I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 14070

The Influence of Dietary Patterns on Outcomes in a Bayesian Choice Task

David L Dickinson
Caleb Garbuio

JANUARY 2021

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 14070

The Influence of Dietary Patterns on Outcomes in a Bayesian Choice Task

David L Dickinson
Appalachian State University, IZA and Chapman University

Caleb Garbuio
Appalachian State University

JANUARY 2021

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

The Influence of Dietary Patterns on Outcomes in a Bayesian Choice Task*

This paper reports on a preregistered study aimed at testing for executive function differences across individuals who self-reported one of four distinct dietary patterns: No Diet, No Sugar, Vegetarian, and Mediterranean Diet patterns. The incentivized decision task involves Bayesian assessments where participants may use existing (base rate) as well as new information (sample draw evidence) in making probability assessments. Sample size, hypotheses, and analysis plans were all determined ex ante and registered on the Open Science Framework. Our hypotheses were aimed at testing whether adherence to a specialty diet improved decision making relative to those who reported following No Diet. Our data fail to support these hypotheses. In fact, we found some evidence that adherence to a No Sugar Diet predicted a reduced decision accuracy and was connected to an increased imbalance in how the participant weighted the two sources of information available. Our results suggest that decision making is nuanced among dietary groups, but that short-term incentivized decisions in an ecologically valid field setting are likely not improved solely by following a promoted diet such as the Mediterranean or Vegetarian diet.

JEL Classification: D90, C90, I10

Keywords: behavioral economics, bayes rule, decision making, dietary patterns, mediterranean diet

Corresponding author:
David L. Dickinson
Economics Department
Appalachian State University
Boone, NC 28608
USA

E-mail: dickinsondl@appstate.edu

* The authors thank Manan Roy and Ji Yan for helpful comments on this draft. The Barnes program for faculty mentored research in the Walker College of Business at Appalachian State University funded the survey sample for this project.

1. INTRODUCTION

The ability to engage in high level cognitive thinking is beneficial for decision making and adaptive reasoning, which can help one incorporate multiple sources of information into a decision. Recent studies between diet and cognition show that certain dietary patterns not only improve physical health but affect brain function in a way that results in higher-level thinking. This paper examines the impact of self-reported dietary patterns on decision making in a Bayesian choice task that targets high-leveling reasoning skills useful in decision making environments. We followed a pre-registered design, data collection, and analysis plan in our study, and we contribute additional exploratory analysis as well. This paper concludes that most of the identifiable behavioral impacts in the tasks are nuanced and indicate that choice patterns over repeated trials may be what differs most by dietary pattern when comparing the individuals who self-reported not following a specific dietary pattern to those who self-reported a *Vegetarian*, *No-Sugar*, or *Mediterranean* dietary pattern.

The objective of using a validated Bayesian choice task is to test for executive function differences across individuals following different dietary patterns. Health and disease risk impacts of certain dietary patterns have been consistently documented (e.g., Willet, 1994; Kant, 2004; Sofi et al, 2010), but the evidence connecting diet and decision making is scarce, since available research examines the general cognitive effects of diet. There is a common perception that Western diets high in fat and sugar may harm cognition (Magnusson et al, 2015), while vegetarian-based diets or Mediterranean dietary patterns may help improve cognitive functions (Kpolovie, 2012; Martínez-Lapiscina et al, 2013). If one looks more closely, however, the literature has been mixed regarding evidence on dietary patterns and more general cognition (e.g., Féart et al, 2009; Pribis et al, 2012; Peterson and Philippou, 2016; Medawar et al, 2019). The best evidence compiled from systematic reviews of the research supports the role that diets rich with plants, nuts and berries have towards affecting cognition positively. While a recent review of randomized controlled trials found that the Mediterranean dietary pattern largely produced insignificant cognitive effects (Radd-Vagenas et al, 2018), it was also reported that most robustly designed studies reviewed suggested cognitive benefit associated with the Mediterranean diet. Another comprehensive review concluded that dietary patterns, specifically the Mediterranean diet, may improve cognition due to the cumulative effects of several beneficial dietary elements (Scarmeas et al, 2018). This paper aims to contribute to this literature by testing for decision making differences across samples of individuals who self-reported following no specific dietary patterns, a vegetarian, Mediterranean, or no-sugar dietary pattern.

The decision-making paradigm chosen is a Bayesian choice task examined previously in the behavioral economics literature (Grether, 1980; Dickinson and Drummond, 2008; Dickinson et al, 2016). The task asks the decision maker to assess the likelihood that balls were being drawn from a particular box (rather than another box), where each box is known to contain a different population of black versus white balls. The decision maker is given the base rate odds of the utilized target boxes and is shown the results of drawing five balls with replacement from the chosen box without being explicitly revealed which box was being used. Across trials, the base rate odds and/or the resultant sample draw changes. In each instance, the respondent is

asked to indicate their beliefs regarding the "chances out of 100" that they feel the balls were drawn from a particular box. One can use Bayes' rule to calculate the exact likelihood (i.e., probability) that either box was used based on these two pieces of information: the base rate odds, and the new evidence. The task is one that requires the incorporation of multiple pieces of information into a single decision. The Bayes task has been shown to be sensitive to the use of heuristics as a simple way to approach the decision (Grether, 1980), and shown sensitive to the effects of sleep deprivation or voluntary restriction (Dickinson and Drummond, 2008; Dickinson et al, 2016). It is also the case that the same type of sleep manipulation shown to impact the weight decision makers place on the base rate odds relative to the new evidence in the original task has been shown to harm decision making predominantly in more complex decision environments (McElroy and Dickinson, 2019). As such, the existing literature suggests a study that differentiates between more complex versus more difficult Bayesian choice scenarios, which describes our study.

The present paper merges these two previously separate literatures by examining decision outcomes in the Bayesian task across participants who self-reported different dietary patterns. While we did not experimentally monitor dietary intake, the participants had no incentive to self-report following a particular dietary pattern. In fact, the custom screening process for our participants allowed us to determine the custom sample we desired (e.g., a set of only individuals who report following a vegetarian diet), and the survey was only offered to participants on the Prolific survey platform who met those criteria in their registration profiles. Regarding the decision task, it was incentivized such that a randomly drawn trial was used to determine a bonus payment that was larger if the participants were within a few percentage points of correctly identifying the outcome likelihood for that trial. The sample size was preregistered to have sufficient statistical power for the ex-ante hypotheses, but we offer additional exploratory analysis and results from our data in what follows as well.

2. METHODS

2.1 *Survey and sample screening details*

We preregistered our methods on the Open Science Framework at https://osf.io/472bg (Dickinson and Garbuio, 2020) to establish hypotheses, sample sizes, variable specification, and analysis plans. When not describing pre-registered hypotheses or analysis, we will refer to our analysis as exploratory. The basic methodology was to imbed a decision task within an online survey that would be administered to participants who self-reported following one of three dietary patterns of interest or self-reported no specific dietary pattern. All methods for data collection were approved by the human subjects review board at the authors' home institution.

Our sample was recruited from the prolific.ac subject pool, which is a service tailored for researchers as an alternative to Amazon's mTurk platform for online research studies (see Palan and Schitter, 2018). One of the benefits of Prolific is the availability of a variety of sample screening options that allow the researcher to recruit custom samples based on one or more criteria captured by Prolific in each research subject's profile with the service. In this way, we

were able to run our study on young adult (ages 20-45) participants who self-reported following a particular dietary pattern: *No Diet*, *No Sugar Diet*, *Mediterranean*, or *Vegetarian Diets* were examined. By custom screening for each separate dietary pattern, we recruited approximately equal sample sizes for each group. Along with a self-reported dietary pattern, we elicited each participant's self-reported "strength of adherence" to their indicated dietary preference. Therefore, our data set is observational regarding dietary patterns, although there was no incentive to misrepresent one's self-reported dietary pattern in our methodology. Rather, the protocol with Prolific custom sample screening is that a research study is *only* offered to participants if they meet all criteria set up by the researcher for sample eligibility, and participants have no way to know what participant profile characteristics may disqualify them from some studies but make them eligible for others. Subjects were compensated for participation using a flat fixed rate ($2.40 for a study with an estimated 18-minute completion time) that met the Prolific platform's "fair-pay" conditions, and an additional $1.00 bonus payment was offered as an incentive for accuracy on a randomly selected trial from the Bayes choice task described below. Appendix B contains the survey administered to the participants.

Our sample size target of n=100 participants for each of the dietary groups was established based on an ex-ante power analysis of a single regression coefficient in a linear multiple regression using G*Power 3.1.9.2. With an assumed $\alpha = .05$, a total sample size of n = 400 participants has sufficient power (power of .80 as recommended for the social sciences) to identify small-sized effects on a single variable of interest, and the sample size of n = 100 for each dietary pattern subgroup is sufficiently powered to identify medium-sized single coefficient effects (our sample size also implies sufficient power for identifying interaction or moderating effects in the pooled sample. We additionally note that our decision task presents 20 trials of the Bayes task to each subject, which implies a panel data set of repeated measures per subjects that add statistical power to this paper's ability to test the hypotheses. Next, we describe the decision task administered to each participant before outlining our pre-registered hypotheses.

2.2 *The Bayesian decision task*

The decision task is based on a design from Grether (1980). Assume two boxes are each populated with three balls. As shown in Figure 1, the LEFT box has two black and one white ball. Either the LEFT or RIGHT box will be selected in a trial. The participant is not told which box is selected, but they are presented with two sources of information with which to form their beliefs regarding which box was selected: the base rate or "prior odds" of either box being selected, and the results from drawing five balls with replacement from the chosen box that would remain hidden from the participant. The prior odds were represented as the chances out of six that either box would be selected, ex ante, and this can be considered the initial information. The results of the five-ball sample draw can be considered the new evidence presented to the participant for that stimulus. As shown in Figure 1, the stimulus image offered a visually concise way to present the information to the participant, and the task varies the information on one or both dimensions across a series of 20 trials. In the original task, the response elicitation was dichotomous in the sense that, for a given set of prior odds and evidence, the participant was

asked to indicate which box was thought to have been selected for that trial. Bayes rule can be used to calculate the actual posterior probability that the LEFT box was used, given the prior odds and the new sample evidence)

The task we administered differed from the original task (Grether, 1980) in that we elicited the participant's subjective view of how likely it was that the LEFT box had been selected in that trial (i.e., the "chances out of 100" that the LEFT box was used). Accuracy can therefore be assessed in a continuous way by constructing a variable to indicate how far the participant's assessment of the LEFT box selection probability was from the true probability as calculated by Bayes rule (the bonus pay was offered if one's assessment was within five above or below the true probability on the randomly selected trial). However, we also preregistered our plan to construct a dichotomous version of accuracy on each trial for comparability of our data set on some analysis with previous studies that administered the task with a dichotomous response option. To do this, we simply scored a dichotomous variable =1 for *Left Choice* if the participant's assessed probability the LEFT box was chosen was greater than 50% (*Left Choice* = 0 if assessed probability was <50% and we discarded trials where the assessed probability was exactly equal to 50% for such comparative analysis. Table 1 shows the specific combinations of prior odds and evidence we used across the 20 total trials administered to each participant. The combinations of prior odds and evidence allowed us to identify 14 of these trials as "Hard" trials, in the sense that the prior odds and evidence pointed towards different conclusions. The remaining six trials we considered "Easy" trials. Each subject saw the same set of stimuli, but the survey software presented the stimuli in randomized order to each participant. Finally, we preregistered our plan to collect response time (RT) data for each task stimulus, as RT is evaluated in one of our planned hypotheses tests.

