Original Article

On the Psychology of the Psychology Subject Pool

An Exploratory Test of the Good Student Effect

Hashem Sadeghiyeh[1], Siyu Wang[1], Hannah M. Kyllo[1], Maxwell R. Alberhasky[2], Shlishaa Savita[1], Kathryn L. Kellohen[1], and Robert C. Wilson[1,3,4]

[1]Department of Psychology, University of Arizona, Tucson, AZ, USA
[2]McCombs School of Business, University of Texas at Austin, TX, USA
[3]Cognitive Science Program, University of Arizona, Tucson, AZ, USA
[4]Evelyn F. McKnight Brain Institute, University of Arizona, Tucson, AZ, USA

Abstract: Many psychology researches are performed through "psychology subject pools" which give participants considerable flexibility when they participate. This "participant degree-of-freedom" has led to concern that the characteristics of subject pool participants may change with time, with the most engaged students signing up at the start of the semester and the least engaged students leaving it all to the end. In this paper, we performed an exploratory analysis to look for evidence of this "good student effect." Consistent with previous work, we find support for the good student effect with earlier participants scoring higher on the Big-Five subscales of Achievement-Striving and Cooperation, as well as Grit and Empathic-Concern. In addition, we found a non-linear effect of time-of-semester on Sensation-Seeking, with this measure peaking in the middle of the semester as well as the end. However, the vast majority of the measures we tested, including measures of personality, cognition, decision-making, and social interaction, did not correlate with time-of-semester or time-of-day at all. Thus, we conclude that, while some studies directly related to measures of Grit and Sensation-Seeking would do well to recruit throughout the semester, in most cases any bias introduced by the good student effect is likely to be small.

Keywords: psychology subject pool, time-of-semester, time-of-day, individual differences, grit, sensation seeking

Unless the research is aimed at a specific population, the subjects of most psychology experiments, especially in the United States, are psychology students, mostly those taking introductory psychology classes (Findley & Cooper, 1981; Higbee, Millard, & Folkman, 1982). In almost all of these subject pool systems, students are compensated by receiving course credit. According to Kangas and Hackenberg (2009), the use of course credit as an incentive was first reported by Greene and Sutor (1971) in the *Journal of the Experimental Analysis of Behavior*. Then after a decade of infrequent use, it became common practice in the mid-1980 s and 1990 s when around 32% of undergraduate psychology departments (Landrum & Chastain, 1999) and 74% of psychology departments with a graduate program (Sieber & Saks, 1989) used subject pools.

The most obvious benefit of such a system is convenience and access to lots of subjects at minimal cost (Cassidy & Kangas, 2014). It also has an educational benefit to the participants. The downside of such a system is that it may introduce several biases to the sample. First, college undergraduates represent only a tiny sliver of the total population differing along dimensions such as age, race/ethnicity, and socioeconomic status (SES) (Cooper, Baumgardner, & Strathman, 1991). Second is that the subjects have considerable choice in the experimental process. For example, Jackson, Procidano, and Cohen (1989) showed that subjects may choose specific types of experiments based on their personality traits.

Here we focus on a specific kind of subject choice, namely the choice of date and time of participation. Across all psychology studies, Miller (1981) estimated in 81% of cases, subjects have freedom to choose the date and time of experiment. In a subject pool situation, this number is likely closer to 100%. Regardless of the actual number, a subject's freedom to choose may introduce bias as certain personality types may be more likely to participate early or late. This bias could be especially problematic if the experiment is running for just a brief period concentrated either early or late in the semester (Cooper et al., 1991).

Anecdotally, we find that most of our colleagues (if they have the option between early and late subjects) prefer early subjects due to a belief that the quality of data is higher in early than late participants. The literature is in line with this implicit impression, which Zelenski, Rusting, and Larsen (2003) call the "good student effect". For example, early participants have higher GPAs (Cooper et al., 1991),

more positive attitudes toward the experiment (Adair, 1973), more internal control beliefs and interest in academia (Evans & Donnerstein, 1974), and are more motivated and better organized (Jackson et al., 1989) than late participants who tend to be more playful, more exhibitionistic, less socially responsible, and less dominant (Holden & Reddon, 1987). Interestingly procrastination does not seem to be correlated with time-of-semester (Wang & Jentsch, 1998). Aviv, Zelenski, Rallo, and Larsen (2002) investigated the relations between time-of-semester and the Big-Five personality traits (NEO PI-R; McCrae & Costa, 1997) and found weak but significant correlations between early participation and higher Conscientiousness, lower Extraversion and lower Openness to Experience. In addition to personality factors, demographic factors have also been found to vary across the semester. Most notably is the observation that females tend to participate earlier than males (Aviv et al., 2002; Ebersole et al., 2016).

