in the consistency-of-interest facet of grit. However, despite the apparent mapping of the important economic concepts of discounting and time-inconsistency on the two dimensions of the psychological measure of grit, there is no evidence yet on the empirical relationship between these concepts.

Despite the broad interest in grit, there is little evidence yet on its relevance for economic outcomes in representative populations (Lechner et al., 2019), and no evidence on its relationship with measures of time preference¹. Given the relevancy of both the economic and psychological measures for policy in several domains of regulation, a deeper understanding of their relationship is warranted. To this end, the current paper presents the first joint measurement of grit, time discounting, and time inconsistency for a large probability sample of the population. Specifically, we measure the Grit-S scale for more than 3000 members of the LISS panel, a representative panel of the Dutch population, and combine it with incentivized measurements of impatience based on Rohde (2019), which also allow us to identify deviations from constant discounting. To probe the external validity of the grit measure, discount rates, and time inconsistency in the two important policy domains of household finance and health, we add two sets of analyses. First, we survey participants regarding their satisfaction with their own financial and health-related decision-making. If our measures of intertemporal preference and behavior capture people's failure to implement their own long-term goals in dynamic intertemporal settings, we predict that they correlate meaningfully with measures of dissatisfaction with one's own behavior and outcomes. Second, we make use of existing indicators of personal finances and health, both subjective and objective, available on the LISS panel. Here we test if grit and time preference predict outcomes in the cross section of the population.

Our findings show that the Dutch representative sample is moderately impatient with an average willingness to wait of four months for an additional €15 (on top of €100). This implies an annualized discount rate of 63%. About 43% of participants exhibit constant discounting across the two time horizons we study, with the remaining participants showing decreasing impatience to a larger degree than increasing impatience (33% versus 23%). As hypothesized, impatience appears to be negatively associated with the perseverance-of-effort component of grit. However, we do not find systematic evidence of deviations from constant discounting correlating with the consistency-of-interest component of grit. Participants are on average dissatisfied with both their financial and their health-related situation. Dissatisfaction in both domains correlates negatively with grit. Despite its correlation with grit, impatience sustains predictive power for dissatisfaction in the financial domain. Grit is also predictive of broader

¹ There is some literature linking the time preferences to conscientiousness (e.g., Anderson et al. 2011, Daly et al. 2009, Jagelka 2020, Letkiewicz and Fox, 2014, Manning et al. 2014), which has been argued to have considerable overlap with the concept of grit (e.g., Credé et al. 2017, Ponnock et al. 2020, Schmidt et al. 2018).

health and financial outcomes, with again impatience sustaining some predictive power for financial outcomes.

Section 2 lays out the details of our design. Section 3 reports results regarding the relationship between grit and time preference, and Section 4 presents results on the predictive power of these measures for financial and health satisfaction and outcomes. Section 5 discusses the findings in the light of previous research and draws conclusions for future work with these concepts.

2 Study design

We conduct a three-part study on the LISS panel. In part 1 we elicit time preferences. Part 2 comprises the elicitation of ambiguity attitudes and is reported on in a companion paper (König-Kersting and Trautmann, 2023). In part 3 we measure participants' grit and collect self-reports on their satisfaction regarding household finances and health-related behaviors. In the study, either part 1 (time preferences) or part 2 (ambiguity attitudes) is randomly selected for payment. We augment the data collected in our experiments and questionnaires with demographic, financial and health data available on the LISS panel.

2.1 Time preference elicitation

We elicit time preferences using choice lists, in which participants always choose between two timed payoffs (i.e., delayed payoffs), referred to as Option A and Option B. Throughout a choice list, timing and payoff associated with Option A remain fixed. Option A always involves a payoff of €100. For Option B, we vary the point in time the payment is received, while the payoff itself remains unchanged at €115.

We employ two such choice lists with different up-front delay to be able to identify and quantify increasing and decreasing impatience (Rohde, 2019). In the first choice list, Option A always pays in 5 weeks, while the payoff delay of Option B increases monotonically from 5 to 55 weeks. We call this the *5-week* list. In the second choice list, all delays are increased by an additional 3 weeks. That is, the delay for Option A is 8 weeks, while the delay for Option B ranges from 8 weeks to 58 weeks. We refer to this second list as the *8-week* list.

To keep the choice lists shorter and increase data quality, we employ an iterative method and enforce a single switching point per list. We first present participants with a choice list with time steps Δt between options equal to 5 weeks ('the coarse list', see Figure 1). Implementing a maximum time difference of 50 weeks, the first choice list comprises 11 items. For each item,

participants have to choose between Options A and B; consistency dictates the participants start with Option B and switch at most once to Option A and then stick with this option until they reach the bottom of the list. Thus, we have participants choose the longest delay for which they are willing to choose the larger payoff Option B, and have all other choices automatically filled in. Participants can adjust the auto-filled selection and have to confirm their choices before being able to continue. When participants have made their choice on this coarse list, we ‘zoom-in’ on the time interval around their switching point. Participants then see a 6-item choice list with steps Δt equal to one week. They make their fine-grained selection by choosing from the one-week steps in between the two options that marked their switching point on the coarse list. Figure 2 shows an example of a zoomed-in list that appeared after indicating a switching point after 10 weeks on the coarse list (*5-week*). Note that choices in both iterations together result in a complete revelation of the preference for timed payments from the initial delay after the date of survey (5 or 8 weeks) to the longest payment delay after the date of survey (55 to 58 weeks).

Figure 1: 5-week, coarse choice list

↕	Option A		Option B		↕
	Payoff	Timing	Payoff	Timing	
	100 €	in 5 weeks	115 €	in 5 weeks	●
○	100 €	in 5 weeks	115 €	in 10 weeks	●
●	100 €	in 5 weeks	115 €	in 15 weeks	○
●	100 €	in 5 weeks	115 €	in 20 weeks	○
●	100 €	in 5 weeks	115 €	in 25 weeks	○
●	100 €	in 5 weeks	115 €	in 30 weeks	○
●	100 €	in 5 weeks	115 €	in 35 weeks	○
●	100 €	in 5 weeks	115 €	in 40 weeks	○
●	100 €	in 5 weeks	115 €	in 45 weeks	○
●	100 €	in 5 weeks	115 €	in 50 weeks	○
●	100 €	in 5 weeks	115 €	in 55 weeks	○

Note: This example shows switching after week 10 on the coarse list.

Figure 2: 5-week, fine choice list, with switch after 10 weeks

↵	Option A		Option B		↴
	Payoff	Timing	Payoff	Timing	
	100 €	in 5 weeks	115 €	in 10 weeks	●
○	100 €	in 5 weeks	115 €	in 11 weeks	○
○	100 €	in 5 weeks	115 €	in 12 weeks	○
○	100 €	in 5 weeks	115 €	in 13 weeks	○
○	100 €	in 5 weeks	115 €	in 14 weeks	○
●	100 €	in 5 weeks	115 €	in 15 weeks	

Note: This example shows the zoomed-in choice list based on switching from B to A after week 10 on the coarse choice list (5-week) shown in Figure 1. The first and the last line correspond to the lines selected in the coarse choice list and were disabled, such that participants could only refine, but not change their switching point.