2.3 *Hypotheses*

Our hypotheses were pre-registered based on the existing literature showing some possible cognitive benefits of more plant-based or Mediterranean dietary patterns. While less evidence would suggest similar cognitive benefits of sugar-free diets, we preregistered the hypothesis that such a "no-sugar" diet would also improve performance on the Bayesian task. We also anticipated any benefits would be observed in a more difficult Bayesian choice environment, compared to more simple ones. Also, though response times (RT) as a choice process measure must be examined with caution, we built upon the idea that deliberation (as opposed to more automatic quick-thinking) is a longer response time decision process (see Kahneman, 2011). Finally, our fourth hypothesis involves estimation of a model of decision making that assesses the decision weight one places on the prior odds versus the evidence. A Bayesian decision maker is hypothesized to place (equal) weight on both information sources, and our analysis will model results across dietary patterns and compared to previous results in the literature using this decision task.

Hypothesis 1: We hypothesize those who indicate adherence to a Mediterranean, Vegetarian, or No Sugar diet will make probability assessments (i.e., Bayesian probability estimates) that are significantly more accurate than those indicating they do

not follow any dietary pattern. We hypothesize that the greatest effect of dietary pattern on Bayesian accuracy will be among those following a Mediterranean dietary pattern.

Hypothesis 2: Improvements in Bayesian accuracy by those following the Mediterranean, No Sugar, or Vegetarian dietary patterns will be primarily observed in more difficult Bayesian choice environments (e.g., such as those where the two sources of information regarding the likely state of the world in the decision task point to opposite states).

Hypothesis 3. More Bayesian accurate decisions will be associated with longer task response times. This will be most apparent in the more difficult Bayesian choice trials.

Hypothesis 4: Those following a Mediterranean, No Sugar, or Vegetarian dietary pattern will show more Bayesian decision tendencies (e.g., weighting both sources of information in making choice), with the greatest Bayesian tendencies being for those following a Mediterranean diet.

2.4 *Variables*

The key dependent variable measures generated from the Bayesian task include accuracy (*Accuracy*—at the individual-participant and trial level) and response times (*RT*), which were capture for each trial of the 20-trial task. At the participant level, *Avg Accuracy* is defined as the average level of accuracy across all trials, or across the subset of hard trials (*Hard Trial Avg Accuracy*) or easy trials (*Easy Trial Avg Accuracy*). For an individual trial, accuracy is defined based on the absolute difference between one's subjective assessment of the Bayesian probability (i.e., one's "response" to the probability elicitation for that trial) and the true probability for that trial, given the base rate odds and the evidence:

$$Accuracy = 1 - |Response - True\ Bayesian\ Probability| \quad \in [0,1]$$

This individual trial-level *Accuracy* measure is used to construct the *Avg Accuracy* measures, but this construct will also be used in analysis of accuracy at the trial-level by considering the data as a panel of 20 trials per participant. *RT* will also be used as a dependent variable measure to assess the impact of dietary preference on *RT* in the task, although *RT* may also be a control measure in the analysis of accuracy to examine whether *RT* may have predictive capacity as choice-process data in this task. Finally, to allow for analysis of a decision model comparable to past research on this task (Dickinson and Drummond, 2008; Dickinson et al, 2016), we preregistered our plan to construct the binary measure of accuracy, *Bin Accuracy*, which equals 1 if the individual correctly identified the Bayesian more likely outcome. For example, if the true Bayesian probability of the LEFT box on a given trial was 0.64 and the individual gave a subjective assessment of the likelihood of the LEFT box anywhere from .51 to 1.00, then we set *Bin Accuracy* =1 (otherwise, *Bin Accuracy* =0). While this construct does waste information in the continuous subjective probability elicitation, it allows a direct comparison to past research and the estimation of a decision model that has been previously evaluated in the context of this environment with a binary assessment task. This will serve to

complement the analysis that uses the continuous *Accuracy* measure(s) to evaluate the impact of dietary preference on decisions.

Regarding individual-specific control variables, we obtained data on age, gender, cognitive measures, and dietary pattern descriptors. In addition to *Age* and *Female* (=1) as controls, we captured measures intended to described the cognitive reflection style of the individual (*CRT score*) and sleep measures that may help describe one's cognitive state, *Last Week Avg Sleep* and *Sleepiness*. *CRT score* is the individual's outcome $\in [0, 6]$ on a 6-item version of the cognitive reflection test (Primi et al, 2016) that measures one's style of thinking (high scores indicate more reflective and less impulsive thinking style). Sleepiness has been formally examined in the context of sleep deprivation for its impact on Bayesian decision making in this specific task (Dickinson and Drummond, 2008), and so we include the commonly used 9-item Karolinska sleepiness scale as a measure of current subjective sleepiness (Åkerstedt and Gillberg, 1990). Additionally, we elicit a self-report in the survey for one's average nightly sleep level over the prior week, *Last Week Avg Sleep*. Dietary pattern is further described with the variables *Stick-to-Diet*, which measured one's self-reported strength of adherence to the dietary pattern indicated, and *Supplements* (=1) if the individual self-reported taking dietary supplements.

3. RESULTS

Our final sample size by dietary preference was: *No Diet* (n=110), *Mediterranean or "Medit" Diet* (n=104), *Vegetarian or "Veggie" Diet* (n=108), and *No-Sugar Diet* (n=105). Table 2 shows the summary statistics on key individual-specific control measures that will be used as independent variables in our analysis. Differences across mean or median values in paired comparisons of dietary pattern samples were tested using the 2-sample proportions test for dichotomous indicators *Female* and *Supplements*, or Mann-Whitney tests for other variables. We report no significant differences in *CRT score*, *Last Week Avg Sleep*, or *Sleepiness* in any of the 6 paired comparisons across dietary group samples ($p > .05$ in each instance). Some differences across samples were found regarding *Age*, *Female*, *Stick-to-diet*, and *Supplements*. Regarding *Age*, participants were younger in *No Diet* compared to both *Veggie Diet* and *No Sugar Diet* participants ($p < .01$ in both tests), and both *Medit Diet* and *Veggie Diet* participants were younger than in *No Sugar Diet* ($p < .01$ in both tests). Proportions of *Female* participants were different in all pairwise sample comparisons ($p <.05$ or better) except in comparisons of *No Diet* vs *Medit Diet* and *Medit Diet* vs *No Sugar Diet* ($p > .05$). The most stark characteristic difference is perhaps the significantly higher proportion of *Female* participants in the *Veggie Diet* group compared to others.

Comparisons of differences in dietary preference adherence and the use of dietary supplements is also present across our samples. Specifically, all participant in the specialized dietary categories (*Medit, Veggie, No Sugar*) reported stronger adherence to their dietary choice

than did the *No Diet* group ($p < .01$ in each test).[1] Also, those in the *Veggie Diet* sample reported a stronger adherence to the dietary pattern than did those either in the *Medit Diet* or *No Sugar Diet* groups ($p < .01$ in each test). Finally, regarding the use of dietary supplements, the proportion of participants in *No Sugar* and *Veggie Diet* who reported taking supplements was higher than with *No Diet* or *Medit Diet* participants ($p < .01$ for each test). However, there was no significant difference in *Supplements* between participants in *Medit* vs *No Diet* or *Veggie* vs *No Sugar Diet* ($p > .05$ in each instance).

3.1 *Hypotheses 1-3 tests*

The key hypothesis tests were conducted using multivariate regression analysis. Hypotheses 1-3 can each be evaluated using participant-level data (pooling outcomes across trials) as well as at the individual trial level. We present evidence using both approaches, as well as sensitivity analysis using alternative specifications.[2] For this analysis 15 participants (3.5% of the sample) who failed the poison pill question in the survey are omitted, resulting in a sample of n=412 participants included in the analysis.

Tables 3-6 show estimation results used to evaluate Hypotheses 1-3 at the subject-level as well as trial-level. Subject level specifications are used in Tables 3 and 4 to examine whether dietary patterns significantly impact one's average level of Bayesian accuracy, which involves an evaluation of the coefficient estimates on the dietary pattern indicator variables (*No Diet* is the omitted reference group). Table 4 estimates similar models with the inclusion of a control variable for the average response time across trials (depending on the model, all trials, Hard trials, or Easy trials), which is used to test Hypothesis 3. Regressions both with and without additional control measures were estimated. Positive and significant coefficient estimates on *No Sugar Diet, Medit Diet,* and *Veggie Diet* would support Hypothesis 1 in the models (1) and (2). Hypothesis 2 would involve a comparison of these coefficient estimates in the Hard versus Easy trial models of Tables 3 and 4. Our results are robust and fail to support either Hypothesis 1 or Hypothesis 2. There is no evidence in the pooled data (subject level) that individuals in any of the specialized dietary patterns have average Bayesian accuracy that is higher than for those in the *No Diet* group. If anything, Table 3 shows modest evidence that those following a *No Sugar* diet have average Bayesian Accuracy levels that are lower than those from the *No Diet* group, although this evidence fades in Table 4 when the additional control for *Avg RT* is included in models (2), (4), and (6) that include the full set of control measures. The positive and significant

[1] The question of dietary adherence was phrased a bit differently when presented to the group who were sample screened to indicate "no diet" was followed. Specifically, the wording of the *Stick-to-diet* question for the *No Diet* group was as follows:
"On the scale below, please indicate **how closely you stick to your "no dietary pattern" rules?** (e.g., you may not stick to these rules if you regularly try out different dietary patterns just to see how it goes, or because your friends are trying it, etc)"

[2] Our preregistration plan included nonparametric tests of *Avg Accuracy* across participant samples, for all trials as well as the tests separated by Hard versus Easy trials and for the *Avg Accuracy* measure based on probability assessments as well as the binary constructed variable *Binary Accuracy*. These results of these unconditional nonparametric tests, which are supported by multivariate estimation results we report in the main text, are in Appendix A, Table A1.

coefficient estimates on *Avg RT* in Table 4 support the initial premise of Hypothesis 3—longer *Avg RT* predicts increase *Avg Accuracy* in all types of trials. However, it does not appear that this effect differs across Easy versus Hard trials, which does not support the second component of Hypothesis 3.

We next turn to an evaluation of Hypotheses 1-3 using the panel data set of trial-level observations. Here, the estimation results in Tables 5 and 6 are from specifications similar to the subject-level analysis, with the addition of a *Trial* (=1-10) control to account for learning across trials, and *Response Time* (in model 3 of Table 5 and models 3 and 6 of Table 6) of the trial used to evaluate Hypothesis 3. These estimations are random effects generalized least squares estimations with error terms clustered at the subject level to account for the non-independence of the error term across trials for a given participant.

