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of Indian Adults**

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## ABSTRACT

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# Willingness to Sacrifice for Climate Mitigation in Representative Samples of Indian Adults

Under the Paris Agreement, each country submits national pledges that reflect common but differentiated responsibility. Policy-makers therefore need to understand the mitigation policy interests of domestic populations, especially in developing countries where survey data are relatively scarce. Here we describe results from a new survey-experiment that is representative of adults in the Indian state of Rajasthan and city of Mumbai: most respondents report willingness to sacrifice to achieve climate mitigation.

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**Keywords:** environment, climate, India, electricity, survey, phone survey, development

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Under the Paris Agreement, each country submits national pledges that reflect common but differentiated responsibility. Policy-makers therefore need to understand the mitigation policy interests of domestic populations, especially in developing countries where survey data are relatively scarce. Here we describe results from a new survey-experiment that is representative of adults in the Indian state of Rajasthan and city of Mumbai: most respondents report willingness to sacrifice to achieve climate mitigation.

In contrast with developed countries,<sup>1-4</sup> few studies investigate climate policy preferences or willingness to sacrifice for mitigation in developing countries,<sup>5-7</sup> and even fewer use samples representative of populations. In this paper, we describe results from a questionnaire-experiment included in the Rajasthan and Mumbai samples of the Social Attitude Research, India (SARI) survey. The methodology and details of the SARI survey have been explained in detail in the published literature.<sup>8</sup> SARI is a phone survey that combines random digit dialing, facts about the distribution of phone numbers, intra-household randomization, and census-weighting to produce samples that are representative of various Indian states. The data that we study were collected from August 2016 through May 2017 and had two subsamples, each representative of a population of adults: the north Indian state of Rajasthan and the large city of Mumbai.

Each survey participant who reported having electricity at home was read the following question. Respondents completed the interview in their choice of Hindi, Marathi, or Marwari. Although the question is stylized and simplified, it reflects a core tradeoff between mitigation costs and climate vulnerability:

Now, I would like to ask you about a problem that may happen many years from now, when your grandchildren are grown. Many scientists think that at that time the temperature of the earth will start to become too hot, so much so that agriculture will become difficult and people will fall sick. One reason for this is that smoke that comes from the electricity that is produced today makes the earth hotter. As a result of this, the earth is warming. Some scientists say that one solution to this problem could be for people today to reduce their use of electricity, which may reduce rising temperatures in the future.

Would you be willing to bear an additional [randomized treatment: 1 hour, 3, hours, or 5 hours] of electricity cuts so that the temperature does not rise more by the time your grandchildren are living?

Embedded in the survey question of interest was a randomized experiment. Each participant was asked about one particular depth of hypothetical sacrifice, quantified as a number of additional hours of electricity cut per day: one additional hour per day, three hours, or five hours. The randomized treatment was independently assigned at the individual respondent level. Electrical cuts are a familiar experience to these respondents: about three-fourths of the weighted sample report currently experiencing electrical cuts, for an average of five hours per day of cuts among those who experience them.

This randomized experiment was designed to allow us to describe a demand curve for mitigation: we can plot by how much demand for mitigation decreases as this “price” of mitigation

increases.<sup>4</sup> Other studies in development economics have similarly used randomized prices to learn about policy-relevant demand curves.<sup>9–12</sup> The randomized script also serves as an attention check, to verify that respondents were understanding and attending to our questionnaire: if the demand curve for mitigation were not decreasing in price, that would be evidence suggesting that our survey question were not informative about respondents’ views.

In figure 1, the maroon dashed linear regression line presents the main result, pooling all 4,340 respondents who reported having electricity at home and all three randomized treatment groups. Most respondents are willing to accept some electricity cuts to prevent climate damages — at least, in the particular stylized exchange offered in this survey question — and the demand curve slopes down, meaning that fewer respondents are willing to accept larger costs of mitigation. Although not shown in the figure (to make the split-sample results visible) the sample mean of all observations in each of the three treatment groups is statistically significantly different than each of the other two treatment group means at the 5% level. At the lowest cost of mitigation — one extra hour of electricity cuts per day — over four-fifths of respondents report willingness to accept the cut. At the highest cost — five hours — this falls to about three-fifths.

The blue dots and green squares split the sample according to respondents’ answer to an additional, non-randomized set of survey questions about their perception of temperature changes. Averaging over all 4,340 respondents, those who reported that temperatures are increasing and that this is bad were 4.12 percentage points (robust standard error = 2.09,  $p = 0.049$ ) more likely to report being willing to accept electricity cuts for mitigation than those who either did not report

that temperatures are increasing or did not report that this is bad. Adding regression controls for treatment group, respondent age indicators, and respondent education indicators intersected with sex leaves this difference essentially unchanged: 4.06 percentage points (robust standard error = 2.04,  $p = 0.047$ ). As figure 2 shows, the pattern across treatment groups is approximately parallel. Confidence intervals overlap because of the small samples that are analyzed when the data are split into six groups.

