Information Avoidance, Moral Wiggle Room, and High Air Conditioning Usage

Pre-Analysis Plan

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Fieldwork locations: USA

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1. Introduction

This document outlines our pre-analysis plan (PAP) for a field experiment on the impact of cost of compliance and moral obligation on the tendency of individuals to avoid information on the environmental impact of AC usage, conducted with online workers recruited from Amazon Mechanical Turk (MTurk). The document summarizes: (i) our experiment and resulting data and (ii) our research questions and the plan of statistical analysis.

The field experimental data collection consists in an online experiment that will take place between July and September 2019. At the time of writing this plan, we conducted a pilot and are about to start the data collection. We will begin data analysis in September 2019.

We intend to submit this Pre-Analysis Plan to the AEA RCT Registry.

2. Sample and treatment

2.1. Description of the sample

This project is centered around an online experiment studying the impact of varying the perceived cost of and moral obligation associated to acting upon a piece of information on individuals' decision to avoid the information. The experiment is planned for the summer of 2019. Our analysis will study the impact of the experimental treatments on the choice to acquire or not a piece of information on the environmental impact of AC usage, and on the subsequent temperature setting of the AC thermostat.

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To be eligible for the study, workers must be 18 or older, be at home at the time of taking the survey, have an AC system with the option to set the thermostat temperature, and be able and willing to upload a picture of their thermostat. Subjects are compensated 2 USD for participation. We expect the survey to last about 15 minutes.

The experiment targets an estimated number of around 2000 MTurk workers, or 500 per experimental condition. This corresponds to the sample size of published papers using subjects recruited from MTurk (Della Vigna and Pope, 2018). We conducted a pilot study to run power calculations and determine the minimum sample size for the current experiment. For our main outcome, information acquisition, and for the comparison between control and the experimental condition, which combines the two treatments described below, a sample of 279 subjects per condition is deemed sufficient to detect differences significant at the 5 per cent level. For other outcomes and treatment pairs, the required sample size ranges between less than 100 and more than 39k subjects. We thus expect to be able to detect at least some treatment effects, and in particular the ones that are the main focus of the analysis, with the planned sample size.

2.2. Structure of the treatments and randomization

Eligible subjects who agree to take part in the experiment are administered a survey, which begins with questions on current outside temperature and AC thermostat temperature. Then subjects are exposed to the experimental treatments, described below. Immediately after, all subjects are asked to estimate the impact of their own choices of AC settings on the environment: these questions provide a manipulation check and evidence on the mechanisms at work. Then we ask respondents whether they wish to read information on the environmental impact of AC usage. This is our main outcome variable: we monitor this decision and the time spent by subjects on the information page, which discusses the impact on the environment of AC usage in terms of electricity consumption and cooling gas emissions, and gives subjects the possibility to compute their own CO2 emissions from AC usage by clicking on a link to an online calculator. Subjects are then asked whether they are willing to raise their AC thermostat temperature and are required to upload a picture of their thermostat display. Reported willingness to raise the AC temperature and thermostat temperature are our second outcome variables. Finally, the survey asks a series of questions on subjects' demographic and socio-economic characteristics, AC usage, beliefs in climate change and values. Appendix A reports the full text of the survey.

The experiment varies the perceived cost of, and the moral obligation associated with, acting upon the information on the environmental impact of AC usage. This corresponds to two treatment dimensions:

- Moral obligation: subjects in the moral obligation treatment are shown a picture of, and given a brief statement by, a volunteer for the Sierra Club, a well-known US environmental NGO. They are then told that the volunteer will observe their choices and thermostat settings. This manipulation creates social pressure to conserve energy. Subjects in the no moral obligation treatment are simply shown a picture of a thermostat and told that they will be shortly asked to upload a picture of their own AC thermostat.

