

APPENDIX A: Additional estimation details

TABLE A1: Sample Selection and Attrition Analysis (used for IPW estimations)

Probit Estimation	Dep Var = Finished Protocol (=1) (Conditional on being recruited)
Variable	Coefficient (SE)
SR (=1)	-.568 (.192)***
Female (=1)	-.156 (.203)
Minority (=1)	.096 (.248)
Age	-.047 (.030)
Optimal Sleep	-.117 (.095)
Anxiety Risk	-.035 (.039)
Depression Risk	.138 (.131)
Epworth	.062 (.030)**
Reduced-MEQ	.039 (.031)
Observations	N=279
Log Likelihood	-115.01616

Notes: Full recruited sample of n=279 participants, n=258 started the protocol (i.e., showed up for Session 1) and n=237 finished the protocol (a small number lacked complete sleep data or failed to complete a task, as reflected in sample sizes for individual tasks). * $p < .10$, ** $p < .05$, *** $p < .01$ for the 2-tailed test. Predicted likelihood of protocol completion for each participant used to determine weights for selection correction based on inverse probability weighting (IPW) in individual outcomes analysis. *Optimal Sleep* is the participants self-reported optimal amount of nightly sleep for optimal performance from the initial online screening survey. *Anxiety* and *Depression* risk are scores from validated short-form primary screeners for major depressive disorder and generalized anxiety disorder. *Epworth* is one’s score on the *Epworth Sleepiness Scale*, which is a validated measure of daytime sleepiness, with higher scores indicating greater daytime sleepiness. Finally, *Reduced-MEQ* is a short-form validated measure of one’s morningness-eveningness preferences.

TABLE A2: Probability of Burning Money
Inverse Probability Weight correction for sample selection

Marginal Effect (SE) displayed Independent Variable	All Subjects		Compliant Subjects	
	Income ≤ Other's	Income ≥ Other's	Income ≤ Other's	Income ≥ Other's
Diff Income	0.0001 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)	0.0001 (0.0002)
Equal Income (x = y)	-0.191 (0.026)***	-0.038 (0.039)	-0.194 (0.028)***	-0.042 (0.036)
Relative Cost (of burning)	---	0.463 (0.747)	---	0.547 (0.829)
SR	0.043 (0.037)	-0.013 (0.019)	0.053 (0.038)	-0.002 (0.019)
Epworth	.010 (0.005)*	-0.003 (0.002)	0.007 (0.005)	-0.001 (0.020)
Age	0.007 (0.006)	-0.002 (0.002)	0.010 (0.006)	-0.0003 (0.002)
Female	0.043 (0.037)	0.016 (0.018)	0.040 (0.038)	0.025 (0.018)
Minority	0.055 (0.043)	0.040 (0.025)*	0.070 (0.045)	0.025 (0.024)
Observations	1155	1155	1015	1015
# subjects	231	231	203	203
Log Pseudo-Likelihood	-527.87	-201.59	-457.44	-165.85

Notes: *.10, **.05, ***.01 for the 1-tailed test on the hypothesized sleep effect (other tests are 2-tailed). Standard Errors clustered at the individual subject level. Number of subjects reflects reduction due to 4 subjects for which we lacked complete data from the task. Results are all robust to use of a continuous average nightly sleep time (minutes per night) or a personal sleep deprivation variable to control for sleep condition rather than the dichotomous SR indicator. Results available on request.

TABLE A3: Coin Flip task regressions—Continuous Average Nightly Sleep Time measure
see Figure 4 coefficient plots

Dependent Variable = # Reported Heads flipped (out of 15)

Independent Variable	All Subjects			Compliant-Only Subjects		
	(1) Coef (SE)	(2) Coef (SE)	(3) Coef (SE)	(4) Coef (SE)	(5) Coef (SE)	(6) Coef (SE)
Constant	11.166 (0.967)***	13.039 (1.521)***	13.012 (1.465)***	11.401 (1.002)***	13.268 (1.585)***	13.247 (1.517)***
Avg Sleep Time (min/night)	-0.005 (0.002)**	-0.004 (0.002)**	-0.004 (0.003)*	-0.006 (0.003)***	-0.005 (0.003)**	-0.005 (0.003)**
Epworth	---	0.040 (0.046)	0.044 (0.051)	---	0.031 (0.049)	0.036 (0.053)
Age	---	-0.100 (0.058)*	-0.112 (0.046)**	---	-0.095 (0.060)	-0.108 (0.047)**
Female	---	-1.098 (0.338)***	-1.040 (0.361)***	---	-1.007 (0.371)***	-0.040 (0.405)**
Minority	---	0.411 (0.384)	0.401 (0.412)	---	0.031 (0.049)	0.298 (0.053)
<i>IPW correction for sample selection</i>	No	No	Yes	No	No	Yes
Observations	196	196	192	173	173	169
R-squared	.023	.086	.085	.032	.084	.082