Results in Tables 5 and 6 largely mirror the results found in the pooled data analysis, which increases our level of confidence that we have identified the true effects in our data, some of which are null effects. Again, the evidence does not support Hypotheses 1 or 2 in Tables 5 and 6, and there is marginal evidence in the most complete specifications ($p < .10$) that *No Sugar* diet may predict less accurate Bayesian assessments compared to a *No Diet* individual. The findings here are summarized in Figure 2, which shows the coefficient plots of the impact of dietary pattern on *Accuracy* at the trial level reported across the various specifications of Tables 5 and 6. Regarding Hypothesis 3, because it is difficult to identify differences in Tables 5 and 6 estimates of the *Response Time* coefficient given our rounding convention, Figure 3 presents these in the form of coefficient plots. Here, we display the *Response Time* estimates from models (3) of Table 5, and models (3) and (6) of Table 6, along with estimates from two other simple specifications, to further highlight our view of the Hypothesis 3 evidence. While it is clear that larger values of *Response Time* for a trial predicts an increased *Accuracy* in that trial, this beneficial effect of RT is not significantly different across types of trials (Easy versus Hard). Thus, we conclude limited support for Hypothesis 3, but we fail to find support for Hypotheses 1 and 2 in our data.

Tables 3-6 also highlight some exploratory findings that were not identified as hypotheses in our preregistration plan. For example, we find robust support across Tables 3-6 that higher levels of *CRT score* predict higher Bayesian accuracy. This supports the exploratory hypothesis that more reflective thinkers do better in Bayesian decision environments. Also, the coefficient estimates on the *Trial* variable in Tables 5 and 6 show some support for the exploratory hypothesis that participants learn over time and improve their accuracy across trials. While results regarding *Sleepiness* are less clear, the trial-level estimation results from the Hard trials in Table 6 models (2) and (3) indicate sleepier participants have *higher* accuracy than less sleepy participants. This result is counter-intuitive, but may give an indication of additional (and effective) compensatory effort expended in difficult Bayesian choice environments when aware of one's sleepiness.

3.2 *Hypothesis 4 test*

To estimate the Bayesian decision model for comparison with previous research, we first constructed the binary indicator, *Binary Accuracy*, which equals one if the participant's assessment of the Bayesian probability was consistent with the Bayesian more likely outcome.

In other words, *Binary Accuracy* =1 if the true Bayesian assessment and the true Bayesian probability were both either less than .50 or greater than .50. Trials where the Bayesian probability equaled .50 were omitted for this analysis. The Bayesian decision model follows Grether (1980),

$$Y_{it}^{*} = \alpha + \beta_1 lnLR(L)_t + \beta_2 ln\left(\frac{P_L}{1-P_L}\right)_t + \mu_i + \epsilon_{it} \quad (1)$$

Here, Y_{it}^{*} is the subjective log odds in favor of the LEFT box in trial *t* for subject *i*, which is a function of both evidence and base rate information in favor of the LEFT box for that trial. The key independent measures represent the base rate odds and evidence information of that trial, and the econometric specification is based on the foundation that one's subjective assessment of the event's likelihood, according to Bayes' rule, is a function of one's base rate assessment (the prior odds in our environment) and the new information (the sample evidence in our environment). In this choice setting, $lnLR(L)_t$ is the "evidence" measure, which is defined as the log of the statistical likelihood ratio of the LEFT box—this likelihood ratio is likelihood of observing the sample evidence if the balls were drawn from the LEFT box divided by the likelihood of observing that sample if the balls were drawn from the RIGHT box. To capture the base rate odds of a given trial, $ln\left(\frac{P_L}{1-P_L}\right)_t$ is the log of the base rate odds ratio for the LEFT box (p_L is the prior odds that the LEFT box will be used for that trial. Together, we will refer to $lnLR(L)$ and $ln\left(\frac{P_L}{1-P_L}\right)_t$ as the "Evidence" and "Base Rate" variables, respectively. As noted in Grether (198), Y_{it}^{*} is not observed, and so the model can be estimated using probit techniques, where the observable dependent variable Y_{it} equals one when $Y_{it}^{*} \geq 0$. A Bayesian subject should place equal weight on both sources of information in forming one's belief, though a less strict interpretation would simply assess whether or not significant weight is placed on both sources of information.

Table 7 reports marginal effects from the estimation of the basic decision model (1), along with the results from specifications that include main effect indicators for dietary categories and addition control variables from our previous regression specifications. The models are estimated for all trials as well as exclusively for the subset of Hard and Easy trials. Note that in the Table 7 specifications, the coefficient estimates on the dietary indicators are *not* a test of Hypothesis 4, as there is no reason any particular diet should lead one to more likely indicate LEFT box in a given trial. Table 7 estimations serve to replicate previous findings that individuals weigh both the base rate odds and new evidence in making their assessment of a more likely LEFT or RIGHT box used for that trial. Results are consistent across the various specifications, with the key information variable coefficient weights summarized in the coefficient plots of Figure 4 (these are not marginal effects, but rather coefficient estimate plots that reflect the same qualitative differences as found in the marginal effects). While significant decision weight is placed on both sources of information, the overall tendency in the full sample is to weight evidence more than base rates odds, but for Easy trials there is a tendency to weight base rate odds more than evidence.

Table 8 shows the marginal effects from the decision model estimates for simple versus full-controls models estimated for the separate subsamples of each dietary group. The findings

are unaffected by the use of additional control variables and so we focus our attention on the upper panel of estimates in Table 8. An alternative approach would be to pool the data and evaluate Hypothesis 4 using interaction terms of each dietary group with both the base rate and evidence variables. The approach we take is one where we test the linear restriction that the weight on the base rate and evidence variables are equal for each model. Rejection of this null hypothesis indicates a significantly higher weight placed on one or the other source of information. We have already documented limited evidence to support the hypothesis that dietary patterns studied improve Bayesian accuracy relative to a *No Diet* group, but the decision weight model provides additional insights. The one finding from the earlier Hypothesis 1 and 2 test was contrary to our expectation and indicated that the *No Sugar* group had reduced *Accuracy* relative to the *No Diet* group, and so we continue to compare against the *No Diet* group as we interpret the Table 8 findings.

To summarize the Hypothesis 4 tests, Table 8 highlights the general tendency for all to place significantly more decision weight on the sample evidence relative to the base rate information. For Hard trials, we find no significant differences in estimated decision weight on base rate versus evidence. For Easy trials, those reporting a *Medit* or *Veggie* diet placed significantly more decision weight on the base rate information compared to the evidence. This did not, however, translate to differences in accuracy (see Tables 5 and 6). In a strict sense, the data fail to support Hypothesis 4 because *all* dietary groups placed significant decision weight on both sources of information in making Bayesian assessments. Figure 5 shows the coefficient plots for the simple specifications from Table 8. Figure 5 highlights the significant "All Trials" lesser weight placed on base rates compared to evidence in the *No Sugar* group. Though more research is needed, it is noteworthy that this decision weight pattern occurs where accuracy suffered most significantly across our dietary groups relative to *No Diet*.

4. DISCUSSION

All groups achieved 70%-80% accuracy across different trial types in the Bayesian task, but we found no evidence to support our preregistered hypotheses regarding accuracy improvements for those following several more common dietary patterns. If anything, our evidence suggests that following a *No Sugar* dietary may harm accuracy in the task relative to not following any dietary pattern. Though research has attempted to document cognitive benefits of certain dietary patterns, our data would not support the claim that the dietary pattern itself make any significant difference in one's ability to perform this particular cognitive task (i.e., incorporating multiple sources of information into a decision).

In naturally occurring settings, individuals who pursue a particular dietary pattern likely pursue other lifestyle choices that may be important determinants of decision-making capacity in cognitive tasks such as the Bayesian environment. It should also be noted that an individual in our data set who self-reports a *No Diet* pattern may nevertheless consume healthy nutrients and/or be aligned in many ways with healthier dietary patterns that have shown some positive impact on cognitive outcome (Scarmeas et al, 2018). Much of the current research has defined cognitive outcomes in the context of more general metrics with a focus on limiting cognitive

decline the often occurs in the elderly. Younger adults may be more resilient with respect to cognitive outcomes and dietary choice, with cumulative effects only being observed later in life.

It is worth noting that our participants were first screened for self-reported dietary pattern through the survey participant (Prolific) platform, then offered to participant in the study blind to the dietary pattern screening criteria, and then re-assessed in our survey that they self-reported the anticipated dietary pattern. Because the initial screening was based on Prolific profile data gathered at an (unspecified) earlier point in time relative to our study, the fact that we required the participant pass the screening question again in our survey indicates that captured individuals who self-reported following the same dietary pattern at two *different* points in time. This somewhat increases our confidence in the validity of the self-reported dietary patterns in our data. Importantly, it is also the case that participants were blinded to the screening criteria used for the study (i.e., Prolific simply makes available studies for which the participant is eligible after participant profiles have already been completed). This means it was not possible to self-report a particular dietary pattern just to become eligible for our study, which should limit any concern of invalid dietary pattern reports used to generate our custom samples.

4.1 *Limitations*

While we felt it important in our study to restrict our focus to younger adults (e.g., given our sample size per dietary group), a similar study focused on those more at risk of age-related cognitive decline would be useful. Also, a study with sufficient numbers of participants across a more wide range of ages would allow for a more systematic examination of whether age moderates any link between dietary pattern and Bayesian choice (or whether any such moderating effect is linear or nonlinear). Future research should consider the importance of socioeconomic variables such as education and income level, while also considering innate cognitive abilities. While we included a control measure for cognitive reflection style (*CRT score*), future research should place further emphasis on cognitive ability and evaluate whether innate cognitive ability offers some resiliency that renders dietary patterns more or less important. One's cognitive ability or style may also contribute to one's choice of dietary pattern, although the evidence in our sample shows that no significant impact of *CRT score* on one's dietary pattern category (either in binary or with-controls regressions, $p > .10$ in all instances). Also, while we felt our focus on a specific and vetted high-level cognitive task was an asset in our study, others may prefer data collection on more general cognitive function measures. In this sense, we hope our study is seen as a useful contribution to the literature in ways that have not been previously presented.

As an observational study, this research is subject to the usual criticism that dietary intake was not experimentally varied and participants perhaps tracked over longer time periods. We also relied on self-reported dietary pattern and did not collect data from food recall or diary reports. Participants self-reported a relatively high adherence to their dietary pattern (mean value of 6.79 ± 1.81 on a 1-9 scale of adherence to dietary pattern), but we have no direct evidence on these reports. Additional research with alternative methodologies is needed to address these concerns. For this reason, we caution the reader to view our results in the context of our methodology. While these limitations exist, a strength of our data is that we generated a

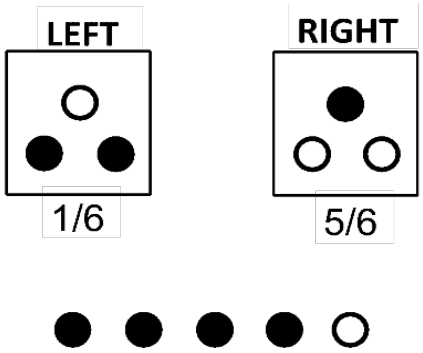
reasonably sized sample of data on a specific cognitive task that mimics a basic foundation of decision making (information updating), and we did so with parallel samples of individuals reporting specific dietary patterns of interest. Obviously, an experimental study is needed to generate data without confounding factors that may drive one's results. We captured subject-specific information on certain characteristics that were used as co-variates in our estimation equations, but such an econometric fix does not negate the fact that our data were generated in a largely uncontrolled environment.