Another related question concerns the possible relationship between the time of participation in the day (time-of-day) and the results of the study. There are fewer studies on the relationship between time-of-day and personality traits and it seems the relationships are fewer and weaker compared to the time-of-semester factor. For example, Zelenski et al. (2003) found significant positive correlations between participation later in the day and social desirability, need for achievement, extraversion, conscientiousness, activity level, and negative correlation with birth order. Zelenski et al. (2003) also reported an indirect correlation between time-of-semester and time-of-day through a self-report "morningness" questionnaire: participants higher in morningness tend to sign up earlier in the semester.

Several authors have proposed a solution whereby subjects are recruited over the entire course of semester instead of running an experiment in a short period of semester or the day (Cooper et al., 1991; Zelenski et al., 2003). However, such a conservative solution could be demanding, and it is often more convenient to run experiments all at once over a period of 1 or 2 weeks. Given the widespread usage of short-period sampling, the question is does it meaningfully bias the results? While some authors highlight the importance of its consideration (e.g., Evans & Donnerstein, 1974; Richter, Wilson, Milner, & Senter, 1981), others concluded the effect sizes were small and inconsistent and suggested researchers should not be worried about the time-of-semester effect (Cooper et al., 1991; Wang & Jentsch, 1998). More recently, Ebersole et al. (2016) investigated the time-of-semester variation in 2,696 participants in 20 different subject pools and with 10 experimental or correlational effects (e.g., Stroop task, availability heuristic, metaphoric structuring) and reported very small or no differences in those effects between early and late participants.

In the current study, we investigated the relationships between time-of-semester and time-of-day factors with a variety of demographic and personality traits we have used in our previous studies (Sadeghiyeh, 2019; Sadeghiyeh, Wang, & Wilson, 2018; Sadeghiyeh et al., 2020). In these studies, demographic and personality traits were not the main focus of the study but acquired as potential covariates and for exploratory analyses and included measures of demographic and different personality, cognitive, decision-making, and social traits. Based on the previous literature, we predicted weak to moderate correlations between time-of-semester and a variety of traits like gender, GPA, Extraversion, Agreeableness, Conscientiousness, Grit, and Sensation-seeking. Although the experiments were not designed with this question in mind, all analyses are corrected for multiple comparisons.

Methods

Participants

We collected data from a total of 485 participants (age: 18–29 years, average = 19.08 years; Females = 279, Males = 205, Transgender = 1) who took part in various experiments in our laboratory in 2015 and 2016 in which they responded to a bundle of questionnaires using Qualtrics. Not all of the measures were used in each experiment, so we have different sample numbers (from 146 to 485) for different measured traits. Participants were recruited through the Psychology subject pool at the University of Arizona and received course credit for their participation. The experiments were advertised online through SONA system and usually provided participants with a wide range of choices regarding the date (from early to last days of semester; both weekdays and weekends) and time (from 7 a.m. to 7 p.m.). All experiments were run in person on a computer in an experimental room with up to 3 other participants. Before answering the questionnaires, participants played a specific computer task depending on the purpose of the experiment. The task usually took about 20–30 min and the whole experiment was designed either for a 1-hour or 2-hour slot. All participants gave informed consent and the study was approved by the Institutional Review Board at the University of Arizona.

Measures

To aid exposition, we group the questionnaires used in our experiments in six categories based on the types of individual differences measured:

(1) *Demographic*: gender, age, race, US-born, years-in-US, GPA, parents' job, parents' education, family income, family size, and subjective SES.

(2) *Personality – Big-Five*: IPIP-NEO-120 (Johnson, 2014).
(3) *Personality – Others*: Grit Scale (Duckworth, Peterson, Matthews, & Kelly, 2007), Dispositional Positive Emotion Scale (DPES; Shiota, Keltner, & John, 2006), Personal Need for Structure (PNS; Neuberg & Newsom, 1993), Life History Strategy (Mini-K; Figueredo et al., 2006), and Life Orientation Test-Revised (LOT-R; Scheier, Carver, & Bridges, 1994).
(4) *Cognitive*: Rotter's Locus of Control (Rotter, 1966), Need for Cognition (Cacioppo & Petty, 1982), and Santa Barbara Sense of Direction (Hegarty, Montello, Richardson, Ishikawa, & Lovelace, 2006).
(5) *Decision-making*: Arnett Inventory of Sensation Seeking (AISS; Arnett, 1994), Financial Risk Tolerance Assessment (Grable & Lytton, 1999), Barratt Impulsivity Scale (BIS-11; Patton, Stanford, & Barratt, 1995), Tolerance of Ambiguity (Stanley Budner, 1962), Interest/Deprivation Epistemic Curiosity Scale (I/D; Litman, 2008), and Curiosity and Exploration Inventory (CEI-II; Kashdan et al., 2009).
(6) *Social*: Interpersonal Reactivity Scale (IRI; Davis, 1983), Revised Competitiveness (Harris & Houston, 2010), Fear of Negative Evaluation (Leary, 1983), Social and Economic Conservatism Scale (SECS; Everett, 2013), and Collectivism/Individualism (Triandis & Gelfand, 1998).

For a more detailed description of the measures, see Electronic Supplementary Material, ESM 1, Section A.