Notes: *.10, **.05, ***.01 for the 1-tailed test on the hypothesized sleep effect (other tests are 2-tailed). Sample size reduced by those who chose not to complete this additional (voluntary) online task for extra compensation and one additional participant with corrupted actigraphy data. Robust standard errors shown for models using the inverse-probability weight (*IPW*) correction for selection. These *IPW*-correction models have sample size reduced by 4 observations in models (3) and (6) due to uncertainties regarding inclusion of these participants in the selection equation estimation missing data on selection equation regressors (e.g., one withdrew at less than 24 hrs from completion due to military orders, another preferred to withdraw but was asked to continue so that we would have an even number of participants for a paired task not reported here).

TABLE A4: Coin Flip task regressions—Continuous *Personal Sleep Deprivation* measure
see Figure 4 coefficient plots

Dependent Variable = # Reported Heads flipped (out of 15)

Independent Variable	All Subjects			Compliant-Only Subjects		
	(1) Coef (SE)	(2) Coef (SE)	(3) Coef (SE)	(4) Coef (SE)	(5) Coef (SE)	(6) Coef (SE)
Constant	8.978 (0.259)***	11.740 (1.308)***	11.451 (1.071)***	8.802 (0.277)***	11.573 (1.370)***	11.274 (1.130)***
<i>Personal SD</i> (min/night)	.002 (0.002)	.002 (.002)	.001 (.002)	.003 (.002)	.003 (.002)	.002 (.002)
Epworth	---	.036 (0.047)	.043 (0.051)	---	.028 (0.050)	.036 (0.054)
Age	---	-0.127 (0.062)**	-.116 (0.046)**	---	-.125 (0.064)*	-.113 (0.047)**
Female	---	-1.129 (0.344)***	-1.082 (0.360)***	---	-1.050 (0.379)***	-1.002 (0.406)**
Minority	---	.430 (0.401)	.432 (0.3413)	---	.349 (0.435)	.353 (0.447)
<i>IPW correction for sample selection</i>	No	No	Yes	No	No	Yes
Observations	192	192	192	174	174	170
R-squared	.0037	.0765	.0739	.0080	.0704	.0665

Notes: *.10, **.05, ***.01 for the 1-tailed test on the hypothesized sleep effect (other tests are 2-tailed). Sample size reduced by those who chose not to complete this additional (voluntary) online task for extra compensation, 1 participant whose actigraphy data were corrupted, and 4 participants for whom we did not have the self-perceived sleep need measure (needed to construction the *Personal SD* variable—these participants were also those dropped from the *IPW* estimations when using the *SR* indicator or *Avg Sleep Time* measure). Robust standard errors shown for models using the inverse-probability weight (*IPW*) correction for selection.

TABLE A5: Matrix Task regressions— Continuous Average Nightly Sleep Time measure
See Figure 5 coefficient plots

Dependent Variable = Matrix Pay (= \$ amount self-paid in the matrix task)

Independent Variable	All Subjects			Compliant-Only Subjects		
	(1) Coef (SE)	(2) Coef (SE)	(3) Coef (SE)	(4) Coef (SE)	(5) Coef (SE)	(6) Coef (SE)
Constant	3.638 (1.331)***	5.725 (2.107)***	6.020 (2.240)***	4.243 (1.389)***	6.393 (2.223)***	6.672 (2.369)***
Matrix Report	0.915 (0.071)***	0.904 (0.073)***	0.897 (0.079)***	0.925 (0.075)***	0.913 (0.077)***	0.902 (0.070)***
Avg Sleep Time (min/night)	-0.005 (0.003)*	-0.004 (0.003)*	-0.005 (0.004)*	-0.006 (0.003)**	-0.006 (0.003)**	-0.006 (0.004)**
Epworth	---	0.026 (0.062)	0.015 (0.074)	---	0.011 (0.066)	0.001 (0.078)
Age	---	-0.115 (0.078)	-0.115 (0.037)***	---	-0.111 (0.083)	-0.113 (0.039)***
Female	---	-0.260 (0.469)	-0.141 (0.520)	---	-0.220 (0.506)	-0.106 (0.548)
Minority	---	-0.235 (0.541)	-0.342 (0.492)	---	-0.246 (0.576)	-0.363 (0.534)
<i>IPW correction for sample selection</i>	No	No	Yes	No	No	Yes
Observations	232	232	232	204	204	204
R-squared	.423	.430	.418	.439	.445	.430