5. CONCLUSION

This paper reported results from a pre-registered study of self-reported dietary patterns and decision making in an incentivized Bayesian decision task. The task is useful because it represents a building block environment for many more complicated decisions that involve the use of multiple information sources to make judgments. Consistent with previous research (Grether, 1980; Dickinson and Drummond, 2008; Dickinson et al, 2016) participants weight both base rate and new information in making their assessments. However, we found little support for our ex ante hypotheses regarding how self-reported *No Sugar, Medit,* or *Veggie* dietary patterns would improved accuracy or lead to increased decision emphasis on both information sources over a singular source. If anything, relative to those who reported not following any specific dietary pattern, our data showed some evidence that those following a *No Sugar* diet may be somewhat less accurate in make Bayesian assessments in our task. While speculative, the decision model results indicated these *No Sugar* dietary pattern participants may be those who the largest estimated difference in decision weights between information sources overall (in the direction of overemphasizing the sample evidence relative to base rate information). More research is needed to speak to this exploratory result. The one hypothesis for which we found some support was not related to dietary preferences, but we did find support for our hypothesis that increase response times led to improved Bayesian accuracy (Hyp 3).

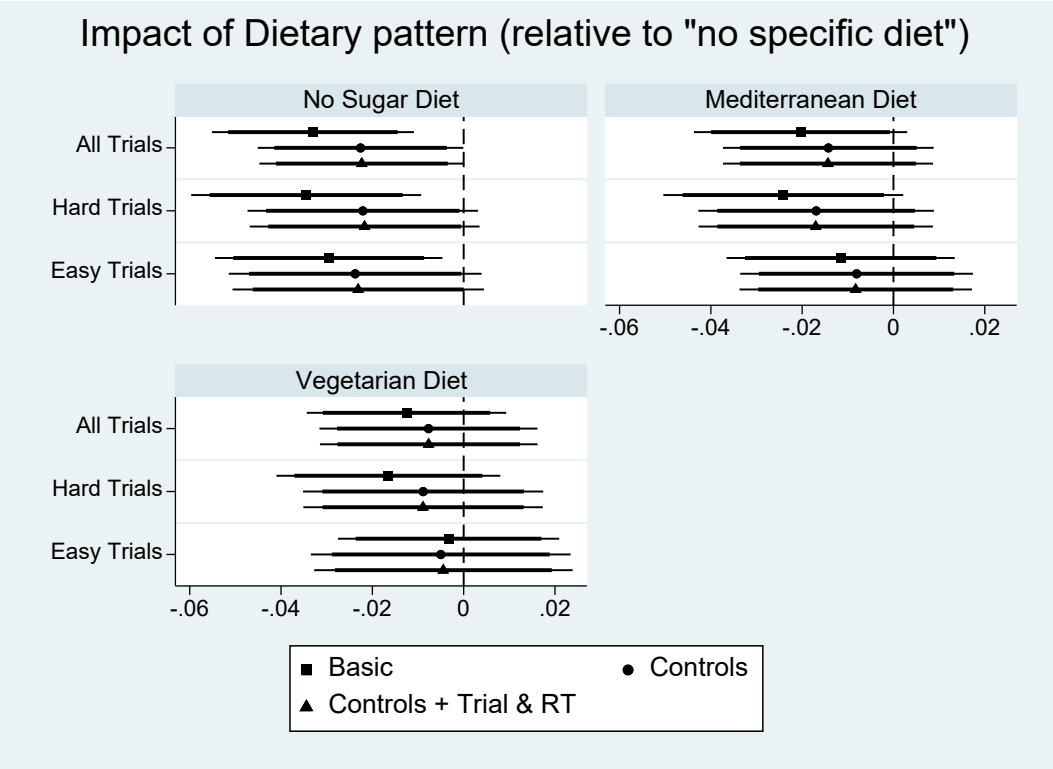
Our results contribute to the literature on diet and cognitive performance. While more controlled studies are clearly needed, our findings are more aligned with the view that dietary patterns have negligible impact on decision making in precise tasks where incentives for good decision or assessments are present. This is not to say that there are not clear and identifiable benefits of diet and certain nutrients on cognition, brain function, or overall well-being, but in ecologically valid settings other factors may be equally important in short-term decision quality. More sustained decision performance in settings that use tight controls, as well as random assignment and objective measurement of dietary intake, are worth studying as well. These are other questions are, for now, left to future research.

Figure 1: Bayes task stimulus



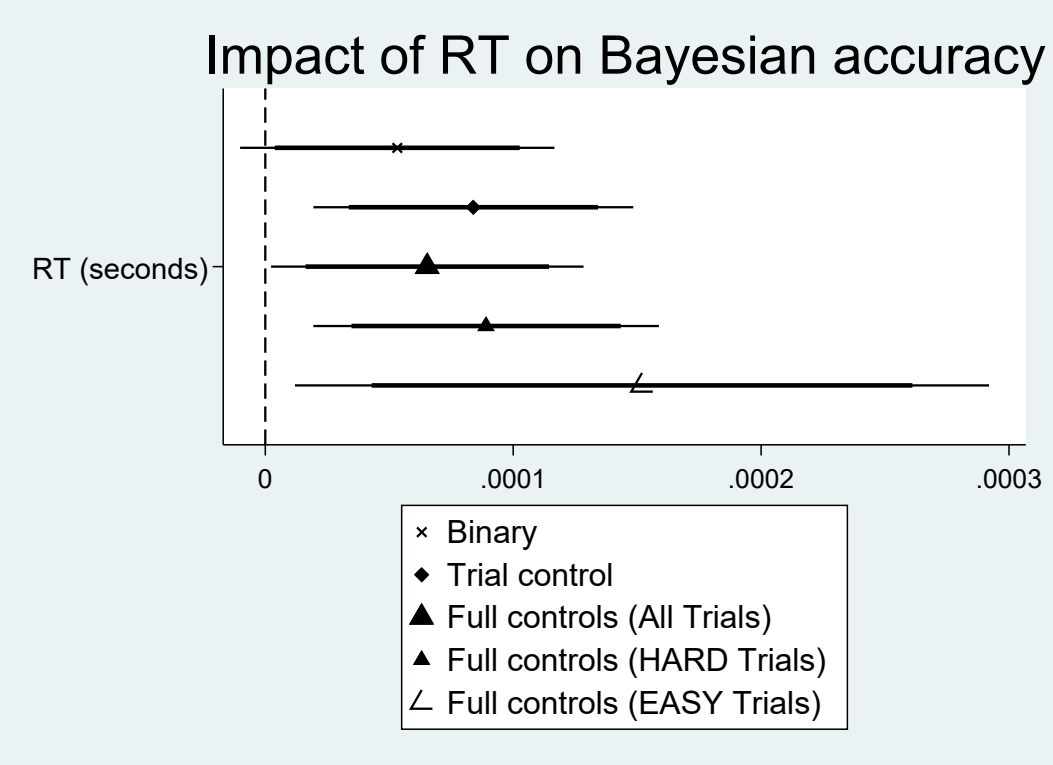
Notes: (example shows trial with Prior Odds of LEFT Box=1/6 and sample evidence of 4 black balls drawn out of a sample draw (with replacement) of 5 total balls)

Figure 2: Accuracy Impact of dietary pattern



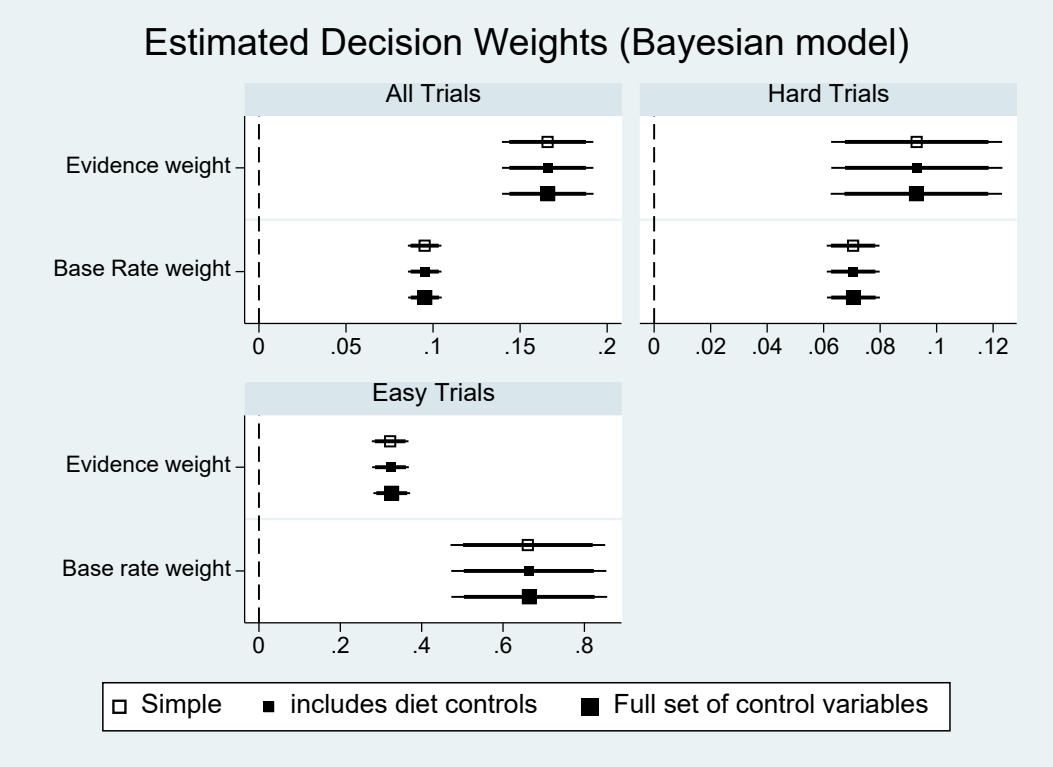
Notes: Coefficient estimates of Dietary pattern indicator variables predicting Bayesian accuracy relative to the reference group of "no specific dietary pattern". Point estimates shown with 95% (thin line) and 90% (thick line) confidence intervals for models with varied specifications of control variables and sample of trial difficulty. Coefficient estimates are from Table 5 and Table 6 estimation results.