Results

Table 1 summarizes the descriptive statistics (minimum, maximum, mean, standard deviation, and number of participants) for most of the personality and demographic traits in our study (categorical and ordinal parameters are excluded). To have a better sense of the distribution of traits in our sample, the histogram of all 105 demographic and personality traits can be found in ESM 1, Section B – Figures S1–S5.

We defined the time-of-semester by counting days from the opening of subject pool (when students could sign up for experiments). At the University f Arizona, the first day of experiments was 7 and 10 days after the first day of semester in Fall and Spring semesters, respectively. The range of days of experiment happened to be exactly 100 days for each semester. The median of time-of-semester in our 485 participants was 66 (Males = 67; Females = 64) which shows most subjects signed up for the second half of the semester. Landrum and Chastain (1995) also reported most of their subjects participated in the second half of semester. The average "days into semester" was 70.1 which seems very close to ours considering an approximately one-week difference in our way of counting the time-of-semester and theirs.

Time-of-day was defined as the linear transformation of the time of experiment into 0–1 interval. For example, 12 a.m. → 0.0, 12 p.m. → 0.5, 11:59 p.m. → 1.0. The average of time-of-day for our 485 participants was 0.584 (∼2:01 p.m.) (Males = 0.60–2:24 p.m.; Females = 0.57–1:41 p.m.).

There was a significant correlation between time-of-semester and time-of-day of participation, (Pearson's $r(483) = .10$; $p = 0.03$), which shows those who tend to participate earlier in the semester also tend to participated earlier in the day. This finding is in line with Zelenski et al. (2003) who found that people high in "morningness" tend to participate early in the semester, though their "morningness" trait was assessed by a self-report questionnaire while in ours it is the actual time subjects participated in the study.

Correlations With Demographic/ Personality Traits

Tables 2–7 summarize the Pearson correlation coefficients between each demographic/personality trait (in six categories) we used in our experiments and both time-of-semester and time-of-day variables. Significant correlations are marked with one star (*) for $p < .05$ and double star (**) for those still significant after Bonferroni correction for multiple comparisons. We used Holm's sequentially rejective Bonferroni test (Holm, 1979) implemented in MATLAB by Groppe (2020). Table E1 (ESM 1, Section C) shows the calculated *adjusted p* by this method for the 20 highest p values in correlations between demographic/personality traits and time-of-semester. Alternatively, we can implement the Bonferroni correction by setting a protected α level of $.05/n$ in which n is the number of hypotheses. Here we tested correlations between 105 traits with 2 variables (time-of-semester and time-of-day) yielding 210 tests in total. Applying Bonferroni correction in this way yielded similar results except for A4 – Cooperation which survived only the Bonferroni-Holm method.

Demographic

Table 2 shows the results for the demographic traits. Gender and Age had a negative correlation with time-of-semester (i.e., younger and females participated earlier in the semester than older and males, respectively). This pattern was also observed for the time-of-day: females and

Table 1. Descriptive statistics; range, mean (*M*), and standard deviation (*SD*)

Traits	Range		*M*	*SD*	*N*
	Min	Max			
Demographic					
Age	18	29	19.08	1.38	485
Years-in-US	0	29	15.79	6.50	485
GPA high school	2	4.7	3.50	0.41	483
Temporal discounting	4	27	15.26	4.15	220
Family size	1	15	4.09	1.39	485
SES	0.4	3	2.16	0.53	485
Subjective SES	10	100	63.53	18.52	485
Neuroticism	33	106	68.37	14.81	220
N1 Anxiety	4	20	12.98	3.62	220
N2 Anger	4	20	11.23	3.78	220
N3 Depression	4	20	9.75	3.72	220
N4 Self-consciousness	4	20	11.50	3.14	220
N5 Immoderation	4	20	12.01	2.96	220
N6 Vulnerability	4	20	10.91	3.56	220
Extraversion	31	112	84.27	12.54	220
E1 Friendliness	4	20	14.55	3.07	220
E2 Gregariousness	4	20	13.24	3.57	220
E3 Assertiveness	4	20	14.25	3.07	220
E4 Activity level	5	20	12.28	2.80	220
E5 Excitement seeking	4	20	14.26	3.09	220
E6 Cheerfulness	7	20	15.68	2.78	220
Openness to Experience	52	109	80.09	11.03	220
O1 Imagination	7	20	14.80	2.98	220
O2 Artistic interests	6	20	14.02	3.30	220
O3 Emotionality	5	20	14.52	3.25	220
O4 Adventurousness	4	19	11.79	2.81	220
O5 Intellect	6	20	13.24	3.09	220
O6 Liberalism	4	19	11.72	2.91	220
Agreeableness	60	113	88.46	11.38	220
A1 Trust	4	20	13.83	3.23	220
A2 Morality	8	20	15.72	3.12	220
A3 Altruism	6	20	16.06	2.57	220
A4 Cooperation	4	20	15.13	3.17	220
A5 Modesty	4	20	12.79	3.41	220
A6 Sympathy	8	20	14.92	2.50	220
Conscientiousness	44	117	83.49	12.86	220
C1 Self-efficacy	4	20	14.89	2.64	220
C2 Orderliness	4	20	13.09	3.67	220
C3 Dutifulness	7	20	15.44	2.40	220
C4 Achievement striving	4	20	14.41	3.06	220
C5 Self-Discipline	4	20	12.89	2.76	220
C6 Cautiousness	4	20	12.77	3.53	220
BIS total	39	92	65.52	9.99	393
BIS Attentional	9	29	17.70	3.51	393
BIS Attentional – Attention	5	19	10.95	2.53	393
BIS Attentional – Cognitive instability	3	12	6.75	1.79	393
BIS Motor	12	41	22.80	4.53	393
BIS Motor – Motor	8	28	15.61	3.54	393