Further note that in the coarse list, the first row was pre-set such that subjects were forced to choose the higher payment. In the fine list, the two end-point comparisons derived from the coarse list were also pre-set. While we allow participants to switch at most once, it is permissible to never switch. A zoomed-in weekly choice list is not shown if a participant chooses Option B in the last row of the coarse list, because the participant's switching point lies outside the range of our choice lists. Auto-filling is done on both the coarse and the fine choice lists.

Each of the two choice lists provides us with a switching point from the higher-later to the lower-sooner payoff-timing pair expressed in weeks.² We subscribe to the Consume-on-Receipt Model (Cohen et al., 2020) and assume locally linear utility to calculate implied annualized discount rates (continuous discounting) based on the payoff differences and switching points for each participant. To measure impatience, we calculate the discount rate that is implied by the choices on the 5-week list, which was always presented first. The discount rate is given by³

$$r = \frac{52 \cdot \ln(1.15)}{t_5 - 5}$$

and a higher discount rate is associated with greater impatience (t_5 is the switching point on the 5-week list).

Time inconsistent behavior is hypothesized to be driven by changes in the level of impatience (Rohde, 2019). We use the two switching points elicited using the 5-week (t_5) and

² Technically, we add 0.5 to all switching points expressed in weeks. This is to account for the indifference lying between the week the switch occurs after and the subsequent week. We use the midpoint between the two weeks as an approximation.

³ Implied by the indifference $€100 \cdot e^{-r \cdot \frac{5}{52}} = €115 \cdot e^{-r \cdot \frac{t_5}{52}}$ if the switching row is given by t_5 .

the 8-week (t_8) choice lists to calculate the Decreasing Impatience Index (DI-index; Rhode, 2019) as

$$DI = \frac{(t_8 - t_5) - 3}{3(t_5 - 5)}$$

with a first-list delay of 5 weeks and additional delay of 3 weeks for the second list. The DI-index allows to identify and measure the changes of the level of impatience independently of the level of impatience itself. While an index value of zero indicates constant impatience, lower values ($DI < 0$) indicate increasing impatience and higher values ($DI > 0$) indicate decreasing impatience.

As noted by Rohde (2019), the elicitation method may lead to very patient subjects always choosing Option B. This also happened in our study, and we scored these subjects as $t_5 = 55.5$, respectively $t_8 = 58.5$, and $DI = 0$ (if they were very patient in both lists). We decided to include the subjects in the regression analyses to not skew results by excluding the most patient people in the population sample. However, as we cannot be sure that these participants exhibit constant discounting despite their extensive patience, we include an indicator variable for these subjects in all regressions. This indicator captures any effects that are specific to this special group of subjects or their scoring. In univariate and descriptive analyses of the DI-index that cannot control for the imputation $DI = 0$ we do not include these data.

In addition, participants may indirectly violate the impatience assumption underlying both choice lists. This is the case if a participant switches from Option B (115€) to Option A (100€) at an absolutely later time (after more weeks of total waiting) in the first choice list with the 5-week delay than in the second choice list with the 8-week delay. We cannot calculate the DI-index for these participants (cf. Rohde, 2019).

2.2 Questionnaires

We use the 8-item Short Grit Scale (Grit-S, Duckworth and Quinn, 2009) to measure all participants' perseverance and orientation towards long-term goals. The scale has two primary factors, consistency of interests (CoI) and perseverance of effort (PoE), and improves upon the psychometric properties of the earlier and longer Grit-O scale (Duckworth et al. 2007). The perseverance component has also been demonstrated to correlate significantly with a behavioral measure based on a real effort task (Gerhards and Gravert, 2021). For the analysis, we construct a total of three scores: the main *Grit Score* comprising all items, as well as the sub-scales *Grit CoI* and *Grit PoE*, which represent the two components of Grit and only include the respective four items. Each score is the average of the responses to the included items.

In addition, we assess participants' dissatisfaction with their behavior in regards to financial planning and spending decisions. Specifically, we ask them to indicate how strongly they agree or disagree (7-point Likert scales) with statements regarding their (long-term) financial planning, savings behavior, spending behavior, and overall satisfaction with their financial habits. From their responses, we construct a *Finance Dissatisfaction Score* by averaging the responses to the respective four items. Similarly, we measure participants' dissatisfaction with their health-related behaviors. Specifically, we ask them to indicate how strongly they agree or disagree (7-point Likert scales) with statements concerning their (long term) health planning, physical activity, eating behavior, and overall satisfaction with their health-related habits. Participants' responses to these four items are averaged and constitute the *Health Dissatisfaction Score*.

One half of the participants first answers the questionnaire on finances, then answers the questionnaire on health behavior second. The other half of the participants encounters the two questionnaires in reversed order. The order of the questionnaires is randomly determined on the individual level. All questionnaires are reproduced in Appendix A.

2.3 Procedures

The experiment and surveys were run on the LISS Panel,⁴ which consists of 5000 households and about 7500 individuals. The sample is representative of the Dutch population. Panel members complete the questionnaires online and are paid for their participation. A total of 3421 individuals participated in our experiment of which 300 participants (about 9%) were randomly selected to be paid for the experiments. This random selection was implemented to allow for significant payments for the selected participants in the context of the long time horizons studied in our experiment. If a participant was selected for payment, one of the two experimental parts of the study (time preference or ambiguity attitude elicitation) was selected at random to be payoff relevant. If the time preference task was selected, we selected one of the two choice lists, *5-week* or *8-week*, and one of the weekly steps at random. The participant received a payment in accordance with their choice of the timed payoff in the selected decision. All payments were made as bank transfers by the LISS panel administration. As participants interact with LISS and receive payments regularly, there should be no trust issues regarding the delayed payoffs.

⁴ LISS stands for Longitudinal Internet studies for the Social Sciences. The panel is organized and maintained by CentERdata in the Netherlands. More information, as well as the extensive data archive, is available on their website: <https://www.lissdata.nl>

2.4 Demographic controls and LISS modules for finance and health

We augment our experimental data with selected variables from the LISS Core Study and its modules ‘Health’⁵, ‘Assets’⁶, and ‘Income’⁷. These are used as control variables (education and net income) and as additional dependent variables (see Tables 8 and 9). When we control for the level of education, we include the education categories of Statistics Netherlands (1 = primary school to 6 = university). To control for income, we use the logarithm of participant’s net income.⁸

There are six finance outcome variables, of which the first two measure participants’ assets: The sum on bank accounts represents the total balance of checking, savings, and term deposit accounts as well as savings bonds, savings certificates, and savings schemes at the end of 2017. The sum of investments covers growth funds, share funds, bonds, debentures, stocks, options and warrants at the end of the same year. Both variables can be positive or negative. In addition, there are two measures related to income: Net income as defined before and an 11-point Likert type question asking the participants to indicate how hard or easy it is for them to live off their income (0 = very hard to 10 = very easy). Finally, participants are asked how satisfied they are with their financial situation (0 = not at all satisfied to 10 = entirely satisfied) and where they would place themselves on an imaginary ‘ladder of life’. The bottom of the ladder represents the worst possible life while the top represents the best possible life (0 to 10, higher is better). These questions, while less specific, are conceptually quite similar to our dedicated financial dissatisfaction scale.