Notes: *.10, **.05, ***.01 for the 1-tailed test on the hypothesized sleep effect (other tests are 2-tailed). *Matrix Report* measures the number of matrices the subject reported correctly completing. Two subjects failed to complete the matrix task though we had complete sleep data on the participant. One participant completing the task had corrupted sleep watch data and had missing *Total Sleep Time* data (but could still be used for estimation based on binary *SR* assignment. Robust standard errors shown for models using the inverse-probability weight (*IPW*) correction for selection.

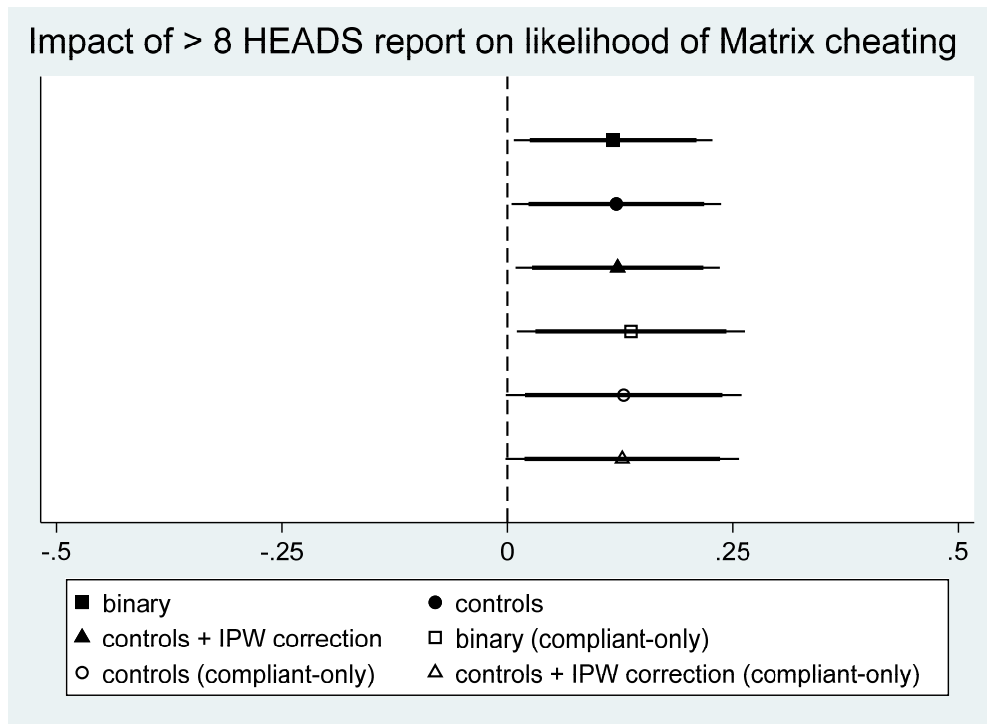
TABLE A6: Matrix Task regressions— Continuous *Personal Sleep Deprivation* measure
See Figure 5 coefficient plots

Dependent Variable = *Matrix Pay* (= \$ amount self-paid in the matrix task)

Independent Variable	All Subjects			Compliant-Only Subjects		
	(1) Coef (SE)	(2) Coef (SE)	(3) Coef (SE)	(4) Coef (SE)	(5) Coef (SE)	(6) Coef (SE)
Constant	1.251 (0.434)***	3.519 (1.791)*	3.607 (1.283)***	1.201 (0.459)***	3.522 (1.904)*	3.673 (1.369)***
Matrix Report	0.918 (0.071)***	.906 (0.073)***	.899 (0.069)***	.929 (0.075)***	.916 (0.077)***	.905 (0.069)***
<i>Personal SD</i> (min/night)	.005 (.003)**	.004 (.002)**	.005 (.003)*	.005 (0.003)**	.005 (0.003)**	.005 (.003)**
Epworth	---	.023 (0.062)	.012 (0.075)	---	.011 (0.066)	.001 (0.078)
Age	---	-.111 (0.078)	-.112 (0.036)***	---	-.111 (0.083)	-.114 (.039)***
Female	---	-.272 (0.465)	-.166 (0.507)	---	-.244 (.504)	-.138 (0.541)
Minority	---	-.115 (0.545)	-.218 (0.472)	---	-.093 (0.583)	-.209 (0.510)
<i>IPW correction for sample selection</i>	No	No	Yes	No	No	Yes
Observations	232	232	232	204	204	204
R-squared	.4263	.4325	.4201	.4398	.4454	.4293