(Continued on next page)

Table 1. (Continued)

Traits	Range		*M*	*SD*	*N*
	Min	Max			
BIS Motor – Perseverance	4	14	7.20	1.85	393
BIS Nonplanning	11	41	25.02	4.69	393
BIS Nonplanning – Self-control	6	24	12.94	3.06	393
BIS Nonplanning – Cognitive complexity	5	18	12.07	2.49	393
Tolerance of ambiguity total	37	87	60.76	7.23	391
Tolerance of ambiguity novelty	7	28	16.97	3.41	391
Tolerance of ambiguity complexity	15	53	32.00	5.25	391
Tolerance of ambiguity insolubility	3	19	11.80	2.53	391
Personal need for structure	25	62	40.94	6.66	219
I/D total	11	40	25.48	4.98	219
I/D Interest type	6	20	14.14	2.83	219
I/D Deprivation type	5	20	11.35	2.92	219
CEI-II total	10	50	31.92	6.98	219
CEI-II Stretching	5	25	16.65	3.72	219
CEI-II Embracing	5	25	15.27	4.01	219
DPES Joy	11	42	29.35	5.42	219
DPES Contentment	6	35	23.42	5.76	219
DPES Pride	5	35	25.60	5.39	219
DPES Love	9	42	28.20	6.27	219
DPES Compassion	9	35	28.26	5.06	219
DPES Amusement	13	35	26.70	4.99	219
DPES Awe	6	42	29.65	6.00	219
Sensation seeking total	28	69	50.02	7.51	391
Sensation seeking novelty	14	36	25.07	4.38	391
Sensation seeking intensity	12	38	24.95	4.46	391
Locus of control	2	21	11.85	3.64	219
Need for cognition	25	86	56.99	10.02	481
Mini-K	34	135	102.17	13.76	481
Competitiveness total	16	70	46.69	9.77	481
Competitiveness enjoyment of competition	9	45	32.30	7.56	481
Competitiveness Contentiousness	5	25	14.39	4.06	481
Sense of direction	25	100	62.64	14.85	389
IRI Perspective taking	11	35	23.92	4.56	481
IRI Fantasy	10	35	23.51	5.09	481
IRI Empathic concern	7	35	25.84	4.80	481
IRI Personal distress	7	31	18.36	4.48	481
Fear of negative evaluation	12	60	38.15	9.71	342
LOT-R	7	30	20.19	3.64	342
Conservatism total	56	917	516.91	160.87	341
Economic conservatism	−16	379	178.40	71.29	341
Social conservatism	−20	600	338.51	125.54	341
Financial risk tolerance	24	56	39.78	5.76	249
Grit scale	20	57	38.55	6.50	342
Horizontal individualism	12	36	27.93	5.52	337
Vertical individualism	4	36	22.24	6.62	337
Horizontal collectivism	4	36	27.15	5.44	337
Vertical collectivism	4	36	27.39	5.70	337

Note. SES = Socioeconomic Status; BIS = Barratt Impulsivity Scale; I/D = Interest/Deprivation Epistemic Curiosity Scale; CEI-II = Curiosity and Exploration Inventory; DPES = Dispositional Positive Emotion Scale; Mini-K = the 20-item short form of the Arizona Life History Battery; IRI = Interpersonal Reactivity Scale; LOT-R = Life Orientation Test-Revised.

Table 2. Demographic traits' correlations with time-of-semester and time-of-day

	Time-of-semester		Time-of-day		
Demographic trait	*r*	*p*	*r*	*p*	*N*
Gender	−.11*	.016	−.12*	.009	485
Age	−.09*	.050	−.13*	.004	485
Race	.04	.330	.07	.105	485
US born	.12*	.007	−.02	.600	485
Years-in-US	.11*	.015	−.04	.382	485
GPA high school	−.09*	.041	< .01	.909	483
Parents' education	.06	.163	−.01	.825	485
Parents' job	.03	.695	.09	.287	144
Mother's education	.08	.075	< .01	.980	485
Father's education	.03	.472	−.05	.250	478
Mother's job	.08	.363	.05	.608	118
Father's job	< .01	.993	.12	.158	130
Family income	.15*	.001	.03	.450	485
Family size	−.02	.612	.03	.523	485
SES	.13*	.004	.03	.546	485
Subjective SES	−.06	.217	.09	.054	485

Note. SES = Socioeconomic Status. *Significant at $p < .05$; **significant after Bonferroni Correction.

younger students participated earlier in the day than males and older students. In line with previous researches, GPA also had a negative correlation with the time-of-semester: higher GPA students participated earlier than lower GPA ones. Socioeconomic status and family income had a positive correlation with the time-of-semester: higher SES students participated later in the semester than lower SES ones. Lastly, international students tended to participate earlier than US born ones and the more they had lived in the US, the more similar they became to the US-born students in this regard. These correlations are around .10–.15 and none of them stand significant after Bonferroni multiple comparison correction.