Figure 3: Response time impact on accuracy



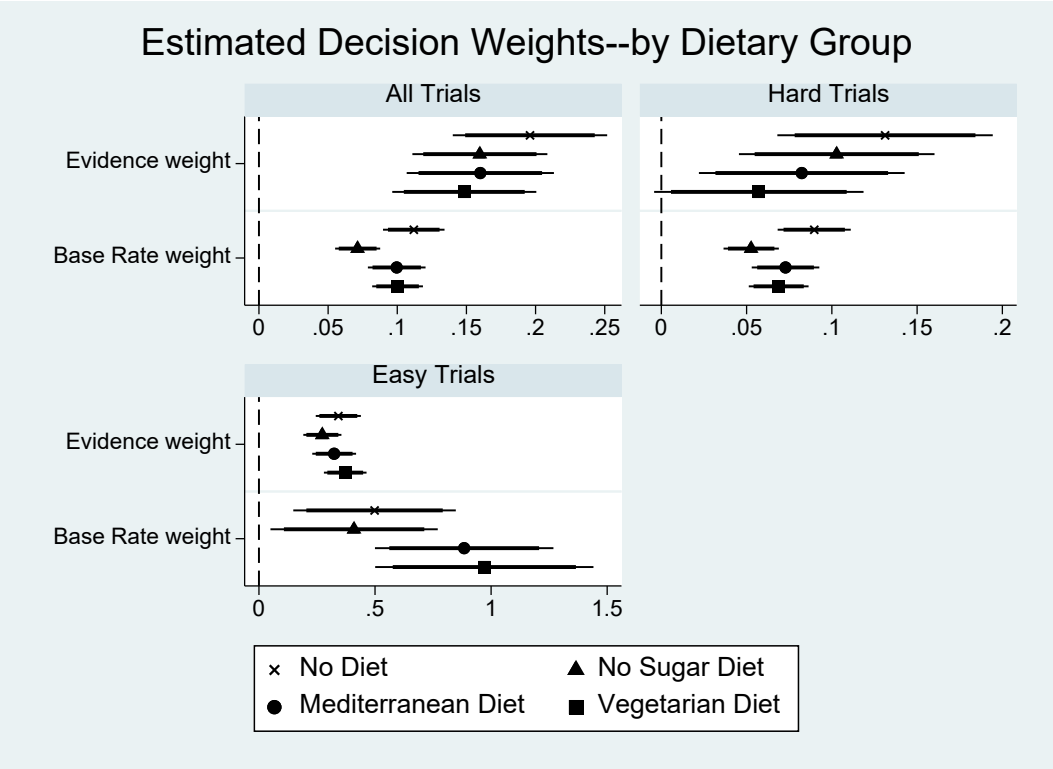
Notes: Coefficient estimates shown are of the *Response* Time binary indicator variable in the trial-level models of *Accuracy.* Point estimates shown with 95% (thin line) and 90% (thick line) confidence intervals for models with varied specifications of control variables and sample of trial difficulty. See Table 3 model 5 and Table 6 models 3 and 6 for the "Full controls" estimation results (full estimation results for the "Binary" and "Trial controls" models available on request).

Figure 4: Estimated decision weights on Base Rates and Evidence information in Bayesian decision model. Robustness analysis.



Notes: X-axis are scaled differently in each panel. See Table 7 for marginal effect of the coefficient estimates. Plots above show coefficient estimates (not marginal effects) on the information variables for the specifications in Table 7. Point estimates shown with 95% (thin line) and 90% (thick line) confidence.

Figure 5: Evidence and Base Rate weights effects (by Dietary Group)



Notes: X-axis are scaled differently in each panel. See Table 8 for marginal effects of the coefficient estimates. Plots above show coefficient estimates (not marginal effects) on the information variables for simple specifications (no controls) in Table 8. Point estimates shown with 95% (thin line) and 90% (thick line) confidence. Results are qualitatively similar if estimating the models with the full set of control variables, as seen in Table 8.

Table 1: Experimental Design—Bayesian Probability of Box A (Bpr) given base rates and evidence

(*#stimuli per odds-evidence combination shown in parenthesis*)

	Evidence in Favor of LEFT Box (has 2 black balls 1 white ball)						
Prior Odds of LEFT Box Selection	Black Balls=0	Black Balls=1	Black Balls=2	Black Balls=3	Black Balls=4	Black Balls=5	Total n
0/6						Bpr=0.00	1
1/6				Bpr=.29	Bpr=.62	Bpr=.86	3
2/6			Bpr=.20	Bpr=.50	Bpr=.80	Bpr=.94	4
3/6		Bpr=.11	Bpr=.33	Bpr=.67	Bpr=.89		4
4/6	Bpr=.06	Bpr=.20	Bpr=.50	Bpr=.80			4
5/6	Bpr=.13	Bpr=.38	Bpr=.71				3
6/6	Bpr=1.00						1
Total n	3	3	4	4	3	3	**TOTAL STIMULI = 20**

Notes: Of the total possible combinations of prior odds and evidence, the indicates cells show the stimuli used and the Bayesian probability (Bpr) of that particular "Evidence" and "Prior Odds" combination for the stimulus. We classified 14 Hard (shaded) and 6 Easy (dashed border) trials among the set of 20 stimuli presented to each participant. Two degenerate choices (the extreme probabilities of 1 and 0) should constitute an "easy" choice for one fully understanding the task, but we employed the convention to label as "Hard Trials" those trials where the evidence and the prior odds point to opposing boxes (e.g., Evidence indicated a more likely LEFT box used, but the Prior Odds indicated a more likely RIGHT box used). This is a more defensible categorization of Hard versus Easy trials given our modification of the task to elicit probabilities rather than a dichotomous response of Left or Right (in which case Bayesian probabilities closer to .50 indicate more difficult dichotomous choices, as categorized in Dickinson et al, 2016).

Table 2: Summary Statistics (Means and Standard Deviations)

Variable	No Diet	Mediterranean Diet	Vegetarian Diet	No Sugar Diet
Age	Mean: 26.83 sd: 5.74	Mean: 28.08 sd: 6.60	Mean: 29.13 sd: 6.44	Mean: 32.50 sd: 6.57
Female (=1)	Mean: 0.34 sd: 0.47	Mean: 0.41 sd: 0.49	Mean: 0.79 sd: 0.41	Mean: 0.50 sd: 0.50
CRT score	Mean: 3.70 sd: 2.06	Mean: 3.25 sd: 2.08	Mean: 3.43 sd: 1.99	Mean: 3.22 sd: 2.08
Stick-to-Diet	Mean: 5.89 sd: 1.94	Mean: 6.55 sd: 1.46	Mean: 8.06 sd: 1.54	Mean: 6.68 sd: 1.54
Supplements (=1)	Mean: 0.21 sd: 0.41	Mean: 0.22 sd: 0.42	Mean: 0.47 sd: 0.50	Mean: 0.36 sd: 0.48
Last Week Avg Sleep	Mean: 7.36 sd: 1.16	Mean: 7.34 sd: 1.09	Mean: 7.46 sd: 1.20	Mean: 7.10 sd: 1.34
Sleepiness	Mean: 4.04 sd: 1.78	Mean: 3.90 sd: 1.86	Mean: 3.91 sd: 1.75	Mean: 4.02 sd:1.82
Observations	110	104	108	105

Table 3: All Trials, Easy Trials, and Hard Trials (Hypothesis 1 & 2 tests)

Dep Var = *Avg Accuracy*	**All Trials** (20 trials per subject)		**Hard Trials** (14 Trials per subject)		**Easy Trials** (6 Trials per subject)	
Variable	**(1)** Coef (SE)	**(2)** Coef (SE)	**(3)** Coef (SE)	**(4)** Coef (SE)	**(5)** Coef (SE)	**(6)** Coef (SE)
Constant	0.768 (.008)***	0.730 (0.04)***	0.756 (0.01) ***	0.700 (0.05)***	0.796 (0.01)***	0.800 (0.05) ***
No Sugar Diet (=1)	-0.033 (.011)***	-0.023 (0.01) **	-0.035 (0.01) **	-0.022 (0.01)**	-0.029 (0.01)**	-0.024 (0.01)*
Medit Diet (=1)	0.0197* (0.011)	-0.014 (0.01)	-0.024 (0.01)*	-0.017 (0.01)	-0.011 (0.01)	-0.007 (0.01)
Veggie Diet (=1)	-0.0125 (0.011)	-0.008 (0.01)	-0.017 (0.01)	-0.009 (0.01)	-0.003 (0.01)	-0.004 (0.01)
Age	---	-0.001 (0.001)	---	-0.001 (0.001)	---	-0.001 (0.001)
Female (=1)	---	-0.008 (0.01)	---	-0.015 (0.01)	---	0.007 (0.01)
CRT score	---	0.010 (0.001)***	---	0.011 (0.002)***	---	0.008 (0.002)***
Stick to Diet (=1)	---	0.001 (0.002)	---	0.001 (0.003)	---	0.001 (0.003)
Supplements (=1)	---	0.007 (0.01)	---	0.009 (0.01)	---	0.002 (0.01)
Last Week Sleep level	---	-0.0002 (0.003)	---	0.001 (0.004)	---	-0.003 (0.004)
Sleepiness	---	0.003 (0.003)	---	0.004 (0.002)	---	0.001 (0.002)
N	412	412	412	412	412	412
R^2	.0224	.1112	.0194	.1119	.0170	.0548

Notes: *$p < .10$, **$p < .05$, *** $p < .01$

Table 4: Specification with Response Time control (Hypothesis 3)

Dep Var = ***Avg Accuracy***	**All Trials** (20 trials per subject)		**Hard Trials** (14 trials per subject)		**Easy Trials** (6 trials per subject)	
Independent Variable	**(1)** Coef (SE)	**(2)** Coef (SE)	**(3)** Coef (SE)	**(4)** Coef (SE)	**(5)** Coef (SE)	**(6)** Coef (SE)
Constant	0.739*** (.009)	0.724 (.039)	0.726*** (.010)	0.705*** (.043)	0.785*** (0.009)	0.796*** (0.045)
No Sugar Diet (=1)	-0.025** (.01)	-0.018 (.011)	-0.027** (.012)	-0.017 (0.013)	-0.026** (0.012)	-0.022* (0.013)
Medit Diet (=1)	-0.021* (.011)	-0.015 (.010)	-0.025** (.012)	-0.019 (0.012)	-0.011 (0.012)	-0.008 (0.012)
Veggie Diet (=1)	-0.011 (0.010)	-0.007 (.012)	-0.017 (0.012)	-0.010 (0.013)	-0.0001 (0.012)	-0.002 (0.014)
Average RT	0.001*** (0.0002)	0.001*** (0.0002)	0.001*** (0.0002)	0.001*** (0.0002)	0.001*** (0.0002)	0.0004** (0.0002)
Age	---	-0.001 (0.001)	---	-0.001 (0.001)	---	-0.001 (0.001)
Female (=1)	---	-0.008 (0.008)	---	-0.015 (0.009)	---	0.008 (0.010)
CRT score	---	0.008*** (.002)	---	0.009*** (0.002)	---	0.007*** (0.002)
Stick to Diet (=1)	---	0.001 (0.002)	---	0.001 (0.003)	---	0.001 (0.003)
Supplements (=1)	---	0.007 (.008)	---	0.009 (0.009)	---	0.002 (0.010)
Last Week Sleep level	---	-0.001 (.003)	---	-0.000 (0.004)	---	-0.004 (0.004)
Sleepiness	---	0.003* (0.002)	---	0.004* (0.002)	---	.001 (0.002)
N	412	412	412	412	412	412
R^2	.1170	.1755	.1072	.1708	.0353	.0663

