

Affecting Mealtime Choices through Smartphone Reminders - Personalizing the Fight Against Climate Change.

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Less Meat and Changing Behaviours

We are constantly bombarded with bad news about the warming climate and the impact this will someday have on our lives and the ability for our planet to sustain the human race. Mostly, we scroll through the news stories and social media memes and shake our heads. We cheer on people like Greta Thunberg, and climate strikes but fail to take concrete action in our lives. This phenomenon has been studied (Gifford, 2011), and many groups have plans and suggestions to help humans take action ("How You Can Help Fight Climate Change," 2017; "The Lazy Person's Guide to Saving the World," n.d.). Appealing to someone's altruism to get them to change behaviours because it is 'good for the planet' is not likely to help ("What works for behaviour change?," 2018). An easy win for the planet and health, would be to encourage people to eat less meat, the question is how do we affect that change?

By making use of technology that is in (almost) everyone's pocket (*Global Mobile Consumer Trends, 2nd edition*, 2017; Silver, 2019), the smartphone, we hope to investigate ways to change meat-eating behaviour. Our research question is: Can a smartphone-based daily reminder about the impacts of eating meat on the environment, alone, or in combination with recipe suggestions for meatless meals result in eating less meat? There are many observational studies on behaviour modification with electronic reminders, many fewer experimental studies (Fjeldsoe, Marshall, & Miller, 2009; Monroe, Lofgren, Sartini, & Greene, 2015; Stea & Pickering, 2019), and with this study, we hope to contribute to the body of work that supports or refutes the utility of smartphone reminders with respect to behaviour change in support of climate change goals.

Experimental Design

Outcome, Treatment and Control

The outcome that we will measure in this experiment is the number of meals at which meat is eaten during the course of the experiment, proposed to be 1 week in duration - and the treatment effect is the difference in the number of meat containing meals between control and treatment groups.

The subjects for the study will comprise the 'general' population of Western culture - most likely friends, family, fellow students, contacts of the research team on social media, etc. We will ask for only people who are 18 or over in order to avoid strictures in

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studies with children. Additionally, we will eliminate people who do not eat meat (vegans, vegetarians and pescatarians). For this study, we define meat to be from land-based animals - beef, pork, chicken, lamb, goat, rabbit, etc.

The treatment and control conditions will both receive a baseline survey prior to the study where basic information about demographics is defined. This information will allow us to better randomize the treatment group.

The treatment group will receive 1 of three treatments (possibly):

- 1 treatment group receives reminders only
- 1 treatment group recipes only
- 1 treatment group both recipes and reminders

The reminders will occur two times per day by SMS - late morning (prior to a midday meal) and late afternoon (prior to an evening meal). These reminders will contain little snippets of information about how eating less meat is better for the planet.

The recipes will be provided to the two recipe treatment groups 2 days before the beginning of the study and again midweek - this should allow the people in those treatment groups time to plan different meals, allowing for grocery shopping and cooking ahead if needed.

Both treatment and control groups will receive a survey every evening asking them to indicate how many meals they ate meat at (0,1,2,3). Surveys will be distributed using Google Forms.

An ideal experiment would likely involve significantly more participants, a broader range of participants and might even involve the writing of a custom smartphone app. However, for the purposes of experimental design, SMS and Google Forms will likely capture sufficient data for analysis.

Randomization, Clustering and Blocking

Assignment to treatment or control within blocks will be done randomly in order to ensure independence.

Three types of blocking may be required, depending on the researchers involved. Further research into the three covariates presented below and their propensity to predict outcomes should be completed prior to blocking.

Blocking based on age and also gender may be needed, due to differences in which male/female/non-binary and young, middle-aged, and seniors use smartphones in their

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daily lives (Andone, Blaszkiewicz, Eibes, & Markowetz, 2016; Qiu, De Luca, Muslukhov, & Beznosov, 2019).

Blocking may also be considered on a geographic basis, especially if the primary researchers are geographically separated - and thus the subjects they recruit may be geographically separated. This geographic separation might affect the underlying information that the subjects in the area receive (and have received), on average, in regards to both climate change and eating meat. For instance - if you live in Alberta, you might be subject to a lot of beef industry marketing and a strong oil industry which might be perceived as denying climate change. Conversely, if you live in the San Francisco Bay Area, you may be more receptive to both eating less meat and to messages about climate change.