- Cost of action: subjects in the low cost of action treatment are told that raising the AC thermostat picture by even 1 degree is enough to reduce AC's impact on the environment, while for subjects in the high cost of action treatment the suggested thermostat increase is of 5 degrees. Consistent with this, when asked for their willingness to actually raise the temperature of their thermostats, the suggested increase is of 1 and 5 degrees for subjects in the low and high cost treatments, respectively. This treatment should induce a variation in the perceived cost of acting upon the information, which should be higher the larger the suggested increase in AC temperature is.

The combination of the two treatment dimensions results in a 2x2 factorial design, which will allow us to test the impact of moral obligation and perceived cost of action in isolation and combined, in order to test the hypotheses discussed in Section 3 below.

Assignment to treatment will be performed by the randomization tool of the survey software we use to program the questionnaire, Qualtrics.

2.3. Non-experimental variation

In addition to the experimental treatments, we will examine whether the cost of action is affected by outside temperature as a subject takes the survey. We will conduct the experiment in several locations, namely the three largest US states – California, Florida and Texas - over 5 different days, namely on Mondays over 5 consecutive weeks starting from the first week of July. Within each day and state, subjects will be randomly allocated to one of the four experimental conditions. This sampling protocol should ensure that our data display within day and location variation in participants' experienced outside temperature, and thus presumably in the perceived costs, in terms of reduced comfort, associated with raising the air conditioning (AC) thermostat temperature. We plan to explore outside temperature as a source of variation in the perceived cost of acting upon the information, in addition to the one coming from the experimental treatment on cost of action.

We thus have two potential independent random sources of variation in the cost of raising the thermostat: 1) the treatment of asking for a 5 degree increase (high cost =1) relative to the treatment of asking for a 1 degree increase (high cost =0); 2) the difference between the outside temperature that day in that place and the average outside temperature in that place (after controlling for day and place fixed effects) (cost as a continuous variable). We will look for effects with both specifications of cost, as discussed in further detail below.

3. Hypotheses

The main research question that the study aims to address concerns the drivers of information acquisition. Other analysis, on perceived impact and AC usage, is to be considered exploratory, of

mechanisms and correlations between information acquisition and action, respectively. We test the following hypotheses:[5]

Manipulation check:

The 5-degree ask should be perceived to have higher potential impact than the 1-degree ask.

Information acquisition

H1A: With no outside observer there should be more information acquisition at high cost (based on standard instrumental value of info).

H1B: With no outside observer there should be less information acquisition at high cost (based on moral wiggle room).

H2A: With the outside observer there should be more information acquisition at high cost (based on standard instrumental value of info).

H2B: With the outside observer there should be less information acquisition at high cost (based on moral wiggle room).

H3: The outside observer should increase information acquisition (based on social pressure)

H4: There should be a negative interaction effect on information acquisition from the combination of the outside observer and high cost (based on social pressure inducing moral wiggle room)

AC usage

H5: With the outside observer there is less AC usage (based on social pressure)

H6: Information acquisition negatively correlates with AC usage (based on moral wiggle room and/or selection effect)

H7: For information avoiders, there should be more AC usage with an outside observer (based on moral wiggle room and/or selection effect)

Perceived impact

H8: Higher outside temperature causes people to perceive lower impact from raising thermostat (based on wishful thinking)

H9A: Outside observer causes people to perceive higher impact from raising thermostat (based on social pressure)

[5] The theoretical background for these hypotheses is discussed in d'Adda et al. (2018).

H9B: Outside observer causes people to perceive lower impact from raising thermostat (based on moral wiggle room)

H10: There should be a positive correlation between perceived impact and information acquisition (based on moral wiggle room and/or selection effect)

4. Data

The analysis relies on the survey data and will focus on the variables described in this section.