We also include six additional health outcome variables. The first two are related to general health and use 5-point Likert scales: Participants indicate how they would describe their health in general (1 = poor, 2 = moderate, 3 = good, 4 = very good, 5 = excellent) as well as how many days of the last month they were unable to work, go to school, or do housekeeping work because of illness (1 = 0 days, 2 = 1 or 2 days, 3 = 3 to 5 days, 4 = 5 to 10 days, 5 = more than 10 days). Next, we include an indicator for smoking and a question about the number of days in the last week that alcohol was consumed (0 to 7), which both aim to capture current health-related decision making. Finally, we include two questions on physical activity. We ask on how many of the past 7 days participants engaged in strenuous physical activity (lifting heavy loads,

⁵ Wave 11, items ch18k004, ch18k099, ch18k125, ch18k126, ch18k135, ch18k185, ch18k191.

⁶ Wave 6, items ca18f012, ca18f016.

⁷ Wave 11, items ci18k006, cu18k005, ci18k244.

⁸ Variable: nettoink, describing net monthly income in Euros. If not provided by the participant, this value is imputed from net income categories (nettoicat) by using the average of the indicated category.

digging, aerobics, cycling, etc.; 0-7) and on how many days they spent at least 10 minutes walking (0-7).

3 Results: Time preference and grit

We first provide descriptive statistics, study variation in demographics, and then the correlation of the time preference with the grit measures. Table 1 shows the summary statistics of our key variables of interest: impatience, the DI-index, and the Grit Score including its two components. The median participant switches from Option B to Option A after 16 weeks, implying a discount rate of 0.63 and moderate impatience. In terms of the DI-index, the median is zero, with the mean being positive at 0.65. There appears to be a tendency to towards decreasing impatience. We observe a median Grit Score of 4.875 with mean 4.9, which is relatively high on the 7-point scale. For comparison, Duckworth and Quinn (2009) report a grand mean of 3.4 for a large online sample of participants aged 25 up to 65+. The median and mean of the Grit PoE subscale are 5.5 and 5.29, respectively. Both are slightly higher than the corresponding values of the CoI subscale, which are both 4.5.⁹ Internal reliability is high with Cronbach's alpha approaching 0.78 for the 8-item total score (0.75 for the 4-item CoI, 0.77 for the 4-item PoE).

Table 1: Summary statistics

	Impatience	DI-index	Grit	Grit CoI	Grit PoE
Median	0.632	0	4.875	4.5	5.5
Mean	2.718	0.648	4.895	4.5	5.290
Std. dev.	4.762	3.822	0.841	1.090	0.959
N	3421	2229	3370	3370	3370

Notes: Impatience = annual discount rate as implied by first choice list with a 5-week up-front delay; Grit, Grit CoI, Grit PoE $\in [1, 7]$; Extremely patient participants with imputed DI-index = 0 are excluded in the DI-index and the Time inconsistency columns.

Table 2 takes a closer look at the DI-index. The table presents the share of participants that exhibit decreasing, constant, or increasing impatience. For comparability, we show our data along-side values that have been reported in Rohde (2019). Constant impatience is relatively prevalent in our sample, with about 43% of participants not showing signs of increasing or decreasing impatience across our two choice lists. A significantly larger share of participants exhibits decreasing impatience than increasing impatience (33.4% vs 23.5%, $p < 0.0001$, sign test). Interestingly, there seems to be a decreasing relationship between the number of weeks of up-front delay and the prevalence of decreasing impatience. Neglecting the differences in

⁹ The choice lists were the first part of the three-part study. We observe very minor attrition between parts. While 3421 participants filled-in the first choice list, 3414 (7 less) participants also completed the second choice list. In part two, we lost another 44 participants and ended up with 3370 completed Grit-S questionnaires.

samples, Rohde finds 46% for 0 weeks of delay and 40% for 2 weeks of delay, while we find just 33% for 5 weeks of up-front delay. No systematic pattern stands out from constant and increasing impatience data.

Table 2: Deviations from constant discounting

Up-front delay	Rohde 1 0 weeks	Rohde 2 2 weeks	Our data 5 weeks
Decreasing impatience ($DI > 0$)	0.457	0.396	0.334
Constant impatience ($DI = 0$)	0.298	0.231	0.431
Increasing impatience ($DI < 0$)	0.245	0.374	0.235
N	94	91	2229

Notes: Shares of all participants reported; Rohde 1 and Rohde 2 are based on the two choice lists of the second experiment reported in Rohde (2019). We exclude extremely patient participants with imputed DI-index = 0 from our data.

To identify how demographic characteristics are associated with our measures of impatience, time inconsistency, and grit, we run individual regressions of these variables on a basic set of individual- and household-level background variables available on the LISS panel (see section 2.4). Table 3 shows the results of these regressions. In terms of time preferences, we find impatience (model 1) to be significantly positively related to age. We find a significant negative association with the level of education, home ownership, and net income.

The DI-index extends both in the negative and the positive domain and expresses different deviations from constant discounting. As such, effects of the background variables on the DI-index are hard to interpret. To avoid this complication, we split the DI-index at zero into its positive and negative two components. While an index value of zero expresses time consistency, positive values of the index express degrees of decreasing impatience and negative values express degrees of increasing impatience. In the subsequent analysis we include two variables to capture the two components separately: Decreasing Impatience matches the DI-index when it is positive. Increasing Impatience matches the absolute value of the DI-index when it is negative. Increasing impatience (Table 3, model 2) is not statistically significantly associated with any background variable. Decreasing impatience (model 3) is significantly positively related to female gender and negatively with being divorced.