Big-Five

For the Big-Five traits (Table 3), Openness to Experience (and O6 – Liberalism), Agreeableness (and A2 – Morality, A4 – Cooperation, A6 – Sympathy), and Conscientiousness (and C3 – Dutifulness, C4 – Achievement Striving, C5 – Self-Discipline) had a negative correlation with time-of-semester, that is, more Agreeable, more Conscientious and more Open students tend to participate earlier. The only positive correlation was for E2 – Gregariousness (a sub-scale of Extraversion). This pattern is similar to previous research (Aviv et al., 2002). After Bonferroni correction, only two sub-scales of the Big-Five stand significantly correlated with time-of-semester: A4 – Cooperation (Pearson's $r(218) = -.24$; $p < .001$) and C4 – Achievement Striving (Pearson's $r(218) = -.25$; $p < .001$). None of the main and sub-scales traits was correlated with the time-of-day.

Table 3. Big-Five personality traits' correlations with time-of-semester and time-of-day

	Time-of-semester		Time-of-day		
Big-Five traits	*r*	*p*	*r*	*p*	*N*
Neuroticism	.04	.604	.04	.572	220
N1 Anxiety	−.02	.730	.04	.545	220
N2 Anger	.12	.065	.05	.467	220
N3 Depression	.04	.603	.05	.500	220
N4 Self-consciousness	.02	.732	.09	.166	220
N5 Immoderation	−.04	.520	−.06	.384	220
N6 Vulnerability	.02	.804	−.02	.813	220
Extraversion	.08	.233	−.02	.755	220
E1 Friendliness	.07	.271	.04	.556	220
E2 Gregariousness	.19*	.005	.01	.937	220
E3 Assertiveness	−.05	.479	.04	.508	220
E4 Activity level	−.03	.696	−.05	.457	220
E5 Excitement seeking	.11	.111	−.08	.255	220
E6 Cheerfulness	< .01	.993	−.06	.380	220
Openness to Experience	−.14*	.038	.04	.535	220
O1 Imagination	−.07	.317	.06	.368	220
O2 Artistic interests	−.13	.061	−.04	.584	220
O3 Emotionality	−.04	.523	.10	.154	220
O4 Adventurousness	.02	.769	−.01	.914	220
O5 Intellect	−.10	.122	.04	.533	220
O6 Liberalism	−.18*	.009	−.01	.927	220
Agreeableness	−.18*	.008	−.06	.393	220
A1 Trust	−.02	.732	.03	.648	220
A2 Morality	−.15*	.029	.01	.918	220
A3 Altruism	−.11	.091	.03	.609	220
A4 Cooperation	−.24**	< .001	−.13	.063	220
A5 Modesty	−.03	.658	−.09	.165	220
A6 Sympathy	−.14*	.032	−.06	.370	220
Conscientiousness	−.21*	.001	−.09	.161	220
C1 Self-efficacy	−.11	.118	−.10	.134	220
C2 Orderliness	−.11	.120	−.07	.277	220
C3 Dutifulness	−.17*	.010	−.03	.612	220
C4 Achievement striving	−.25**	< .001	−.10	.159	220
C5 Self-discipline	−.20*	.003	−.09	.177	220
C6 Cautiousness	−.11	.118	−.02	.821	220

Note. *Significant at $p < .05$; **significant after Bonferroni Correction.

Personality-Other

Table 4 shows the results for the third category (Personality-Other). Hopefulness as measured by the LOT-R, the Compassion component of DPES and Grit Scale, all showed negative correlations with the time-of-semester, while no traits in this category showed a significant correlation with the time-of-day. Students with higher grit, higher hopefulness, and higher "compassion" (as measured by DPES) tended to participate earlier in the semester. After Bonferroni correction, only Grit scale stands significantly

Table 4. "Other Personality" traits' correlations with time-of-semester and time-of-day

	Time-of-semester		Time-of-day		
Other Personality traits	*r*	*p*	*r*	*p*	*N*
Grit scale	−.26**	< .001	−.07	.206	342
DPES					
Joy	.01	.866	.01	.862	219
Contentment	−.04	.584	.01	.941	219
Pride	−.09	.198	−.06	.414	219
Love	.04	.562	.04	.606	219
Compassion	−.19*	.006	.02	.787	219
Amusement	−.06	.397	−.10	.157	219
Awe	−.10	.127	−.10	.131	219
Personal need for structure	.03	.646	.09	.195	219
Life history					
Mini-K	−.03	.479	< .01	.917	481
LOT-R	−.11*	.037	−.04	.465	342

Note. DPES = Dispositional Positive Emotion Scale; Mini-K = the 20-item short form of the Arizona Life History Battery; IRI = Interpersonal Reactivity Scale; LOT-R = Life Orientation Test-Revised. *Significant at $p < .05$; **significant after Bonferroni Correction.

correlated with time-of-semester (Pearson's $r(340) = -.26$; $p < .001$).