4.1 Outcome variables

Table 1 reports the outcome variables that will be used in the analysis:

Table 1. Outcome variables

Variable name	Description
Primary outcome	
Acquire information	Dummy equal to 1 if a subject is willing to read the information on the environmental impact of AC
Secondary outcomes	
Willing to turn up AC	Dummy equal to 1 if a subject says she's willing to turn up the temperature of her AC thermostat
AC temperature	Temperature of the AC thermostat
AC temperature increase = suggested AC temperature increase	Dummy equal to 1 if a subject complies with the requested AC temperature increase
Index of AC action	Index constructed from willingness to turn up AC, AC temperature increase and compliance with requested AC increase using Anderson (2008)

4.2 Mechanism variables

We will investigate whether subjects' information acquisition and AC usage are justified by subjects' beliefs on the environmental impact of their actions, and whether the experimental treatments affect reports of such beliefs. Table 2 reports the variables that will be used in the analysis of beliefs:

Table 2. Beliefs variables

Variable name	Description
AC impact belief	Number between 1 and 10, indicating the answer to the following question "On a scale of 1-10, in your best guess, how much impact does your AC thermostat setting have on the environment?"

CO2 reduction	Number between 0 and 5000, indicating the answer to the following question "Guess how much you would reduce your CO2 emissions (in pounds) if you raise your thermostat setting [1/5] degrees"

These variables may shed light on the mechanism behind the effect of treatments on information acquisition and may also serve as a manipulation check, in that it will reveal whether indeed raising AC temperatures by 5 degrees is perceived to have a larger impact on the environment and generate a greater reduction in CO2 than raising it by 1 degree.

4.3. Independent variables

The analysis will test the impact of treatments and outside temperature on information avoidance, and will control for individual characteristics that we believe to be relevant for explaining individual behavior. Table 3 describes the treatment variables and the measures of outside temperature that will be included in the regressions. The first indicator of temperature - the difference between the outside temperature at the time/place of the survey and the average temperature in that location on the same day of the year – will be the main one that we will use in the analysis, but we will test for the other measures too. For each measure of outside temperature, we will test its inclusion also as quadratic terms.

Table 3. Independent variables

Variable name	**Description**
Treatment variables	
Moral obligation	Dummy equal to 1 if a subject is assigned to the moral obligation (outside observer) treatment
High cost	Dummy equal to 1 if a subject is assigned to the 5-degree-ask treatment
Temperature indicators	
Difference from average temperature (TempDiff)	Outside temperature at the time/place of the survey – Average (over 20 years) outside temperature on the same day of the year in the place of the survey
Real outside temperature	Outside temperature in each participant's location at the time of answering the survey
Reported outside temperature	Outside temperature, as reported by the subject
Outside minus AC temperature, real	Difference between the real outside temperature and the temperature of the subject's AC
Outside minus AC temperature, reported	Difference between the reported outside temperature and the temperature of the subject's AC
Control variables	
Female	Dummy equal to 1 if subject is female
Birth year	Subject's year of birth
Education: some college	Dummy equal to 1 if the subject attended some college

Education: associate degree	Dummy equal to 1 if the subject has an associate degree
Education: bachelor degree	Dummy equal to 1 if the subject has a bachelor degree
Education: postgraduate degree	Dummy equal to 1 if the subject has a post-graduate degree
Democrat	Dummy equal to 1 if the subject is a democrat
Owns energy star AC	Dummy equal to 1 if the subject owns an Energy Star AC system
Knows savings from higher AC temperature	Dummy equal to 1 if the subject correctly estimates the savings from raising the AC temperature
Moral disengagement scale	Average of answers to the moral disengagement questions
Moral values index	Average of answers to the values questions
Mobile	Dummy equal to 1 if the subject took the survey on a mobile
Read paper	Dummy equal to 1 if the subject prefers reading from paper

5. Research questions and analysis

The study addresses primarily the research question concerning the impact of moral obligation and cost of action on information acquisition. In Section 5.2, we indicate the specification and the test of the hypotheses presented in Section 3 on the main outcome variable. In addition, Section 5.1 discusses balance tests, and Sections 5.3 and 5.4 report the empirical specification and predictions concerning our exploratory analysis of secondary outcomes and mechanisms.