I would propose the following 18 blocks. The total numbers of participants may need to be altered in order to ensure sufficient treatment and control group numbers within each block.

Young/Male/LocationA	Middle Age/Male/LocationA	Senior/Male/LocationA
Young/Female/LocationA	MiddleAge/Female/LocationA	Senior/Female/LocationA
Young/Male/LocationB	Middle Age/Male/LocationB	Senior/Male/LocationB
Young/Female/LocationB	MiddleAge/Female/LocationB	Senior/Female/LocationB
Young/Non-Binary/LocationA	Middle Age/Non-Binary/LocationA	Senior/Non-Binary/LocationA
Young/Non-Binary/LocationB	Middle Age/Non-Binary/LocationB	Senior/Non-Binary/LocationB

Clustering will likely not be an important factor - with the above design we should be able to assign the treatment and control groups on an individual basis.

Secondary Measures and Covariates

One secondary measure that we may want to collect would be information about other protein consumed - i.e. asking whether the person consumed nuts, dairy, fish, eggs or beans during that day. This will give us additional information (more observational than inferential) about what people who switch away from meat-filled their protein requirements with.

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Covariates to consider include Age, Location and Gender - which should be handled by blocking as discussed above. Income may be a covariate (in that higher-income people may be more able to afford meat, or conversely, more able to afford non-meat meals), however, asking about income is likely going one step too deep on this study, at least at this point. We may also want to ask if the person participating in the study is the meal planner/grocery shopper for the household. Further research into other possible covariates should be done before the experiment takes place.

Statistical Analysis of Results

The results will be analysed by estimating the Average Treatment Effect (ATE) and Standard Error (SE) between control and the 3 treatment groups. We may use randomization inference to assist in calculations of the ATE and SE, especially if our blocked groups are relatively small. We will ensure that ATE is evaluated **within** blocks and any overall ATE will be weighted based on block size and differences between groups of the probability of being in treatment. This will allow us to draw causal inference as to whether the use of reminders by smartphone (and/or recipes) can change the number of meals at which people eat meat.

Depending on the quantity of the data we may also be able to report inferences based on the blocking we used for the effects of age, gender and location on the number of meals which include meat.

Risks, Challenges and Pilot Study

There are a number of risks to the quality of information gained from this study. The study is over a very short time frame - 1 week. This may not be sufficient time to build a habit or to overcome initial fear and resistance to choosing different meals. In some cases, the person participating in the study may not have much control over what they are eating - e.g. the person may be preparing meals for a family who are picky eaters, or they may be a student who eats what is offered (at home or on campus).

There is a risk that the survey being sent at the end of every day may be missed, and/or the person filling it out may not remember that night or the next morning what they ate during the day - resulting in an outcome not being recorded. If the previous night's email is not seen until the morning, it may influence the current day's behaviour - possibly more so for the control group.

There is a risk that people will sign up and then not participate, or do not participate fully (e.g. only participating on some days and not others) - again missed outcomes. There is a risk of not finishing the study on time to do the analysis before the end of the term. Finally, there may be

pre-existing personal biases against or for eating meat, which may be able to be filtered out prior to the study.

A pilot study is highly recommended. First - to iron out the kinks in the survey and the reminder systems. Smartphone platforms are very different and this has been an issue for past class members and should be avoided if possible. Testing out question wording and timing of reminders is also important. A pilot study could be prepared and then either a small subset of potential participants used, or we could test it on our classmates. This would allow us to ensure the study is well formulated.

Items remaining to Address

There are a number of items that should be addressed before proceeding to the next stage of this study. Further study of possible covariates is required to finalize if and how blocking should be implemented. A more extensive literature search will assist with this. Risk mitigation strategies should be developed based on the risks above and others that may be determined by the experimental team. Further ways to solicit participants should be investigated. We should also study if there is a benefit or disadvantage to a 'pre-study' - sending both treatment and control the end of day survey for one week prior to the week of the treatment?

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