Cognitive

No traits in this group were correlated with time-of-semester or time-of-day, as shown in Table 5.

Decision-Making

Table 6 summarizes correlations between traits in decision-making group. Arnett Sensation Seeking and both of its subscales: Novelty and Intensity, BIS-11 and two of its subscales: Attentional – attention and Nonplanning – Self-control showed a positive correlation with time-of-semester; that is, the higher the BIS or Sensation seeking, the later students tend to participate. After Bonferroni correction, only Sensation seeking and one of its subscales, Novelty, remained significantly correlated with time-of-semester (Pearson's $r(389) = .26$; $p < .001$). One measure in this category, Tolerance of Ambiguity, showed a significant correlation with time-of-day (Pearson's $r(389) = .11$; $p = .03$), but it did not remain significant after Bonferroni correction.

Social

In the "Social" group, Horizontal Collectivism and all four subscales of IRI were significantly correlated with time-of-semester (Table 7). IRI – Personal distress showed a positive correlation: the higher the Personal distress, the later the participation. Other IRI subscales (Fantasy, Perspective taking, and Empathic concern), as well as Horizontal Collectivism, showed the opposite direction: students with higher empathy/perspective-taking/fantasy/horizontal-collectivism tended to participate earlier in the semester. After Bonferroni correction, only IRI – Empathic Concern remained significantly correlated with time-of-semester (Pearson's $r(389) = -.17$; $p < .001$). There was one scale which showed a significant correlation with the time-of-day: Fear of Negative Evaluation (Pearson's $r(340) = .12$; $p = .027$). However, it did not hold after Bonferroni correction (like other correlations with time-of-day).

Table 5. "Cognitive" traits' correlations with time-of-semester and time-of-day

	Time-of-semester		Time-of-day		
Cognitive traits	*r*	*p*	*r*	*p*	*N*
Locus of control	.06	.349	.01	.885	219
Need for cognition	−.06	.162	−.01	.833	481
Sense of direction (Santa Barbara)	−.02	.637	−.07	.182	389

Table 6. "Decision-making" traits' correlations with time-of-semester and time-of-day

	Time-of-semester		Time-of-day		
Decision-making traits	*r*	*p*	*r*	*p*	*N*
Sensation seeking	.26**	< .001	−.02	.658	391
Novelty	.28**	< .001	−.04	.379	391
Intensity	.16*	.001	.01	.906	391
Financial risk tolerance	.08	.234	< .01	.950	249
BIS-11	.14*	.004	.03	.579	393
Attentional	.11*	.024	.05	.311	393
Attention	.18*	< .001	.02	.661	393
Cognitive instability	−.02	.625	.07	.172	393
Motor	.08	.116	.02	.662	393
Motor	.07	.163	.01	.807	393
Perseverance	.06	.239	.03	.547	393
Nonplanning	.14*	.004	< .01	.997	393
Self-control	.16*	.001	−.02	.717	393
Cognitive Complexity	.07	.150	.02	.651	393
Tolerance of ambiguity	−.04	.490	.11*	.027	391
Novelty	−.01	.799	.06	.222	391
Complexity	−.02	.668	.08	.095	391
Insolubility	−.04	.462	.06	.230	391
I/D	−.04	.589	< .01	.967	219
Interest type	−.07	.315	−.03	.639	219
Deprivation type	< .01	.959	.03	.701	219
CEI-II	−.05	.470	−.08	.260	219
Stretching	−.07	.330	−.04	.516	219
Embracing	−.02	.722	−.09	.174	219
Temporal discounting	−.05	.429	−.08	.234	220

Note. BIS = Barratt Impulsivity Scale; I/D = Interest/Deprivation Epistemic Curiosity Scale; CEI-II = Curiosity and Exploration Inventory. *Significant at $p < .05$; **significant after Bonferroni Correction.