Notes: *$p < .10$, **$p < .05$, *** $p < .01$

Table 5: Trial-level analysis of Bayesian Accuracy—All Trials

Dep Var = *Accuracy*	**All Trials** (20 trials per subject)		
Independent Variable	**(1)** Coef (SE)	**(2)** Coef (SE)	**(3)** Coef (SE)
Constant	0.758 (0.010)***	0.720 (0.042)***	0.718 (0.043)***
No Sugar Diet (=1)	-0.033 (0.011)***	-0.023 (0.011)**	-0.022 (0.011)*
Medit Diet (=1)	-0.020 (0.012)*	-0.014 (0.012)	-0.014 (0.012)
Veggie Diet (=1)	-0.013 (0.011)	-0.008 (0.012)	-0.008 (0.012)
Trial	0.001 (0.0004)**	0.001 (0.0004)**	0.001 (0.0004)***
Response Time (sec)	---	---	0.00007 (0.00003)*
Age	---	-0.001 (0.001)	-0.0009 (0.0007)
Female (=1)	---	-0.007 (0.008)	-0.008 (0.008)
CRT score	---	0.010 (0.002)***	0.010 (0.002)***
Stick to Diet (=1)	---	0.001 (0.002)	0.001 (0.002)
Supplements (=1)	---	0.007 (0.008)	0.007 (0.008)
Last Week Sleep level	---	-0.0003 (0.004)	-0.0003 (0.0004)
Sleepiness	---	0.003 (0.002)*	0.003 (0.002)*
n	8240	8240	8240
Wald (X^2) test	14.50***	56.17***	58.68***
R^2 (overall)	.0035	.0149	.0156

Notes: *$p < .10$, **$p < .05$, *** $p < .01$. Random effect generalized least squares estimates with error clustered at the subject level.

Table 6: Trial-level analysis of Bayesian Accuracy—Hard vs Easy Trials

Dep Var=*Accuracy*	**Hard Trials** (14 Trials per subject)			**Easy Trials** (6 Trials per subject)		
Independent Variable	**(1)** Coef (SE)	**(2)** Coef (SE)	**(3)** Coef (SE)	**(4)** Coef (SE)	**(5)** Coef (SE)	**(6)** Coef (SE)
Constant	0.746 (0.011)***	0.690 0(.048)***	0.688 (0.048)***	0.786 (0.011)***	0.789 (0.046)***	0.785 (0.047)***
No Sugar Diet (=1)	-0.034 (0.013)***	-0.022 (0.013)*	-0.022 (0.013)*	-0.030 (0.013)**	-0.024 (0.014)*	-0.023 (0.014)*
Medit Diet (=1)	-.024 (0.0134)*	-0.017 (0.013)	-0.017 (0.013)	-0.012 (0.013)	-0.008 (0.013)	-0.008 (0.013)
Veggie Diet (=1)	-0.016 (0.013)	-0.009 (0.013)	-0.009 (0.013)	-0.003 (0.012)	-0.005 (0.015)	-0.004 (0.014)
Trial	0.001 (0.0005)*	0.001 (0.0005)*	0.0011 (0.0005)**	0.001 (0.0006)	0.001 (0.0006)	0.001 (0.0006)**
Response Time (sec)	--	---	0.0001 (0.00004)**	--	---	0.0002 (0.0001)*
Age	---	-0.001 (0.001)	-0.001 (0.001)	---	-0.001 (0.001)	-0.001 (0.001)
Female (=1)	---	-0.015 (0.009)*	-0.015 (0.009)*	---	0.008 (0.009)	0.008 (0.009)
CRT score	---	0.011 (0.002)***	0.011 (0.002)***	---	0.008 (0.002)***	0.007 (0.002)***
Stick to Diet (=1)	---	0.001 (0.003)	0.001 (0.003)	---	0.001 (0.003)	0.001 (0.003)
Supplements (=1)	---	0.009 (0.009)	0.009 (0.009)	---	0.002 (0.009)	0.002 (0.009)
Last Week Sleep level	---	0.001 (0.004)	0.001 (0.004)	---	-0.003 (0.004)	-0.003 (0.004)
Sleepiness	---	0.004 (0.002)**	0.004 (0.002)**	---	0.001 (0.002)	0.001 (0.002)
n	5768	5768	5768	2472	2472	2472
Wald (X^2) test	10.82**	53.04***	56.22***	9.24*	26.94***	33.48***
R^2 (overall)	.0033	.0163	.0171	.0057	.0156	.0176

Notes: *p < .10, **p < .05, *** p < .01. Random effect generalized least squares estimates with error clustered at the subject level.

Table 7: Trial-level analysis of Bayesian decision model

Dep Var = *Left Box Assess*	**All Trials** (20 Trials per subject)			**Hard Trials** (14 Trials per subject)			**Easy Trials** (6 Trials per subject)		
Independent Variable	**(1)** Coef (SE)	**(2)** Coef (SE)	**(3)** Coef (SE)	**(4)** Coef (SE)	**(5)** Coef (SE)	**(6)** Coef (SE)	**(7)** Coef (SE)	**(8)** Coef (SE)	**(9)** Coef (SE)
$lnLR(L)$ (Evidence)	0.07 (.01)***	0.07 (.01)***	0.07 (.01)***	0.04 (.01)***	0.04 (.006)***	0.04 (.01)***	0.12 (.008)***	0.12 (.008)***	0.12 (.008)***
$ln\left({}^{P_L}/_{1-P_L}\right)$ (Base rate)	0.04 (.002)***	0.04 (.002)***	0.04 (.002)***	0.03 (.002)***	0.03 (.002)***	0.03 (.02)***	0.24 (.03)***	0.24 (.03)***	0.24 (.03)***
No Sugar (=1)	---	0.03 (.02)	0,01 (,92)	---	0.02 (.02)	0.002 (.02)	---	0.05 (.03)	0.03 (.04)
Medit (=1)	---	0.01 (.02)	0.01 (.03)	---	-0.004 (.02)	-0.01 (.03)	---	0.05 (.03)	0.05 (.03)
Veggie (=1)	---	0.01 (.02)	0.003 (.02)	---	-0.01 (.02)	-0.01 (.02)	---	0.06 (.03)*	0.04 (.03)
Trial	---	---	-0.002 (.001)*	---	---	-0.0017 (.001)	---	---	-0.003 (.002)
RT (sec)	---	---	-0.0002 (.0001)	---	---	0.00003 (.001)	---	---	-0.0006 (.0004)*
Age	---	---	.0016 (.001)	---	---	0.0015 (.001)	---	---	0.002 (.002)
Female (=1)	---	---	-0.01 (.02)	---	---	-0.01 (.02)	---	---	0.007 (.03)
CRT score	---	---	-0.005 (.003)	---	---	-0.006 (.003)	---	---	-0.0003 (.006)
Stick to Diet (=1)	---	---	-0.0001 (.004)	---	---	-0.002 (.005)	---	---	0.004 (.007)
Supplements (=1)	---	---	0.02 (.01)	---	---	0.01 (.02)	---	---	0.04 (.03)
Last Week Sleep level	---	---	-0.01 (.006)**	---	---	-0.01 (.006)*	---	---	-0.01 (.01)
Sleepiness	---	---	-0.001 (.004)	---	---	-0.002 (.004)	---	---	.002 (.007)
n	7377	7377	7377	4905	4905	4905	2472	2472	2472
Wald (X^2) test	414.24	424.65	451.26	219.68	220.80	237.38	272.09	283.17	294.01
Pseudo-R^2	.0689	.0692	.0711	.0416	.0419	.0437	.2048	.2067	.2114

Notes: *p < .10, **p < .05, *** p < .01. Probit regressions with errors clustered at the subject level. Marginal effects reported above.

Table 8: Trial-level analysis of Bayesian decision model—By Dietary pattern (Marginal effects of Probit estimations shown)

Dep Var = *Left Box Assess*	**All Trials** (20 Trials per subject)				**Hard Trials** (14 Trials per subject)				**Easy Trials** (6 Trials per subject)			
Independent Variable	**No Diet (1)** Coef (SE)	**No Sug (2)** Coef (SE)	**Medit (3)** Coef (SE)	**Veggie (4)** Coef (SE)	**No Diet (5)** Coef (SE)	**No Sug (6)** Coef (SE)	**Medit (7)** Coef (SE)	**Veggie (8)** Coef (SE)	**No Diet (9)** Coef (SE)	**No Sug (10)** Coef (SE)	**Medit (11)** Coef (SE)	**Veggie (12)** Coef (SE)
$lnLR(L)$ (Evidence)	0.08 (.01)***	0.06 (.01)***	0.06 (.01)***	0.06 (.01)***	0.05 (.01)***	0.04 (.01)***	0.03 (.01)***	0.02 (.01)*	0.13 (.02)***	0.10 (.02)***	0.11 (.02)***	0.13 (.01)***
$ln\left(P_L/1-P_L\right)$ (Base rate)	0.04 (.004)***	0.03 (.003)***	0.04 (.004)***	0.04 (.004)***	0.04 (.004)***	0.02 (.003)***	0.03 (.004)***	0.03 (.004)***	0.19 (.07)***	0.15 (.06)**	0.31 (.07)***	0.33 (.07)***
Controls	No	No	No	No	No	No	No	No	No	No	No	No
Wald (X^2) test	104.78	92.85	94.44	129.00	67.36	41.54	52.71	60.41	65.93	61.15	71.77	72.19
Pseudo-R^2	.0926	.0518	.0708	.0679	.0655	.0274	.0445	.0424	.2049	.1417	.2284	.2657
X^2 test of Evidence = Odds weight	10.90***	13.40***	5.75**	3.29*	2.22	3.47*	0.12	0.16	0.64	0.47	7.38***	6.32**
Results from Models with Full Set of Control variables												
$lnLR(L)$ (Evidence)	0.08 (.01)***	0.06 (.01)***	0.06 (.01)***	0.06 (.01)***	0.05 (.01)***	0.04 (.01)***	0.03 (.01)***	0.02 (.01)*	0.13 (.02)***	010 (.02)***	0.12 (.02)***	0.13 (.01)***
$ln\left(P_L/1-P_L\right)$ (Base rate)	0.04 (.004)***	0.03 (.003)***	0.04 (.004)***	0.04 (.004)***	0.04 (.004)***	0.02 (.003)***	0.03 (.004)***	0.03 (.004)***	0.19 (.07)***	0.15 (.07)**	0.32 (.07)***	0.34 (.07)***
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald (X^2) test	132.86	102.13	117.86	136.60	85.41	51.91	75.75	66.85	77.11	63.93	76.13	93.03
Pseudo-R^2	.0989	.0538	.0771	.0694	.0709	.0316	.0502	.0448	.2219	.1490	.2504	.2876
X^2 test of Evidence = Odds weight	10.88***	13.36***	5.63**	3.27*	2.21	3.47*	0.10	0.18	0.68	0.52	7.35***	6.84***
Observations	1899	1809	1791	1878	1263	1203	1191	1248	636	606	600	630

Notes: *p < .10, **p < .05, *** p < .01. Probit regressions with errors clustered at the subject level. Marginal effects reported above.