Table 3: Demographic correlates of time preference and grit

	Impatience	Increasing Impatience	Decreasing Impatience	Grit	Grit CoI	Grit PoE
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.1537 (0.1856)	0.0017 (0.0018)	0.3514* (0.1626)	0.0978** (0.0335)	0.0899* (0.0434)	0.1056** (0.0383)
Age	0.0871** (0.0335)	0.0000 (0.0003)	-0.0160 (0.0291)	0.0142* (0.0061)	0.0145 (0.0079)	0.0139* (0.0069)
Age ²	-0.0005 (0.0003)	-0.0000 (0.0000)	0.0003 (0.0003)	-0.0001 (0.0001)	-0.0000 (0.0001)	-0.0001* (0.0001)
Married	-0.0247 (0.2157)	-0.0010 (0.0021)	-0.3683 (0.1894)	0.0916* (0.0389)	0.0707 (0.0505)	0.1125* (0.0445)
Divorced	0.3230 (0.3178)	-0.0045 (0.0030)	-0.5862* (0.2789)	0.0582 (0.0572)	0.0310 (0.0742)	0.0853 (0.0654)
Education	-0.3168*** (0.0661)	0.0002 (0.0006)	-0.0541 (0.0577)	0.0578*** (0.0119)	0.0588*** (0.0155)	0.0568*** (0.0136)
No. of children	0.1622 (0.0958)	-0.0002 (0.0009)	0.1342 (0.0835)	0.0107 (0.0172)	0.0046 (0.0223)	0.0168 (0.0197)
Home ownership	-0.6637** (0.2057)	-0.0010 (0.0020)	-0.2282 (0.1807)	0.0313 (0.0369)	0.0711 (0.0480)	-0.0086 (0.0422)
Log net income	-0.4307** (0.1580)	0.0004 (0.0015)	0.1722 (0.1353)	0.0793** (0.0284)	0.0371 (0.0369)	0.1215*** (0.0325)
Self- employed	0.2125 (0.3968)	0.0022 (0.0038)	0.6392 (0.3488)	0.1384 (0.0716)	0.0510 (0.0929)	0.2257** (0.0818)
<i>Adj. R²</i>	0.038	0.032	0.013	0.032	0.031	0.031
<i>N</i>	2903	2346	2346	2855	2855	2855

Notes: OLS with standard errors in parentheses; Increasing Impatience = absolute value of DI-index if negative; Decreasing Impatience = DI-index if positive; CoI = Consistency of Interests Grit subscale, PoE = Perseverance of Effort Grit subscale; models 2 and 3 do not include patient respondents with imputed DI=0, which trivially implies consistency. */**/** denote significance of difference from zero at 5% / 1% / 0.1%.

Models 4 - 6 study the main Grit-S Score and its consistency-of-interest and perseverance-of-effort components. In our representative sample of the Dutch population, grit is significantly positively correlated with being female, higher age, being married, higher educational attainment, and net income (model 4). Models 5 and 6 reveal that the correlations with gender and education appear for both factors, while especially being married, being self-employed, and net income mainly associate with the main Grit-S score through the perseverance of effort component. Note that the positive associations with age effect is well established in the psychological literature, the observed association with gender is not commonly observed (Credé et al., 2017).

Table 4 shows raw rank correlation coefficients between our key variables of interest. The Grit-S Score is significantly negatively correlated with impatience and positively with increasing impatience. That is, a strong long-term goal orientation is related to lower impatience. Interestingly, the relationship to both impatience and increasing impatience are mainly driven by the perseverance-of-effort factor of grit, rather than the consistency-of-interests component. We do not observe a statistically significant rank correlation between Grit-

S and its individual components with decreasing impatience. That is, the hypothesized relationship between time inconsistency and the Grit-S consistency-of-interests facet is not supported in the data.

Table 4: Rank correlation coefficients

	Impatience	Increasing Impatience	Decreasing Impatience	Grit Score	Grit CoI	Grit PoE
Impatience	1.00					
Inc. Impatience	-0.26***	1.00				
Dec. Impatience	0.00		1.00			
Grit Score	-0.08***	0.04*	-0.04	1.00		
Grit CoI	-0.02	0.01	-0.04	0.84***	1.00	
Grit PoE	-0.10***	0.06**	-0.02	0.81***	0.40***	1.00

Notes: Spearman's rank correlation coefficients; Impatience = discount rate as implied by first choice list with 5-week up-front delay; CoI = Consistency of Interests Grit subscale; PoE = Perseverance of Effort Grit subscale; Time inconsistency = indicator which is 1 if DI-index is not equal to zero, 0 otherwise; extremely patient participants with imputed DI-index = 0 are excluded; */**/** denote significance of difference from zero at 5% / 1% / 0.1%.

4 Results: Predictive power for financial and health dissatisfaction and outcomes

In a next step, we study whether and how the time preference and grit measures are useful in predicting panel participants' financial and health outcomes, and their subjective assessment of these outcomes. Impatience, time inconsistency, as well as low cognitive control (as potentially captured by low grit) have been related in various ways theoretically and empirically with poor financial and health outcomes (see discussion in Sutter et al., 2013). Importantly, it is typically assumed that people aim for better outcomes, but fail to achieve them due to intertemporally suboptimal behavior. Thus, the items of our dissatisfaction scores are designed to identify such failure to realize financial and health goals due to poor intertemporal decision making. We first look at the survey measures for dissatisfaction, and then consider a broader set of variables available through the LISS panel modules on health and financial assets.

Both of the dissatisfaction scores have relatively high internal reliability scores with Cronbach's alpha reaching 0.78 and 0.8 for the 4-item Finance and Health questionnaires, respectively. We observe substantial variation in both Financial Dissatisfaction (mean = 3.39,

sd = 1.313) and Health Dissatisfaction Scores (mean = 4.78, sd = 1.266), and Health Dissatisfaction is significantly higher than Financial Dissatisfaction ($z = 15.91$, $p < 0.001$, Wilcoxon signed rank test).

Table 5 shows results for Financial Dissatisfaction. In models 1 and 2, we regress the corresponding score on impatience and the time inconsistency measures, with and without additional demographic controls. When including controls, there is a weak positive relationship of impatience and financial dissatisfaction. No association is observed for increasing and decreasing impatience. Models 3 and 4 add the Grit-S score to these specifications. Higher grit is strongly associated with lower dissatisfaction. The explanatory power of impatience is slightly reduced in this model. When splitting grit into its two components in model 5, we observe that the additional explanatory power of grit for financial dissatisfaction stems from consistency of interests, rather than the perseverance of effort. The latter effect is better captured by the economic impatience measure, which reaches statistical significance again.

Table 6 shows results for the Health Dissatisfaction Score. We observe a similar pattern of associations, with grit being strongly negatively associated with health dissatisfaction. Splitting grit into its two components (model 5) reveals that both have explanatory power for health dissatisfaction. Impatience and the time inconsistency measures do not have predictive power for health dissatisfaction in any of the specifications. In sum, for both dissatisfaction scores, even after controlling for demographic characteristics, grit has significant explanatory power for participants' dissatisfaction with their financial and health-related behavior. However, the two components of grit contribute differently, depending on the context. In our study, impatience is only associated with financial dissatisfaction.