Table 7. "Social" traits' correlations with time-of-semester and time-of-day

	Time-of-semester		Time-of-day		
Trait	*r*	*p*	*r*	*p*	*N*
IRI					
Perspective taking	−.15*	.001	.03	.514	481
Fantasy	−.11*	.018	−.04	.405	481
Empathic concern	−.17**	< .001	.04	.368	481
Personal distress	.10*	.028	< .01	.923	481
Competitiveness	.02	.688	−.06	.168	481
Enjoyment of competition	−.01	.816	−.07	.128	481
Contentiousness	.06	.162	−.02	.627	481
Fear of negative evaluation	−.10	.067	.12*	.027	342
Conservatism	.06	.269	−.04	.488	341
Economic	.10	.066	.01	.823	341
Social	.02	.708	−.06	.309	341
Individualism					
Horizontal	−.08	.154	−.06	.292	337
Vertical	.08	.152	−.08	.127	337
Collectivism					
Horizontal	−.15*	.005	−.02	.734	337
Vertical	−.02	.740	−.07	.205	337

Note. IRI = Interpersonal Reactivity Scale. *Significant at $p < .05$; **significant after Bonferroni Correction.

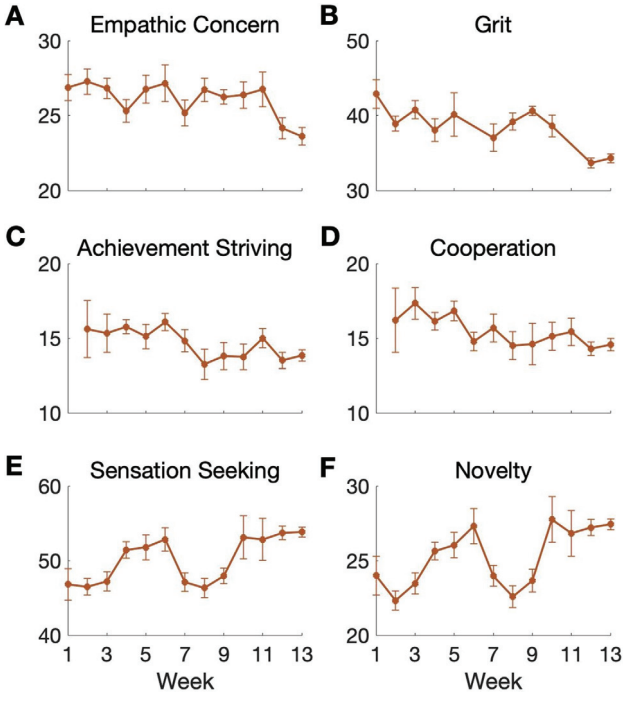

Figure 1. Changes in (A) IRI – Empathic Concern, (B) Grit Scale, (C) A4 – Achievement Striving, (D) C4 –Cooperation, (E) Arnett Sensation Seeking – total, and (F) Arnett Sensation Seeking – Novelty through the semester (Weeks 1–13). The bars represent the standard errors of the means (*SEM*), that is, error bars.

Analysis of Variance (ANOVA)

To test for possible non-monotonic relationships between time of semester and personality traits, we performed an ANOVA. In particular, we discretized time of semester based on week (from 1 to 13) and asked whether there was an effect of group on trait.

Table E2 (ESM 1, Section D) shows the results of this analysis for those traits that yielded a significant F value. These results are not the same as what we obtained through a simple Pearson correlation (A4 – Cooperation and C4 – Achievement Striving did not show up here for example), but the overall scheme is similar, specifically for the Grit scale and Arnett sensation seeking which shows the largest F value and significance at $p < .001$.

Figure 1 shows the plot of means of the six variables that remained after Bonferroni correction in our correlation analysis: Grit Scale, Arnett Sensation Seeking (and its Novelty sub-scale), C4 – Achievement Striving, A4 – Cooperation, and IRI – Empathic Concern. One interesting point from this plot is the non-linear pattern of Arnett Sensation Seeking through the semester: it seems to follow a half-semester time period than a full one. The average score for sensation seeking is comparatively low at the beginning of semester and it goes up until around the mid-term (week 6). Then it goes down sharply to the level of week 1 and again gradually goes up through week 13.

Controlling for Gender

Since females and males have different personality traits and they tend to participate in different time-of-semester, the correlations between time-of-semester and personality traits might be due to gender differences in personality. To take this notation into account, we calculated partial correlations between traits and time-of-semester, controlling for gender. The results (ESM 1, Section E) are almost similar to the original results (Tables 1–6), especially in the Grit Scale, Arnett Sensation seeking, and IRI – Empathic concern. Table E3 in ESM 1, Section E, shows the significant partial correlations ($p < .05$, no multiple comparison correction).

Discussion

In this paper, we investigated time-of-semester and time-of-day effects on demographic and personality variables in the psychology subject pool at the University of Arizona, a large public school in the US. Overall, we found a similar demographic/personality profile mentioned in previous studies with some differences and new findings.

Consistent with previous work, we found that early participants were more likely to be female, more

Conscientious, more Agreeable, more Open, and less Extroverted than those who participated late in the semester. Such a pattern is consistent with the "good student effect" (Zelenski et al., 2003), whereby early participants are better students, and lends weight to earlier studies.