REFERENCES

Åkerstedt, T., & Gillberg, M. (1990). Subjective and objective sleepiness in the active individual. *International Journal of Neuroscience*, *52*(1-2), 29-37.

Dickinson, D. L., & Drummond, S. P. (2008). The effects of total sleep deprivation on Bayesian updating. *Judgment and Decision Making*, *3*(2), 181.

Dickinson, D. L., Drummond, S. P., & Dyche, J. (2016). Voluntary sleep choice and its effects on Bayesian decisions. *Behavioral Sleep Medicine*, *14*(5), 501-513.

Dickinson, D. L., & Garbuio, C. (2020, March 23). Dietary Patterns and Bayesian Choice. Retrieved from https://osf.io/472bg

Dickinson, D. L., & McElroy, T. (2019). Bayesian versus heuristic-based choice under sleep restriction and suboptimal times of day. *Games and Economic Behavior*, *115*, 48-59.

Féart, C., Samieri, C., Rondeau, V., Amieva, H., Portet, F., Dartigues, J. F., ... & Barberger-Gateau, P. (2009). Adherence to a Mediterranean diet, cognitive decline, and risk of dementia. *JAMA*, *302*(6), 638-648.

Grether, D. M. (1980). Bayes rule as a descriptive model: The representativeness heuristic. *The Quarterly Journal of Economics*, *95*(3), 537-557.

Kahneman, D. (2011). *Thinking, fast and slow*. Macmillan.

Kanoski, S. E., & Davidson, T. L. (2011). Western diet consumption and cognitive impairment: links to hippocampal dysfunction and obesity. *Physiology & Behavior*, *103*(1), 59-68.

Kant, A. K. (2004). Dietary patterns and health outcomes. *Journal of the American Dietetic Association*, *104*(4), 615-635.

Kpolovie, P. J. (2012). Lumosity training and brain-boosting food effects on learning. *International Research Journals*, *2*(6), 217-230.

Lloyd-Jones, D. (2009). DIET/EXERCISE/WEIGHT. *Circulation*, *119*, e1-e161.

Magnusson, K. R., Hauck, L., Jeffrey, B. M., Elias, V., Humphrey, A., Nath, R., ... & Bermudez, L. E. (2015). Relationships between diet-related changes in the gut microbiome and cognitive flexibility. *Neuroscience*, *300*, 128-140.

Martínez-Lapiscina, E. H., Clavero, P., Toledo, E., Estruch, R., Salas-Salvadó, J., San Julián, B., ... & Martinez-Gonzalez, M. Á. (2013). Mediterranean diet improves cognition: the PREDIMED-NAVARRA randomized trial. *Journal of Neurology, Neurosurgery & Psychiatry*, *84*(12), 1318-1325.

McElroy, T., & Dickinson, D. L. (2019). Thinking about complex decisions: How sleep and time-of-day influence complex choices. *Consciousness and Cognition*, *76*, 102824.

Medawar, E., Huhn, S., Villringer, A., & Witte, A. V. (2019). The effects of plant-based diets on the body and the brain: a systematic review. *Translational Psychiatry*, *9*(1), 1-17.

Palan, S., & Schitter, C. (2018). Prolific. ac—A subject pool for online experiments. *Journal of Behavioral and Experimental Finance*, *17*, 22-27.

Peterson, S. D., & Philippou, E. (2016). Mediterranean diet, cognitive function, and dementia: a systematic review of the evidence. *Advances in Nutrition*, *7*(5), 889-904.

Pribis, P., Bailey, R. N., Russell, A. A., Kilsby, M. A., Hernandez, M., Craig, W. J., ... & Sabate, J. (2012). Effects of walnut consumption on cognitive performance in young adults. *British Journal of Nutrition*, *107*(9), 1393-1401.

Pribis, P., & Shukitt-Hale, B. (2014). Cognition: the new frontier for nuts and berries. *The American Journal of Clinical Nutrition*, *100*(suppl_1), 347S-352S.

Primi, C., Morsanyi, K., Chiesi, F., Donati, M. A., & Hamilton, J. (2016). The development and testing of a new version of the cognitive reflection test applying item response theory (IRT). *Journal of Behavioral Decision Making*, *29*(5), 453-469.

Radd-Vagenas, S., Duffy, S. L., Naismith, S. L., Brew, B. J., Flood, V. M., & Fiatarone Singh, M. A. (2018). Effect of the Mediterranean diet on cognition and brain morphology and function: a systematic review of randomized controlled trials. *The American Journal of Clinical Nutrition*, *107*(3), 389-404.

Scarmeas, N., Anastasiou, C. A., & Yannakoulia, M. (2018). Nutrition and prevention of cognitive impairment. *The Lancet Neurology*, *17*(11), 1006-1015.

Sofi, F., Abbate, R., Gensini, G. F., & Casini, A. (2010). Accruing evidence on benefits of adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. *The American Journal of Clinical Nutrition*, *92*(5), 1189-1196.

Willett, W. C. (1994). Diet and health: what should we eat? *Science*, *264*(5158), 532-537.

APPENDIX A: Additional Results

Table A1: Mann Whitney results—unconditional tests of accuracy across participant samples

Variable	*No Diet*	*No-Sugar*	*Medit*	*Veggie*	Mann Whitney tests Z-stat: *No-Sugar* vs *No Diet*	Mann Whitney tests Z-stat: *Medit* vs *No Diet*	Mann Whitney tests Z-stat: *Veggie* vs *No Diet*
Avg Accuracy --All Trials	.768 (.089)	.735 (.074)	.735 (.074)	.756 (.073)	-2.775**	-1.890*	-1.327
Avg Accuracy --Hard Trials	.756 (.100)	.722 (.085)	.732 (.093)	.740 (.082)	-2.293**	-1.822*	-1.378
Avg Accuracy --Easy Trials	.796 (.097)	.767 (.085)	.786 (.086)	.794 (.082)	-2.567**	-1.271	-0.580
Avg Binary Accuracy --All	.669 (.191)	.609 (.154)	.621 (.195)	.616 (.184)	-2.410**	-1.998*	-1.980**
Avg Binary Accuracy --Hard	.635 (.212)	.586 (.156)	.587 (.199)	.581 (.183)	-1.332	-1.714*	-1.768*
Avg Binary Accuracy —Easy	.737 (.251)	.647 (.235)	.688 (.273)	.794 (.082)	-2.576***	-1.306	-1.314
Avg Response Time- -All	22.697 (24.121)	16.937 (9.166)	22.924 (16.925)	21.327 (21.807)	-1.059	1.244	0.251
Avg Response Time —Hard	20.773 (21.596)	17.138 (10.357)	23.327 (16.267)	23.069 (27.379)	-1.316	1.564	0.518
Avg Response Time --Easy	22.522 (35.588)	16.470 (11.222)	21.983 (23.740)	17.263 (14.274)	-0.737	0.203	-0.837
Observations	106	101	100	105			

*$p < .10$, **$p < .05$, *** $p < .01$

APPENDIX B: Survey Administered

Note: Page timers, survey logic, and trial randomization not shown (and was not apparent to participants). Dotted lines indicate page breaks in the survey. Pay rates indicated fulfilled the Prolific "fair pay" required hourly compensation level, before bonus consideration (for Bayes task outcomes). Highlights for your (the reader's) benefit are indicated by **Note to reader**

Informed Consent: You are being asked to complete this online survey as part of a research study on decision making related dietary choice.

Participation in this online survey is completely voluntary, your responses to this survey will remain completely confidential, the data will be securely stored, your name will not be recorded anywhere on this survey. The only identifier we will record will be your Prolific ID, which we as researchers cannot link to personally identifiable data of yours.

This survey is estimated to take 18 minutes to complete and your payment for successful and complete survey completion will be $2.40. Additionally, the information use decision task within this survey offers **the chance of earning an *additional* $1.00 bonus payment,** depending on your choice in the task (the instructions will clearly explain how this works on that task)

There are no known risks associated with this study beyond those associated with everyday life. Although this study will not benefit you personally, its results will help our understanding of how people make decisions.

For additional information related to this questionnaire, contact Dr. David Dickinson, Department of Economics, Appalachian State University, at dickinsondl@appstate.edu. Appalachian State University's Institutional Review Board (IRB) has determined this study to be exempt from review by the IRB administration**.**

- ○ **I Consent** and wish to continue with this study
- ○ **I do not consent** to participating and **do not wish to continue**

The following questions are **screener validation questions** to make sure we get the desired sample we advertised for this survey.

What is your current age (in years)? [**Note to reader: this double-checks the 18-45 age restriction]**

18 23 29 34 40 45 50 56 61 67 72

Years of age

What is your sex?
(i.e., what sex were you assigned at birth, such as on an original birth certificate)?

- ○ Female
- ○ Male

Do you currently follow any of the following diets? If yes, choose the one you follow the most. If no, choose "I do not follow any diet".

[**Note to reader**: each custom sample was screened using Prolific tools but double-checked below (with respondent being screened out of the study if response did not match custom sample response)]

- ○ I do not follow any diet
- ○ Vegetarian Diet (you refrain from the consumption of meat (red meat, poultry, seafood, insects and the flesh of any other animal)
- ○ Pescatarian diet (your diet includes fish and seafood, but not the flesh of other animals)
- ○ Vegan Diet (you refrain from eating any animal products)
- ○ Weight Watchers Diet
- ○ South Beach Diet
- ○ Raw Food Diet
- ○ Mediterranean Diet
- ○ Atkins Diet
- ○ The Zone Diet
- ○ 5-2 Diet

Before you start, please switch off phone/ e-mail/ music so that you can focus on this study. Thank you!

Please carefully enter your Prolific ID

_____

[**Note to reader:** Java script automatically piped the participant's Prolific ID into this space for each to verify, but manual input was unnecessary)

You indicated above that you do not follow any specific dietary pattern? Do you do this because **you really have not thought about dietary patterns or you have thought about it and determined that "no dietary pattern" is what is best for you**?
(pick whichever option best describes your situation).

- ○ I really have not thought much about dietary patterns
- ○ I've thought about it and determined "no dietary pattern" is best for me.

On the scale below, please indicate **how closely you stick to your "no dietary pattern" rules ?**
(e.g., you may not stick to these rules if you regularly try out different dietary patterns just to see how it goes, or because your friends are trying it, etc)

	Terrible Adherence	**somewhat weak adherence**	**Neither weak nor strong adherence**	**somewhat strong adherence**	**Excellent Adherence**
	1	2 3	4	5 6	7 8 9
Adherence to my "no dietary pattern" approach					

Do you take any dietary supplements?

- ○ No
- ○ Yes (please specify in box below) _____

Please mark the number that best corresponds to how sleepy you feel **right now**. You may mark any number, but mark only one number.