Table 5: Explaining Financial Dissatisfaction Score

	Financial Dissatisfaction				
	(1)	(2)	(3)	(4)	(5)
Impatience	0.0088 (0.0053)	0.0114* (0.0056)	0.0066 (0.0051)	0.0104 (0.0055)	0.0121* (0.0054)
Inc. impatience	1.4393* (0.6137)	0.5159 (0.6546)	1.3126* (0.5921)	0.5570 (0.6362)	0.4575 (0.6297)
Dec. impatience	-0.0097 (0.0113)	-0.0024 (0.0113)	-0.0115 (0.0109)	-0.0044 (0.0110)	-0.0052 (0.0109)
Grit Score			-0.4114*** (0.0288)	-0.3498*** (0.0303)	
Grit PoE					-0.0038 (0.0285)
Grit CoI					-0.3160*** (0.0250)
Female		0.0031 (0.0561)		0.0285 (0.0546)	0.0206 (0.0540)
Age		0.0248* (0.0100)		0.0296** (0.0098)	0.0302** (0.0097)
Age squared		-0.0005*** (0.0001)		-0.0005*** (0.0001)	-0.0005*** (0.0001)
Married		-0.1203 (0.0653)		-0.0843 (0.0636)	-0.0969 (0.0629)
Divorced		-0.0498 (0.0962)		-0.0218 (0.0936)	-0.0280 (0.0926)
Education		-0.0482* (0.0200)		-0.0264 (0.0196)	-0.0285 (0.0194)
No. of children		0.0704* (0.0287)		0.0744** (0.0279)	0.0721** (0.0276)
Home ownership		-0.2934*** (0.0621)		-0.2739*** (0.0604)	-0.2628*** (0.0598)
Log net income		-0.0842 (0.0466)		-0.0559 (0.0454)	-0.0688 (0.0450)
Self-employed		-0.0776 (0.1203)		-0.0398 (0.1169)	-0.0670 (0.1158)
<i>Adj. R²</i>	0.016	0.136	0.085	0.185	0.202
<i>N</i>	2713	2307	2712	2306	2306

Notes: OLS; standard errors in parentheses; CoI = Consistency of Interests Grit subscale, PoE = Perseverance of Effort Grit subscale; all models include a dummy for DI=0 for patient respondents waiting until the maximum delay of the choice list (see section 2); reduced sample sizes due to missing demographic variables for some participants; */**/** denote significance of difference from zero at 5% / 1% / 0.1%.

Table 6: Explaining Health Dissatisfaction Score

	Health Dissatisfaction				
	(1)	(2)	(3)	(4)	(5)
Impatience	0.0052 (0.0051)	0.0051 (0.0057)	0.0030 (0.0049)	0.0039 (0.0054)	0.0047 (0.0054)
Inc. impatience	0.3864 (0.5959)	-0.1510 (0.6576)	0.2570 (0.5725)	-0.0962 (0.6322)	-0.1440 (0.6309)
Dec. impatience	-0.0073 (0.0110)	-0.0022 (0.0113)	-0.0092 (0.0105)	-0.0049 (0.0109)	-0.0053 (0.0109)
Grit Score			-0.4202*** (0.0279)	-0.4142*** (0.0302)	
Grit PoE					-0.1248*** (0.0285)
Grit CoI					-0.2749*** (0.0250)
Female		-0.1615** (0.0564)		-0.1330* (0.0542)	-0.1368* (0.0541)
Age		0.0396*** (0.0101)		0.0434*** (0.0097)	0.0437*** (0.0097)
Age squared		-0.0005*** (0.0001)		-0.0005*** (0.0001)	-0.0005*** (0.0001)
Married		-0.0164 (0.0656)		0.0241 (0.0632)	0.0180 (0.0630)
Divorced		0.0832 (0.0967)		0.1139 (0.0930)	0.1109 (0.0928)
Education		-0.0524** (0.0201)		-0.0262 (0.0194)	-0.0272 (0.0194)
No. of children		0.0176 (0.0288)		0.0246 (0.0277)	0.0235 (0.0277)
Home ownership		-0.2147*** (0.0625)		-0.1957** (0.0601)	-0.1903** (0.0599)
Log net income		0.0215 (0.0468)		0.0557 (0.0451)	0.0495 (0.0450)
Self-employed		-0.0452 (0.1208)		0.0013 (0.1162)	-0.0118 (0.1160)
<i>Adj. R²</i>	-0.000	0.040	0.077	0.112	0.116
<i>N</i>	2712	2306	2712	2306	2306

Notes: OLS; standard errors in parentheses; CoI = Consistency of Interests Grit subscale, PoE = Perseverance of Effort Grit subscale; all models include a dummy for DI=0 for patient respondents waiting until the maximum delay of the choice list (see section 2); reduced sample sizes due to missing demographic variables for some participants; */**/** denote significance of difference from zero at 5% / 1% / 0.1%.

We next consider the relationship between impatience, time inconsistency, and grit with several measures of participants' financial and health outcomes available on the LISS panel. We report results for the disaggregated PoE and CoI grit Scores. Results using the overall Grit-S score are available in Appendix B, Tables B1 and B2. Table 7 shows results for financial outcomes. Impatient participants hold lower bank account balances, have lower income, are less satisfied with their overall financial situation, and find it more difficult to make ends meet. There are no associations with increasing or decreasing impatience. Both components of the Grit-S scale are associated with financial outcomes. Perseverance-of-effort relates positively to net income, financial satisfaction, self-perceived social status (ladder of life) and making ends meet. Consistency-of-interests relates positively to financial satisfaction and self-perceived social status. These associations are all sizable and meaningful: they are comparable to the strong associations of financial outcomes observed for gender, education and net income.

Table 8 shows results for health outcomes. We find no associations with impatience and only a negative association of the two time inconsistency measures with alcohol consumption. In contrast, there are several associations with both components of the Grit-S scale. Perseverance-of-effort relates positively to general health, fewer sick days, physical activity, and the frequency of taking walks. Consistency-of-interests relates positively to general health and physical activity. Again, these associations are comparable to those observed for relevant demographics like age, gender education or income.