Notes: *.10, **.05, ***.01 for the 1-tailed test on the hypothesized sleep effect (other tests are 2-tailed). *Matrix Report* measures the number of matrices the subject reported correctly completing. Two subjects failed to complete the matrix task though we had complete sleep data on the participant. One participant completing the task had corrupted sleep watch data and had missing *Total Sleep Time* data such that the *Personal SD* variable could not be constructed (but could still be used for estimation based on binary *SR* assignment). Robust standard errors shown for models using the inverse-probability weight (*IPW*) correction for selection.

FIGURE A1: Using coinflip outcomes to predict eventual cheating on the matrix task



Notes: Thick (thin) lines represent the 90% (95%) confidence intervals for the 2-tailed test of the hypothesis that coin flip outcomes will predict matrix task cheating. IPW (inverse probability weight) regression correction for dropout (attrition) from recruitment to final sample (i.e., completing the protocol). These weights are derived from selection equation using sample of all participants recruited into the study (using demographics and sleep characteristics from the online screening response database, along with treatment assignment, to predict likelihood of being in the final sample). Binary regressions include as the dependent variable only an indicator =1 if one's coin flip report was HEADS > 8 in the coin flip task. Controls regressions include the same set of controls as in the main text estimations, except that the SR indicator is omitted in these estimations due to our inclusion of coinflip outcomes as an alternative (which we know predicts outcomes in the coin flip task).

Appendix B : Experiment Instructions

THE MONEY BURNING TASK:

Instructions

In this task you will be randomly assigned with another subject in the room today. Your counterpart will remain anonymous to you and you will remain anonymous to your counterpart. There are two roles in this task: Player A and Player B. There are also several decision scenarios (S1-S9) where you are asked to make a decision, as seen in the table below. For each of these 9 scenarios, you are asked to choose between either the “Start Distribution” of payoffs or the “End Distribution” of payoffs. Payoffs (in cents) are listed in parenthesis, and the payoff amount you would receive is listed **first**, while the payoff listed second would be the payoff received by your counterpart for that distribution of payoffs. For example, if you choose a payoff distribution of (Y , Z), then your payoff would be Y cents, and your counterpart would be Z cents. The difference between the “Start Distribution” and the “End Distribution” is that the “End Distribution” subtracts 100 cents off of Player B’s payoff, and 20 cents off of Player A’s payoff. So, if you choose the “End Distribution” in a particular decision scenario, then you as Player A are choosing to “burn” 100 cents of the counterpart’s payoff (i.e., the “damage”) at a cost to you (Player A) of 20 cents (i.e., the “burning costs”). It is completely up to you as Player A to choose the “Start” or “End” Distribution for none, some, or all of the decision scenarios shown below.

You will notice that the counterpart has no decision to make in this task and is simply a passive recipient of your decision. *However, all subjects in the room today will make decisions as if he/she may be assigned as Player A.* **Only after all decisions are made will we randomly match you with a counterpart, then we will randomly assign one of you as Player A (the other is Player B), and we will also then randomly select one of the nine scenarios, S1-S9, to count for both you and your counterpart’s payoff in this task.** In other words, every subject is equally likely to be a Player A or a Player B in this task, and you will not know your assigned role until all decisions are made. Therefore, you should carefully make your decisions as Player A as if each one may be the one that determines your payoff (because it might!), but it is also possible that you will be assigned as the Player B in your pair such that your payoff will be determined by your counterpart’s decision for the randomly selected payoff scenario. Remember, you will not know your assignment as Player A or B until after all decisions are made and after a single payoff Scenario is randomly drawn. Also remember that neither you or your counterpart will know of the other’s decision before you must make your own decision, and you will never know the identity of your randomly matched counterpart (and vice versa).

Do you have any questions before you start?

NOTE: These payoffs are in “cents” (not “tokens”). So, 100 cents=\$1.00 payoff, for example.