5.1. Balance of the treatments

We test that subjects' characteristics are balanced across treatment groups. We will test for balance by running the following regression:

$$y_{i0} = \beta_1 + \beta_2 MoralObligation_i + \beta_3 HighCost_i + \beta_4 TempDiff_i + \varepsilon_i \qquad (1)$$

Where the outcome variable is the individual trait, and the regressors are the two treatment dummies. We will estimate with robust standard errors and report a p-value from a joint test of the following null hypothesis:

$$H_0: \beta_2 = \beta_3 = \beta_4 = 0$$

We will then obtain a vector of p-values for covariate balance (one p-value for each covariate): for this vector, we will also calculate a vector of sharpened q values.

We view this exercise as essentially being descriptive: as showing how covariates differ across treatments. We view this as distinct from the question of whether any of these covariates should enter our regressions as controls, which we address below.

5.2. Impact on information acquisition

The main goal of the empirical analysis is to evaluate the direct impact of manipulating the moral obligation and perceived cost of action on information avoidance. We proxy the perceived cost of action both through our high cost treatment and through the temperature variables.

Research question 1: What is the impact of increasing the moral obligation to act and the perceived cost of action on information acquisition?

We will estimate the following models:

$$InfoAcq_i = f(\alpha_0 + \alpha_1 MoralObl_i + \alpha_2 HighCost_i + \alpha_3 MoralObl \cdot HighCost_i + \alpha_4 \boldsymbol{X_i} + \varepsilon_i) \quad (2)$$

$$InfoAcq_i = f(\alpha_0 + \alpha_1 MoralObl_i + \alpha_2 TempDiff_i + \alpha_3 MoralObl \cdot TempDiff_i + \alpha_4 \boldsymbol{X_i} + \varepsilon_i) \quad (3)$$

where f(▪) is the logit function, $\boldsymbol{X_i}$ is a set of time and location fixed-effects, and robust standard errors are used. We proxy the cost of action with treatment in (2) and outside temperature relative to the average in (3).

Based on our hypotheses, we expect the following signs of the regression coefficients:

- $\alpha_1 > 0$ based on social pressure (H3 holds)
- $\alpha_2 > 0$ based on instrumental value of information (H1A holds) or $\alpha_2 < 0$ based on moral wiggle room (H1B holds)
- $\alpha_2 + \alpha_3 > 0$ based on instrumental value of information (H2A holds) or $\alpha_2 + \alpha_3 < 0$ based on moral wiggle room (H2B holds)
- $\alpha_3 < 0$ based on moral wiggle room (H4 holds)

5.3. Impact on AC usage

Research question 2: What is the impact of increasing the moral obligation to act and the perceived cost of action on AC usage?

$$ACuse_i = f(\alpha_0 + \alpha_1 MoralObl_i + \alpha_2 HighCost_i + \alpha_3 MoralObl \cdot HighCost_i + \alpha_4 InfoAcq_i + \alpha_5 InfoAcq_i \cdot MoralObl_i + \alpha_6 InfoAcq_i \cdot HighCost_i + \alpha_7 InfoAcq_i \cdot MoralObl \cdot HighCost_i + \alpha_8 \boldsymbol{X_i} + \varepsilon_i) \quad (4)$$

We will estimate the effect of treatment and of information acquisition (which is, of course, endogenous) on the AC use, with the outcome variables being three measures of AC use, namely willingness to turn up the AC temperature (logit), AC thermostat temperature (OLS), and compliance with the requested AC temperature increase (logit). In addition, we will use an index of

these three variables, to address the issue of multiple testing, following the approach described in Anderson (2008).

Based on our hypotheses, we expect the following signs of the regression coefficients:

- $\alpha_1 > 0$ based on social pressure (H5 holds) or $\alpha_1 < 0$ based on moral wiggle room (H7 holds)
- $\alpha_2 < 0$ for willingness and compliance and $\alpha_2 > 0$ for AC temperature (manipulation check)
- $\alpha_3 < 0$ based on moral wiggle room (H7 holds)
- $\alpha_4 > 0$ based on selection effect (H6 holds)
- $\alpha_5 > 0$ based on social pressure (H5 holds)
- $\alpha_6 > 0$ based on moral wiggle room (H6 holds)
- $\alpha_7 > 0$ based on social pressure and moral wiggle room (H5 and H7 hold)

We will also run a regression of AC usage on treatment (similar to 2) for the two samples separately, to make more transparent the differences in treatment effects between subjects who acquire information and those who do not.