Table 7: Explaining financial outcomes

	(1) Balance on Bank Accounts	(2) Sum of Investments	(3) Log Net Income	(4) Financial Satisfaction	(5) Ladder of Life	(6) Ease of Living
Impatience	-1.2638* (0.5408)	-0.3878 (2.8130)	-0.0065** (0.0025)	-0.0161* (0.0074)	-0.0018 (0.0056)	-0.0193* (0.0083)
Inc. Impatience	-0.8274 (60.7773)	-10.4373 (408.9241)	0.0252 (0.2927)	-1.5135 (0.8545)	-0.9439 (0.6496)	-1.7189 (0.9796)
Dec. Impatience	-0.4427 (0.9443)	-5.9850 (10.1805)	0.0076 (0.0050)	-0.0052 (0.0154)	0.0012 (0.0112)	-0.0186 (0.0164)
Grit PoE	0.1527 (2.6142)	3.9707 (11.6362)	0.0402** (0.0132)	0.1343*** (0.0391)	0.1668*** (0.0294)	0.1383** (0.0445)
Grit CoI	-2.5046 (2.2134)	-5.1237 (8.7353)	0.0004 (0.0116)	0.0818* (0.0338)	0.0849*** (0.0257)	0.0244 (0.0387)
Female	1.8926 (4.7196)	3.6781 (19.0232)	-0.4187*** (0.0235)	0.2146** (0.0741)	0.1900*** (0.0561)	0.2790** (0.0861)
Age	1.1555 (0.8149)	5.2679 (3.2967)	0.0590*** (0.0043)	-0.0648*** (0.0133)	-0.0333*** (0.0100)	-0.0506** (0.0164)
Age squared	-0.0037 (0.0076)	-0.0391 (0.0295)	-0.0005*** (0.0000)	0.0007*** (0.0001)	0.0004*** (0.0001)	0.0005** (0.0001)
Married	8.1203 (5.3379)	-8.3354 (19.5659)	-0.1115*** (0.0292)	0.2852*** (0.0854)	0.2303*** (0.0646)	0.2841** (0.0970)
Divorced	-22.4292** (7.6407)	-24.6664 (34.9346)	0.0218 (0.0430)	-0.2594* (0.1243)	-0.0986 (0.0938)	-0.3086* (0.1392)
Education	3.4333* (1.6937)	8.5012 (6.6188)	0.1607*** (0.0083)	0.0697** (0.0264)	0.0979*** (0.0199)	0.0750* (0.0299)
No. of children	-4.0407 (2.4842)	-13.7988 (10.5950)	-0.0630*** (0.0128)	-0.0793* (0.0385)	-0.0133 (0.0293)	-0.1761*** (0.0451)
Home ownership	12.8573* (5.1702)	-5.9997 (25.4820)	0.0907** (0.0277)	0.6483*** (0.0814)	0.4144*** (0.0616)	0.8732*** (0.0939)
Log net income	7.5416 (4.0439)	23.7939 (14.3931)		0.4815*** (0.0628)	0.2160*** (0.0475)	0.7536*** (0.0767)
Self-employed	19.4454 (10.3656)	122.8481*** (32.3590)	-0.0768 (0.0538)	-0.0360 (0.1572)	-0.0583 (0.1190)	-0.0333 (0.1800)
<i>Adj. R²</i>	0.087	0.088	0.349	0.156	0.130	0.184
<i>N</i>	1043	237	2306	2057	2114	1981

Notes: OLS; standard errors in parentheses; dependent variables Balance on Bank Accounts and Sum of Investments in thousand euros; CoI = Consistency of Interests Grit subscale, PoE = Perseverance of Effort Grit subscale; all models include a dummy for DI=0 for patient respondents waiting until the maximum delay of the choice list (see section 2); reduced sample sizes due to missing data for some dependent variables; */**/** denote significance of difference from zero at 5% / 1% / 0.1%.

Table 8: Explaining health outcomes

	(1) General Health	(2) Sick days per month	(3) Smoker	(4) Alcohol intake, days per week	(5) Physically active, days per week	(6) Walking > 10m, days per week
	OLS	O-Logit	Probit	O-Logit	O-Logit	O-Logit
Impatience	-0.0031 (0.0034)	-0.0103 (0.0121)	0.0033 (0.0072)	0.0015 (0.0113)	-0.0055 (0.0095)	-0.0050 (0.0083)
Inc. impatience	0.0312 (0.3942)	-1.1943 (1.4387)	0.7891 (0.8135)	-2.8386* (1.4399)	-0.5175 (1.0805)	1.5011 (1.0093)
Dec. impatience	0.0000 (0.0068)	0.0078 (0.0248)	-0.0317 (0.0259)	-0.0627** (0.0225)	0.0068 (0.0181)	-0.0107 (0.0169)
Grit PoE	0.1418*** (0.0178)	-0.2129*** (0.0604)	0.0122 (0.0382)	-0.0476 (0.0602)	0.2157*** (0.0502)	0.1682*** (0.0435)
Grit CoI	0.0471** (0.0156)	-0.0907 (0.0547)	0.0553 (0.0340)	-0.0351 (0.0509)	-0.0896* (0.0419)	-0.0092 (0.0375)
Female	-0.0498 (0.0338)	0.1967 (0.1187)	-0.2020** (0.0750)	-0.4938*** (0.1059)	-0.3589*** (0.0898)	0.2444** (0.0814)
Age	-0.0395*** (0.0061)	0.0339 (0.0213)	0.0533*** (0.0136)	-0.0052 (0.0195)	-0.0154 (0.0165)	0.0076 (0.0145)
Age squared	0.0003*** (0.0001)	-0.0005* (0.0002)	-0.0006*** (0.0001)	0.0003 (0.0002)	-0.0001 (0.0002)	-0.0000 (0.0001)
Married	-0.0511 (0.0393)	0.1983 (0.1408)	-0.1249 (0.0878)	0.0887 (0.1240)	-0.2675* (0.1047)	-0.0429 (0.0937)
Divorced	-0.0463 (0.0578)	0.2966 (0.1997)	0.3416** (0.1147)	-0.0844 (0.1762)	0.0038 (0.1588)	-0.0204 (0.1375)
Education	0.0395** (0.0121)	-0.0309 (0.0423)	-0.1071*** (0.0264)	0.0554 (0.0381)	0.0172 (0.0330)	0.0747** (0.0287)
No. of children	0.0423* (0.0174)	-0.1172 (0.0616)	-0.0912* (0.0397)	-0.2162*** (0.0559)	0.0389 (0.0450)	-0.0659 (0.0422)
Home ownership	0.1131** (0.0374)	-0.5162*** (0.1252)	-0.3763*** (0.0777)	0.0915 (0.1227)	0.3986*** (0.1034)	0.1250 (0.0894)
Log net income	0.0775** (0.0281)	-0.3027*** (0.0902)	-0.0919 (0.0625)	-0.0262 (0.0907)	0.1221 (0.0746)	-0.0369 (0.0675)
Self-employed	0.1479* (0.0729)	-0.3201 (0.2891)	-0.0964 (0.1685)	0.3053 (0.2113)	0.2839 (0.1888)	0.0251 (0.1786)
<i>Adj. R²</i>	0.130					
<i>N</i>	2281	2279	2279	1398	2278	2278

Notes: Standard errors in parentheses; CoI = Consistency of Interests Grit subscale, PoE = Perseverance of Effort Grit subscale; all models include a dummy for DI=0 for patient respondents waiting until the maximum delay of the choice list (see section 2); reduced sample sizes due to missing data for some dependent variables; */**/** denote significance of difference from zero at 5% / 1% / 0.1%.

5 Discussion & Conclusion

We present the first joint measurement of time preferences, including time inconsistency, and grit on a large representative sample, and combine these measures with a survey of participants' dissatisfaction with their financial and health related behaviors, as well as a broader set of financial and health outcomes. Participants are on average impatient and about 56% deviate from constant discounting, and more often in the direction of decreasing impatience. Impatience is negatively associated with satisfaction with one's financial behaviors, and additionally predicts several financial outcomes. In contrast, we do not observe any associations for increasing or decreasing impatience with dissatisfaction measures or broader outcomes available on the LISS panel for health or finance. Grit has strong predictive power for financial and health-related decision making that goes beyond impatience alone. The higher participants score in grit, the less dissatisfied they are with their behaviors, and the two components of grit predict several financial and health outcomes, after controlling for impatience.