In contrast to previous work, we found no correlation of time-of-semester with temporal discounting (Cassidy & Kangas, 2014) and PNS (Roman, Moskowitz, Stein, & Eisenberg, 1995). Indeed, even without correction for multiple comparisons, there was no relationship between time-of-semester and these variables. For temporal discounting, the discrepancy might be due to using a different measure. In our experiment, participants picked between "today" and "later" options in 27 scenarios with varying rewards and delays (Kirby, Petry, & Bickel, 1999). In contrast, Cassidy and Kangas (2014) used a different procedure in which the future reward was always fixed at $100 and participants reported the delay (between 1 week and 8 years) at which they would be indifferent between the two options. Also, while our task was presented in a short-survey form, in their procedure a search assistant was heavily involved in verbal presentation of each scenario and finding the point of indifference on screen. These major differences hold us from drawing a straightforward speculation on the observed discrepancy. For the PNS, Roman et al. (1995) used the same measure as ours (Neuberg & Newsom, 1993), but there are differences in time (more than 20 years distance between two experiments) and context (New York vs. Tucson) that may contribute to the observed discrepancy.

We also found evidence that two novel traits are associated with time of semester, both of which stand after Bonferroni correction for multiple comparisons. The first is Grit, which is a measure of perseverance and resilience, and was developed to describe the personal qualities essential to high achievement. It is defined as the passion for long-term goals and persistence in working toward these goals despite adversity or failure (Duckworth et al., 2007). As such, the Grit concept fits very well with the "good student" effect (Zelenski et al., 2003).

Consistent with our finding for Grit, several overlapping constructs have also been shown correlated with time-of-semester. For example, Strube and Ota (1982) reported that type A personality traits (which is related to being more competitive, more ambitious and highly organized) are found higher in early than late participants. Richert and Ward (1976) reported a decline in participants' self-esteem over the course of semester. Also, it has been found that early participants spent more time on filling questionnaires than late participants which has been interpreted by some researchers as their greater seriousness of purpose (Mulry & Dunbar, n.d.; cited in Rosenthal & Rosnow, 1975). In the present study, we found that Conscientiousness (and more strongly its subscale Achievement Striving) also decreased over the course of the semester and, in line with previous work (Duckworth et al., 2007) we found a significant correlation between Conscientiousness and Grit ($r(78) = 0.29$; $p = .0089$). In their meta-analysis, Credé, Tynan, & Harms (2017) found a much stronger correlation between Grit and Conscientiousness ($k = 22$, $N = 18{,}826$, $\rho = .84$, $SD\rho = .07$). This suggests that Grit may be just Conscientiousness in disguise and our finding that Grit correlates with time-of-semester is just a replication of previous findings that Conscientiousness correlates with time-of-semester.

The second trait that varies with time of semester, Arnett Sensation Seeking, does not fit so cleanly with the "good student effect". In particular, rather than a monotonic decline in Sensation Seeking through the semester (as one might expect if "good students" were less sensation seeking), we found a non-monotonic relation with time-of-semester with Sensation Seeking peaking in the middle as well as the end of the semester (Figures 1E and 1F). One possible explanation for this is that sensation-seekers seek partying in college and the parties' schedules in colleges seem to distribute unevenly throughout the semester (more partying in the beginning of semester and after mid-terms). Another related parameter involved is short vacations in the middle of semester: fall and spring breaks. The important note here is that for some traits like sensation seeking, a linear assumption might be misleading, and we need to consider the pattern of changes during semester to better detect any time-of-semester effects, if there is one.

So, after all, does any of this matter? Should we control for time-of-semester and time-of-day effects when running a study? On the one hand, most of the effects we measured were small and (statistically)insignificant even at the liberal thresholds without correcting for multiple comparisons. Thus, for many studies, acquisition over a short period of time in the semester is unlikely to lead to major bias. However, for other studies, where the focus is on constructs related to Grit, Sensation Seeking, or the other measures we found above, more care may be required, especially when the anticipated effect sizes may be small (Meyer et al., 2001).

Electronic Supplementary Material

The electronic supplementary material is available with the online version of the article at https://doi.org/10.1027/1614-0001/a000327

ESM 1. Section A: detailed description of the measures; section B: descriptive statistics-histograms (Figures E1–E5); section C: Bonferroni-Holm correction

for multiple comparisons (Table E1); section D: ANOVA table (Table E2); section E: partial correlations (Table E3)

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Publication Ethics
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Hashem Sadeghiyeh, Siyu Wang, and Robert C. Wilson designed the experiments. Hashem Sadeghiyeh, Hannah M. Kyllo, Maxwell R. Alberhasky, Shlishaa Savita, and Kathryn L. Kellohen ran the experiments. Hashem Sadeghiyeh analyzed the data with supervision from Robert C. Wilson. Hashem Sadeghiyeh and Robert C. Wilson wrote the manuscript with input from all other authors.

Open Data
All the data and MATLAB codes for the analyses are available at https://github.com/hashem20/time-of-semester

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ORCID
Hashem Sadeghiyeh
https://orcid.org/0000-0002-5362-3944

Hashem Sadeghiyeh
Department of Psychology
University of Arizona
1503 E University Blvd
Tucson, AZ 85721
USA
sadeghiyeh@email.arizona.edu