Please make your decision as Player A for each of the following scenarios: S1-S9 (recall, one of these will be randomly selected for real payoff)						
Payoffs are listed at (Player A payoff , Player B payoff) You are randomly assigned to counterpart and role only <i>after</i> decisions are made					Which Distribution do you choose?	
Scenario	Start Distribution	Damage (to Player B payoff)	Burning Costs (paid by Player A)	End Distribution	Circle your choice (for each Scenario)	
S1	(500 , 100)	100	20	(480 , 0)	Start	End
S2	(400 , 100)	100	20	(380 , 0)	Start	End
S3	(300 , 100)	100	20	(280 , 0)	Start	End
S4	(200 , 100)	100	20	(180 , 0)	Start	End
S5	(100 , 100)	100	20	(80 , 0)	Start	End
S6	(100 , 200)	100	20	(80 , 100)	Start	End
S7	(100 , 300)	100	20	(80 , 200)	Start	End
S8	(100 , 400)	100	20	(80 , 300)	Start	End
S9	(100 , 500)	100	20	(80 , 400)	Start	End

THE COIN FLIP TASK :

(highlights shown were included in survey text)

This question offers you the chance for additional compensation, so please read carefully.

Please find a coin (any coin with Heads and Tails sides to it). **Flip the coin 15 times** and record the number of HEADS you flip. Please only perform the 15 coin flips once. **Your payoff for this task will be \$0.25 (i.e., 25 cents) for each HEADS outcome from these coin flips**, and this payment will be added to your Amazon gift code compensation for this survey. For example, if you flip HEADS 3 times, your additional compensation (on top of the flat \$5 for completing the survey) will be another \$.75. Similarly, if you flip HEADS 6 times you will receive an additional \$1.50, if you flip HEADS 11 times you will receive an additional \$2.75, etc.

Please tell us below how many times you flipped HEADS out of the 15 coin flips, and we will add 25 cents for each HEADS flipped to your survey payoff when you receive your Amazon gift code.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of HEADS outcomes from flipping coin 15 times																

THE MATRIX TASK:

INSTRUCTIONS:

Thank you for agreeing to take part in this experiment. Please read along as the instructions are read aloud. A clear understanding of the instructions will help you make better decisions and increase your earnings. Your earnings will be determined only by your own decisions in this task. **Do not communicate with the other participants.** If you have any questions, please ask us. Although there are many people participating in today's experiment, everyone is working independently. This means that your earnings in this task are based entirely on your decisions and what others decide has no effect on you.

All decisions that you make today are recorded only by an anonymous subject number (not your sleep study code) and will only be used for research purposes. Your decisions will remain completely anonymous.

Please read the following instructions on the task specifics before we start.

In the large envelope at your station, you will find a sheet with 15 matrices like the one below (front and back side of sheet). Do not open the envelope until we start the experiment.

Example

3.91	0.82	3.75
1.11	1.69	7.94
3.28	2.52	6.25
9.81	6.09	2.46

In each matrix, you should look for a **unique pair of numbers that sum up exactly to 10**. In some matrices there may not be a solution.

When you find a pair, circle the numbers, and mark the corresponding "Got It" box, as in the following example:

Example

3.91	0.82	3.75
1.11	1.69	7.94
3.28	2.52	6.25
9.81	6.09	2.46

Got It

For each correct matrix solution, you will receive \$1.00.

You will have 4 minutes to complete this task. After the 4 minutes is up, you will need to do the following:

- Count the number of correctly solved matrices and indicate that number on the back side of the matrix sheet. This will be your earnings.
- Also inside the large envelope is a smaller envelope containing 15 one-dollar bills. Now pay yourself from this money (stick your earnings in your pocket, wallet, purse, whatever). Leave the extra one-dollar bills in the envelope, seal the envelope, and leave it at your computer station. You will **not** have to sign any receipt for your earnings on this task. That envelope with the remaining

one-dollar bills will remain sealed until after all participants have left the lab, and will be separated from your matrix task sheet.

- Put your matrix task sheet and these instructions (i.e., everything **except your earnings and the sealed small envelope with the extra \$1 bills**) in the large envelope and seal the large envelope. It will remain sealed until after all participants have left the lab.
 - A box will be brought around to each station. Drop the large envelope in the box (shuffle its location in the box....we do not care). These large envelopes containing the matrix task outcomes will not be opened until after all participants have left the lab, and you will note they have been separated from the small envelope.

Matrix Task identification method:

Example of the footers on front and back side of duplexed decision sheet (15 matrices on sheet were split across front and back side of sheet, with space on back side to report total number of matrices solved). AppEEL is the name of the experimental economics laboratory used.

Footer on front side of page:

Appalachian State University	
Economics & AppEEL	
Center for Economic Research and Policy Analysis	

Footer on back side of page (with station #7 indicated between “Economics” and “AppEEL”):

Appalachian State University	
Economics 7 AppEEL	
Center for Economic Research and Policy Analysis	