While our results on the association of impatience with financial outcomes is consistent with the results of the population-level study by Golsteyn et al. (2014), we do not find a link to health outcomes of comparable strength. The reason for this difference could be methodological: Golsteyn et al. (2014) ask adolescents to rate the extent to which they would prefer a hypothetical payment of SEK 900 today over a payment of SEK 9000 five years later. They relate the responses to financial outcome measures later in participants' lives. In contrast, we use an incentivized choice list design with a maximum time horizon of 58 weeks and link the impatience measure to financial outcome measures at the time of the study. It is conceivable that their rather intuitive measure of impatience and the question's longer time horizon capture a broader concept of time preferences (cf. Borghans et al., 2008; Frederick et al., 2002).

Correlations of grit with the demographic variables of our sample are stronger than in earlier research. Specifically, we find female gender, age, being married, education, and net income to be significantly positively correlated with grit. However, the effect of age mainly manifests itself through the consistency-of-interests component of Grit-S, while gender, marital status, and income mainly determine perseverance of effort. Only educational attainment appears to affect both components similarly. The meta-analysis of Credé et al. (2017) reports small correlation for these variables except for age.

Two important insights emerge regarding the relationship between the psychological grit scale and the incentivized economic time preference measures. First, as predicted, impatience correlates with the perseverance-of-effort component of Grit-S. However, the hypothesized

relationship between the consistency-of-interests component of grit and deviations from constant discounting does not materialize in our data. A possible explanation for this again lies in the framework we use to measure time preferences and time inconsistency. As most of the empirical literature in economics, we utilize the Money Earlier or Later (MEL) framework (Cohen et al., 2020). Its defining characteristic is that decisions are made over differently timed *cash flow events*, rather than *consumption events*.¹⁰ While impatience estimated in the MEL framework generally predicts field behavior in various contexts, the evidence for effects of time-inconsistent choices (such as present bias) is less compelling (see Cohen et al., 2020 for a review). For example, Augenblick et al. (2015) find inconsistency to be limited in choices over monetary rewards, but substantially stronger in real effort task behavior. It has even been argued that choices in the MEL framework might be better explained by heuristics than discounting models (Marzilli Ericson et al., 2015). In fact, our results match these previous observations perfectly: Impatience shows predictive power, but time inconsistency fails to add much value.

Second, despite the correlation of impatience and grit, in particular its PoE component, we find that both are predictive of participants' dissatisfaction with their financial behavior and their financial outcomes more broadly. That is, both measures seem to tap into different traits, both relevant to intertemporal financial decision making and consistency in planning (cf. Borghans et al., 2008). However, the economic time preference measures perform poorly for health behaviors and outcomes, while grit is predictive in both the health and the financial domain. Comparing the two components of grit, we find that the consistency-of-interests component is more predictive than the perseverance-of-effort component for the two dissatisfaction measures, but less predictive for broader measures of financial and health outcomes. The latter finding is consistent with previous findings in the domain of wellbeing and education, where the CoI component had little explanatory power (Bowman et al., 2015; Disabato et al., 2019). The strong performance for our dissatisfaction measures suggests that, as intended, these items tap into dissatisfaction deriving from an inconsistency between planned and actual behavior in the two domains of health and finances. Moffitt et al (2011) show that childhood self-control is a strong predictor of life outcomes across a broad range of outcomes, including health. Our results suggest that the discounting measures of time preference as typically employed in economics do not fully capture such psychological self-control effects.

¹⁰ It is implicitly assumed that cash flows (income) are immediately spent on consumption to yield utility. This implicit assumption, as Cohen et al. (2020) point out, is at odds with standard economic theories such as consumption smoothing.

In conclusion, the simple to administer grit measure seems to comprise additional psychological aspects that are not well captured by the standard set of economic time preference measures. How strongly these aspects help to explain behavior, however, may depend on the specific context. Our results suggest that empirical studies on intertemporal economic and financial decisions may strongly benefit from including the Grit-S Scale over and above any traditional time preference measures based on monetary time trade-offs.

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Data and code availability

Analysis files and our experimental data are available on OSF:

https://osf.io/qd63b/?view_only=5370f1ebe7ce45969e0b63829bdc2982.

This paper uses LISS panel data. More information about the panel can be found at <https://www.lissdata.nl>.

Declarations of interests

The authors declare not to have any competing interests.

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Appendix A: Questionnaires

Grit-S

These are a number of statements about how you tackle difficult tasks and projects compared to other people you know. There are no right or wrong answers: We would like to know how you see yourself.

G1: New ideas and projects sometimes distract me from previous ones.

very much like me O O O O O O O not like me at all

G2: Setbacks don't discourage me. I don't give up easily.

very much like me O O O O O O O not like me at all

G3: I have been obsessed with a certain idea or project for a short time but later lost interest.

very much like me O O O O O O O not like me at all

G4: I am a hard worker.

very much like me O O O O O O O not like me at all

G5: I often set a goal but later choose to pursue a different one.

very much like me O O O O O O O not like me at all

G6: I have difficulty maintaining focus on projects that take more than a few months to complete.

very much like me O O O O O O O not like me at all

G7: I finish whatever I begin.

very much like me O O O O O O O not like me at all

G8: I am diligent.

very much like me O O O O O O O not like me at all

Note: This questionnaire is taken from Duckworth and Quinn (2009). Items G1, G3, G5, G6 enter the score in reverse and constitute the consistency-of-interests factor of Grit, while the remaining items target perseverance of effort.

Financial Dissatisfaction Questionnaire

We would like to give you a brief overview of your views on finances.

F1: I think I should spend more time on financial planning, especially with regard to my pension.

strongly agree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly disagree

F2: I think I should save more (eg through a voluntary extra pension) in order to have sufficient income in the future.

strongly agree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly disagree

F3: I often think that I should spend money more thoughtfully in my daily consumption.

strongly agree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly disagree

F4: I am completely satisfied with my financial planning and my daily spending habits.

strongly agree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly disagree

Note: Item F4 enters the Financial Dissatisfaction Score in reverse.

Health Dissatisfaction Questionnaire

We would like to give you a brief overview of your views on health topics.

H1: I think I should spend more time thinking about my lifestyle and health.

strongly agree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly disagree

H2: I think I should spend more time on sports and other physical activities.

strongly agree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly disagree

H3: I often think I should eat more thoughtfully considering my health.

strongly agree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly disagree

H4: I am completely satisfied with my lifestyle (eating patterns and physical activities).

strongly agree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly disagree

Note: Item H4 enters the Health Dissatisfaction Score in reverse.