Finally, we will explore the possibility of testing the impact of information acquisition on AC usage through an instrumental variables approach. While treatment is not a suitable instrument, due to violation of the exclusion restriction, we will explore whether other variables can serve as instruments. One such variable is the type of device used by the respondent to complete the survey: it is conceivable that subjects taking the survey from a mobile phone might be less likely to read the information, as reading off a small may be harder than off a large screen, but device type should not be linked to AC usage.

5.4. Perceived Impact

Research question 3: What is the impact of increasing the moral obligation to act and the perceived cost of action on the perceived impact of own AC usage?

We will estimate the following models:

$$ACImpactBelief_i = \alpha_0 + \alpha_1 MoralObl_i + \alpha_2 HighCost_i + \alpha_3 TempDiff_i + \alpha_4 \boldsymbol{X_i} + \varepsilon_i \quad (5)$$

$$CO2Red_i = \alpha_0 + \alpha_1 MoralObl_i + \alpha_2 HighCost_i + \alpha_3 TempDiff_i + \alpha_4 \boldsymbol{X_i} + \varepsilon_i \quad (6)$$

where $\boldsymbol{X_i}$ is a set of time and location fixed-effects, and robust standard errors are used.

We expect the following signs of the regression coefficients:

- $\alpha_2 > 0$ (manipulation check)
- $\alpha_1 > 0$ based on social pressure (H9A holds) or $\alpha_1 < 0$ based on moral wiggle room (H9B holds)
- $\alpha_3 < 0$ based on moral wiggle room/wishful thinking (H8 holds)

5.5. Control variables

Given that the treatment was randomly allocated to customers, we do not need in principle to include any control variables in the main model specification. However, we will show additional specification where we will include individual characteristics as controls, to show robustness and to improve the precision of our estimates. The regressions will include, among the control variables listed in Table 3, those that will be selected as relevant using the post-double lasso regularization approach by Belloni et al. (2013), and all unbalanced characteristics.

5.6. Heterogeneity

It is possible that treatment effects depend on an individual's tendency to follow norms of behavior. The survey collects two indicators of norm compliance:

- Moral disengagement scale
- Importance of following rules of behavior from WVS

We will test the heterogeneity of treatment effects by subjects' tendency to comply with moral norms by:

- Estimating models 1 to 3 for subjects with high and low moral disengagement and values, defined as above and below the median in the sample.
- Estimating models 1 to 3 interacting the treatment variables with moral disengagement and values, defined both as continuous variables and as dummies for above median values.

We expect moral wiggle room effects to be stronger among subjects with a higher moral disengagement and lower moral values.

We will correct for multiple hypothesis testing by computing false-discovery-rate (FDR) adjusted q-values, following the procedure described in Anderson (2008).

References

Anderson, M. L. (2008). “Multiple inference and gender differences in the effects of early intervention: A reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects.” Journal of the American Statistical Association, 103(484), 1481-1495.

Belloni, A., Chernozhukov, V., and Hansen, C. (2013). “Inference on Treatment Effects after Selection among High-Dimensional Controls”. The Review of Economic Studies, 81(2):608–650.

d'Adda, G., Gao, Y., Golman, R., & Tavoni, M. (2018). “It's so Hot in Here: Information Avoidance, Moral Wiggle Room, and High Air Conditioning Usage.” FEEM Working Paper No. 07/2018.

Della Vigna, S. and Pope, D. (2018). "What Motivates Effort? Evidence and Expert Forecasts." Review of Economic Studies, 85, 1029–1069.