[**Note to reader:** This is the Karolinska sleepiness scale

- ○ 1. Extremely alert
- ○ 2.
- ○ 3. Alert
- ○ 4.
- ○ 5. Neither alert nor sleepy
- ○ 6.
- ○ 7. Sleepy--but no difficulty remaining awake
- ○ 8.
- ○ 9. Extremely sleepy--fighting sleep

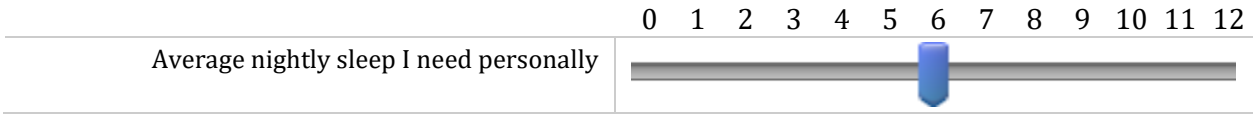
Over the last 7 nights, what is the average amount of sleep you obtained each night?

	0 1 2 3 4 5 6 7 8 9 10 11 12
Average nightly sleep over the LAST WEEK	

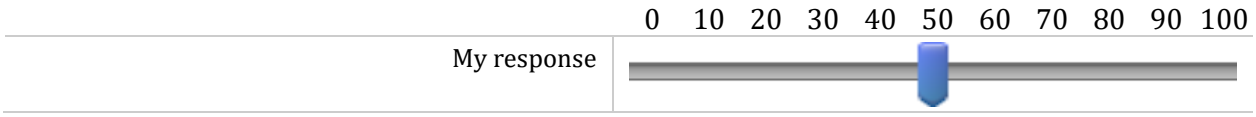
Last night, how much sleep did you get?

	0 1 2 3 4 5 6 7 8 9 10 11 12
Hours of sleep LAST NIGHT	

What do you feel is the optimal amount of sleep for you personally to get each night? (optimal in terms of next day alertness, performance, and functionality for you personally.)



As described earlier, we are interested in factors that influence the decisions you might make. In order for the results of this survey to be valid, it is essential that you read all the instructions and questions carefully. So we know that you have read these instructions, please just place the slider on the number corresponding to the sum of 34 and 25. Thank you for taking the time to read these instructions.



[**Note to reader**: Highlights below were present in survey to participants]

The following task will ask for your assessments on each of several trials. The scenario of each trial is one where **one of two boxes will be selected in each trial: the box on the LEFT or the box on the RIGHT (see the example image of the boxes by scrolling down on this page)**. In each trial, you will be given some initial information on how likely it is either box will be selected, and then you will be shown the result of a series of balls drawn out of the selected box to help in your assessment. In each trial, **you must indicate the likelihood (i.e., the chances out of 100) that the *LEFT* box was selected for that trial**.

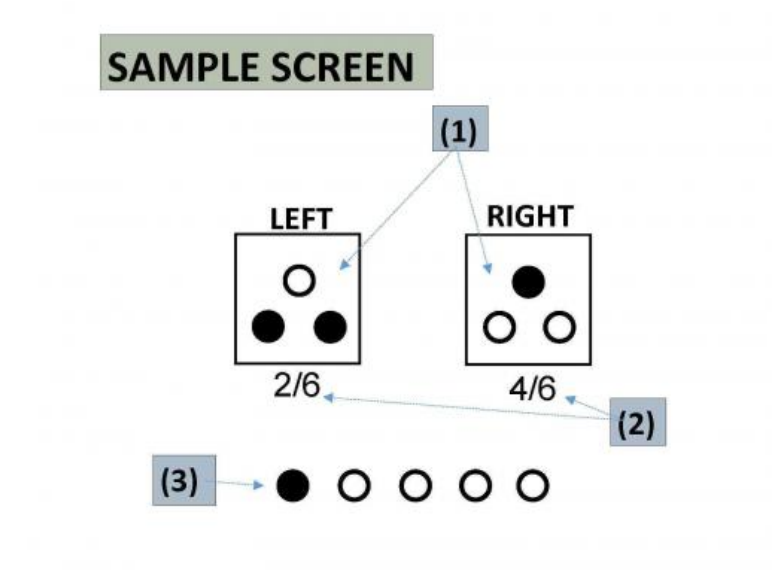
After the completion of the survey, we will select one of the decision trials from this task at random and compensate you a bonus payment of $1.00 if your assessment is within 5 chances out of 100 of the true likelihood that the LEFT box was selected in that trial. For example, if the actual likelihood is a 25 chances out of 100 (i.e., a 25% probability) that the LEFT box was selected in that trial, then you would be compensated the bonus payment of $1.00 if your response was anywhere between 20-30 chances out of 100 (5 points below to 5 points above the exact chances out of 100) that the LEFT box was selected. However, if your response in that trial was 3, or 18, or 31, or 59, etc, chances out of 100, then you would not receive any bonus payment in this task (of course, you still receive the promised Prolific payment for completing the survey whether or not your response in this task earns you the bonus payment)

To more specifically describe the task, consider the contents of each box: the box on the LEFT always contains 2 black and 1 white ball, while the box on the RIGHT always contains 1 black and 2 white balls (see the image below). Without knowing any more information, it is clear that a black ball is more likely to be drawn from the LEFT box, and a white ball is more likely to be drawn from the RIGHT box, although it is certainly possible that either color ball could be drawn from either box.

In order to help you give your assessment of how likely it is that the LEFT box was selected in any given

trial, **<u>you will be given two pieces of information</u>**. ***First***, we will tell you the starting-chance that the LEFT or RIGHT box will be selected for that trial. This will be expressed in terms of flipping a 6-sided die and selecting the box based on the outcome of the die roll. For example, it may be that there will be a 1/6 chance (i.e., a 1 out of 6 chance) that the LEFT box will be selected, which means there is a 5/6 chance the RIGHT box will be selected. It is as if we are rolling a 6-sided die and saying, "if we roll a "1" then the LEFT box is selected, but if we roll a "2, 3, 4, 5, or 6" then the RIGHT box is selected for this trial."

However, you will *not be shown the outcome of the "die-roll"***.** Rather, ***the second piece of information you will be given*** in each trial is that, without knowing the outcome of the die roll, we will show you the result of drawing 5 balls with replacement from the selected box. Drawing "with replacement" means that every time we draw from a box its contents are the same--as shown in the graphic below, if drawing from the LEFT box there is always 2 black and 1 white balls available, and the RIGHT box has 1 black and 2 white balls available every time a draw is made). The results of this sample of 5 balls drawn will be shown to you as well. Because the contents of the LEFT versus RIGHT box are different, seeing the results of 5 balls drawn with replacement from the selected box may be useful information in trying to assess the overall likelihood (i.e., chances out of 100) that the LEFT box was selected for that trial. A picture of the stimulus is shown below, which succinctly reminds you of the contents of the LEFT and RIGHT boxes (this remains constant across all trials), as well as the starting-chance of selecting the LEFT versus RIGHT box and the sample evidence of the 5 ball drawn from the selected box. **Across different trials, the starting-chance and/or sample evidence may change, and so you should pay attention to these pieces of information carefully in each trial.**



<u>The importance of each part of the stimulus image is as follows:</u>

(1) Balls inside of the box show the different contents of each box

(2) The fraction beneath the box shows the starting-chance (out of 6) that the box will be selected. ***A greater fraction below the LEFT box means the starting-chance of selecting the LEFT box is higher*** *(and a lower fraction means the starting-chance of selecting the LEFT box is lower)*. However, remember that you do **not** get to see which Box was actually selected

(3) The set of 5 balls at the bottom show the result of drawing 5 balls, with replacement, from the Box that was selected. Remember, because of the contents of each box shown in **(1)**, ***a sample draw with more black balls is more likely to come from the LEFT box*** *(and a draw with more white balls is less likely to come from the LEFT box).*

Using any of this information that seems relevant to you, **you are then asked to indicate the likelihood (chances out of 100) that you think the LEFT box had been selected** in that particular trial.

Note: From trial to trial, *the information in items (2) and (3) may change* (but not item (1)--the contents of each Box).

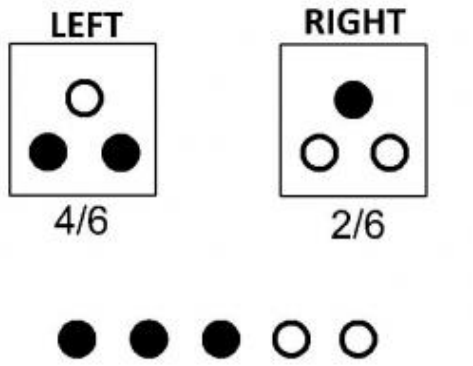
Finally, there is an equally likely chance that any one of the trials below could be the one selected to count for the bonus payment opportunity. **So, it is in your monetary interest to treat *each* and every trial as if it could count for payoff potential ($1.00 bonus), because it might!**

The main assessment task starts on the next page. Please click below when ready to start.

○ I'm ready to start the task

Please indicate on the scale below **how likely you think it is that the LEFT box had been selected**, given the following information below:

(remember, the fractions listed directly below each box indicate the starting-chance that the box will be selected in this trial. The row of 5 balls underneath show the result of drawing 5 balls with replacement from the box actually selected in this trial).



Given this information, I feel the chances out of 100 (i.e., the likelihood) that the LEFT box was selected in this trial is:

	Low chances out of 100 mean I think it is **unlikely the LEFT box was selected** (i.e., more likely the RIGHT box was selected)	Chance of 50 out of 100 means I think it is **equally likely that either the LEFT or RIGHT box were selected**	High chances out of 100 mean I think it is **more likely the LEFT box was selected** (i.e., unlikely the RIGHT box was selected)
	0 10 20 30 40 50 60 70 80 90 100		
Chances out of 100 the **LEFT** box was selected in this trial.			

[**Note to reader:** A total of 20 trials like this one above were presented to cover the combinations of Prior Odds and Evidence as shown in Table 1 (main text). Presentation was in randomized order and with each trial on a separate page for each participant (with response time captured for each trial).

Finally, please answer these final questions on the next set of pages for us.

[**Note to reader:** 6 items below represent the 6-item cognitive reflection task

---

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?
(please indicate your numeric answer **in cents**)

_____

If it takes 5 minutes for 5 machines to make 5 widgets, how long would it take for 100 machines to make 100 widgets?
(please indicate your numeric answer **in minutes)**

_____

If 3 elves can wrap 3 toys in 1 hour, how many elves are needed to wrap 6 toys in 2 hours?
(please give your numeric answer in **# of elves**)

_____

Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are there in the class?
(please give your numeric answer in **# of students)**

_____

In an athletics team, tall members are **three** times more likely to win a medal than short members. This year the team has won 60 medals so far. How many of these have been won by short athletes?
(please give your numeric answer in **# of medals**)

_____

In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover **half** of the lake? (please indicate your numeric answer **in days**)

_____

To finalize this survey, please click "FINISH SURVEY" below.

Note: If your response on the randomly selected trial in the decision task was accurate enough to earn you the $1.00 bonus payment, then we will send this to you within 48 hrs of survey completion. Please understand that we will not be able to respond to personal inquiries about the bonus payment because we may be flooded with messages. If earned, the bonus payment will be sent as indicated. If not earned, then you will not receive the bonus payment, but we will not message you just to tell you this. Thank you for understanding and thank you for participating in our study.

○ **FINISH SURVEY**