Appendix B: Additional Results

Table B1 Explaining financial outcomes (overall Grit Score)

	(1) Balance on Bank Accounts	(2) Sum of Investments	(3) Log Net Income	(4) Financial Satisfaction	(5) Ladder of Life	(6) Ease of Living
Impatience	-1.2738* (0.5405)	-0.3254 (2.8059)	-0.0067** (0.0025)	-0.0163* (0.0074)	-0.0023 (0.0056)	-0.0198* (0.0083)
Inc. impatience	-0.4350 (60.7574)	-16.0615 (408.1110)	0.0379 (0.2928)	-1.4979 (0.8542)	-0.9230 (0.6498)	-1.6593 (0.9794)
Dec. impatience	-0.4560 (0.9438)	-6.3375 (10.1415)	0.0078 (0.0051)	-0.0049 (0.0154)	0.0016 (0.0112)	-0.0180 (0.0164)
Grit Score	-2.6629 (2.5901)	-2.9338 (10.4720)	0.0369** (0.0139)	0.2106*** (0.0411)	0.2435*** (0.0313)	0.1512** (0.0470)
Female	2.0329 (4.7134)	4.5977 (18.9108)	-0.4183*** (0.0236)	0.2150** (0.0741)	0.1912*** (0.0561)	0.2793** (0.0861)
Age	1.1450 (0.8145)	5.1092 (3.2773)	0.0590*** (0.0043)	-0.0649*** (0.0133)	-0.0335*** (0.0100)	-0.0513** (0.0164)
Age ²	-0.0037 (0.0076)	-0.0385 (0.0294)	-0.0005*** (0.0000)	0.0007*** (0.0001)	0.0004*** (0.0001)	0.0005** (0.0001)
Married	8.4188 (5.3169)	-7.4725 (19.4643)	-0.1101*** (0.0292)	0.2864*** (0.0854)	0.2329*** (0.0646)	0.2860** (0.0970)
Divorced	-22.1840** (7.6293)	-24.6650 (34.8772)	0.0226 (0.0431)	-0.2597* (0.1243)	-0.0982 (0.0939)	-0.3080* (0.1393)
Education	3.3933* (1.6921)	8.0192 (6.5437)	0.1612*** (0.0084)	0.0699** (0.0264)	0.0984*** (0.0199)	0.0759* (0.0299)
No. of children	-4.0019 (2.4828)	-14.0656 (10.5654)	-0.0628*** (0.0128)	-0.0787* (0.0385)	-0.0125 (0.0293)	-0.1748*** (0.0451)
Home ownership	12.6688* (5.1607)	-6.7338 (25.4016)	0.0894** (0.0278)	0.6469*** (0.0814)	0.4124*** (0.0616)	0.8714*** (0.0939)
Log net income	7.6339 (4.0403)	25.2232 (14.1085)		0.4836*** (0.0627)	0.2192*** (0.0475)	0.7554*** (0.0767)
Adj. R ²	0.088	0.091	0.348	0.156	0.129	0.183
N	1043	237	2306	2057	2114	1981

Notes: OLS. Standard errors in parentheses; all models include a dummy for DI=0 for patient respondents waiting until the maximum delay of the choice list (see Section 2); dependent variables Balance on Bank Accounts and Sum of Investments in thousand euros; reduced sample sizes due to missing data for some dependent variables; */**/** denote significance of difference from zero at 5% / 1% / 0.1%.

Table B2: Explaining health outcomes (overall Grit Score)

	(1) General Health	(2) Sick days per month	(3) Smoker	(4) Alcohol intake, days per week	(5) Physically active, days per week	(6) Walking > 10m, days per week
	OLS	O-Logit	Probit	O-Logit	O-Logit	O-Logit
Impatience	-0.0036 (0.0034)	-0.0096 (0.0121)	0.0036 (0.0072)	0.0016 (0.0113)	-0.0069 (0.0095)	-0.0060 (0.0082)
Inc. impatience	0.0594 (0.3951)	-1.2385 (1.4383)	0.7760 (0.8131)	-2.8412* (1.4399)	-0.3810 (1.0769)	1.5572 (1.0080)
Dec. impatience	0.0003 (0.0068)	0.0074 (0.0248)	-0.0321 (0.0260)	-0.0628** (0.0225)	0.0080 (0.0181)	-0.0105 (0.0169)
Grit Score	0.1798*** (0.0188)	-0.2940*** (0.0671)	0.0712 (0.0407)	-0.0813 (0.0579)	0.0900 (0.0496)	0.1398** (0.0451)
Female	-0.0471 (0.0339)	0.1924 (0.1187)	-0.2032** (0.0750)	-0.4941*** (0.1058)	-0.3524*** (0.0897)	0.2503** (0.0814)
Age	-0.0397*** (0.0061)	0.0344 (0.0213)	0.0536*** (0.0136)	-0.0052 (0.0195)	-0.0150 (0.0165)	0.0071 (0.0145)
Age squared	0.0003*** (0.0001)	-0.0005* (0.0002)	-0.0006*** (0.0001)	0.0003 (0.0002)	-0.0001 (0.0002)	-0.0000 (0.0001)
Married	-0.0473 (0.0394)	0.1926 (0.1406)	-0.1266 (0.0877)	0.0883 (0.1239)	-0.2554* (0.1046)	-0.0340 (0.0935)
Divorced	-0.0443 (0.0579)	0.2947 (0.1996)	0.3392** (0.1146)	-0.0847 (0.1761)	0.0069 (0.1584)	-0.0143 (0.1375)
Education	0.0401*** (0.0121)	-0.0323 (0.0423)	-0.1074*** (0.0264)	0.0552 (0.0380)	0.0183 (0.0329)	0.0755** (0.0287)
No. of children	0.0432* (0.0174)	-0.1179 (0.0616)	-0.0920* (0.0397)	-0.2164*** (0.0558)	0.0390 (0.0450)	-0.0646 (0.0422)
Home ownership	0.1101** (0.0374)	-0.5111*** (0.1250)	-0.3750*** (0.0776)	0.0925 (0.1225)	0.3906*** (0.1033)	0.1205 (0.0893)
Log net income	0.0816** (0.0282)	-0.3085*** (0.0902)	-0.0941 (0.0624)	-0.0266 (0.0907)	0.1368 (0.0745)	-0.0299 (0.0676)
Adj. R ²	0.126					
N	2281	2279	2279	1398	2278	2278

Notes: Standard errors in parentheses; all models include a dummy for DI=0 for patient respondents waiting until the maximum delay of the choice list (see Section 2); reduced sample sizes due to missing data for some dependent variables; */**/** denote significance of difference from zero at 5% / 1% / 0.1%.

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Grit, Discounting, & Time Inconsistency

Abstract

We study the association of the perseverance-of-effort (PoE) and the consistency-of-interests (CoI) components of the psychological measure of grit, with economic measures of impatience and decreasing impatience (time inconsistency), respectively, in the general population. We find that impatience is associated with grit through the PoE component. No association of time inconsistency with grit is found. Predicting participants' financial and health outcomes and behaviors, we find that both impatience and grit are predictive for both outcomes, but this is not the case for time inconsistency. Our findings suggest that it can be beneficial for empirical studies of intertemporal decisions to include both economic impatience and psychological grit measures.

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