Figure 2 presents results by demographic category, asked about elsewhere in the SARI questionnaire. One unique feature of the SARI data, presented in panel **d**, is that it allows results to be split into higher caste (general and Brahmin) and lower caste (Dalit and what the Indian state calls “Other Backwards Class”). As figure 2 shows, however, none of these observational categories are associated with differences in the outcome that are as large as the randomized price treatment. The differences appear largest for the split by whether respondents currently experience electricity cuts (rather than have uninterrupted electrical supply). However, willingness to accept cuts is not statistically significantly different between these groups ( $p = 0.19$ ).

As in economists’ empirical studies of social choice<sup>13</sup> and in some other studies of sustainability behavior,<sup>4</sup> but unlike game theory experiments in the lab, respondents stated their policy preferences without attached financial incentives. One important question is whether the high rates of reported willingness to sacrifice for climate mitigation in SARI merely reflect experimenter demand or social desirability biases: did the respondents report being willing to sacrifice merely because they believed that this was what interviewers wanted to hear? Although we cannot rule

out the possibility that such bias influenced some respondents, the full context of the SARI survey suggests that this may not be a quantitatively large concern. SARI is a lengthy, multi-purpose survey, out of which we study three of many questions. A principal finding of the SARI survey is that many respondents endorse social inequality, for example, reporting that marriage between higher and lower caste people should be illegal, or that women should not be allowed to work outside the home.<sup>8</sup> The fact that many respondents so readily reported discriminatory social attitudes suggests that they would have been unlikely to answer these climate questions in order to comply with any pro-mitigation social norms (norms of which many respondents may plausibly be unaware).

A further open question is what these results may suggest for energy and sustainability policy. No empirical survey evidence — even evidence that everyone in the Indian population were willing and able to sacrifice for climate mitigation — would resolve the question of what policy should be.<sup>14</sup> India's future emissions, although growing, are projected to be a small fraction of global future emissions. Therefore India, like many other individual countries, may be unable to unilaterally have a large effect on global temperature change. Beyond this question of the effect of mitigation by India, there are the further questions of equity, responsibility, and development that have been recognized by a large literature.<sup>15,16</sup>

Nevertheless, an important methodological application — useful for policy-makers in India and other developing countries — is suggested by the availability of these data. With increasing ownership of inexpensive mobile phones, social attitudes and policy preferences can be feasibly studied in population-representative samples. In the bottom-up framework of the Paris agreement,



each country can and must define its own national interest in climate policy.<sup>17</sup> If investments are made to develop and improve survey data such as these, national policy-makers can consider such evidence in the process of developing nationally-determined contributions. Further, in the periodic international stock-takes of national contributions in the Paris processes, understanding the demand for climate mitigation among understudied developing-country populations may prove informative.

## **Methods**

In the SARI surveys Rajasthan and Mumbai samples, collected between 2016 and 2017, 4,631 adults answered questions about electricity. This sample was collected through random-digit dialing, from a survey frame designed based on the geographic allocation of mobile phone numbers in India.<sup>8</sup> Of these, 4,340 reported having electricity at home (89.2% of the weighted sample); these 4,340 adults are the sample that we study in this paper. Of these 4,340, 1,491 were in the Mumbai sub-sample, which was representative of adult men, and 2,849 were in the Rajasthan sub-sample, which was representative of adult men and women. 2,842 were male and 1,498 were female. The sample is unevenly split between males and females by design: another feature of the Rajasthan sample was an experiment about data collection by male and female surveyors, such that only men were interviewed in Mumbai, but men and women were interviewed in Rajasthan. Respondents' ages range from 18 to 65 with a mean of 35 and a standard deviation of 12. The average respondent reports 5.7 years of education; 12% of males and 29% of females report zero years of education.

The electricity survey-experiment question was immediately preceded by asking whether the respondent's household has electricity and electricity cuts, and those questions were preceded by

two introductory questions that transition from the non-energy portion of the survey:

- My next question is regarding weather and climate. In the past five years, do you think the temperature is getting warmer, colder or is same as before?
- You said that the temperature is getting warmer/colder. Do you think it is good that it is getting warmer/colder, it is bad that it is getting warmer/colder, or does it not make a difference?

For the sample split in figure 1, respondents were classified according to whether they said “warmer” and “bad” respectively to these two questions. Data and the full text of the SARI questionnaire are online at <http://riceinstitute.org/data/sari-dataset-documentation/>.

The data were analysed with summary statistics and, in figure 1, ordinary least squares linear regression using STATA v. 12.1 (<https://www.stata.com>). Throughout this paper, each *p*-value or 95% confidence interval is computed with survey sampling weights and heteroskedasticity-robust standard errors.

**Ethics approval and informed consent.** All survey protocols were approved by the RICE Institute, Inc. IRB (registered as IRB00010425 in the OHRP Database). Methods were carried out in accordance with the relevant guidelines and regulations. Informed consent was obtained from all survey participants.

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**Competing Interests** The authors declare that they have no competing financial interests.

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**Author Contributions Statement** D.S. and D.C. designed the research. D.S. wrote the main manuscript text and prepared the figures. P.H. and D.C. collected the data. All authors reviewed the manuscript.

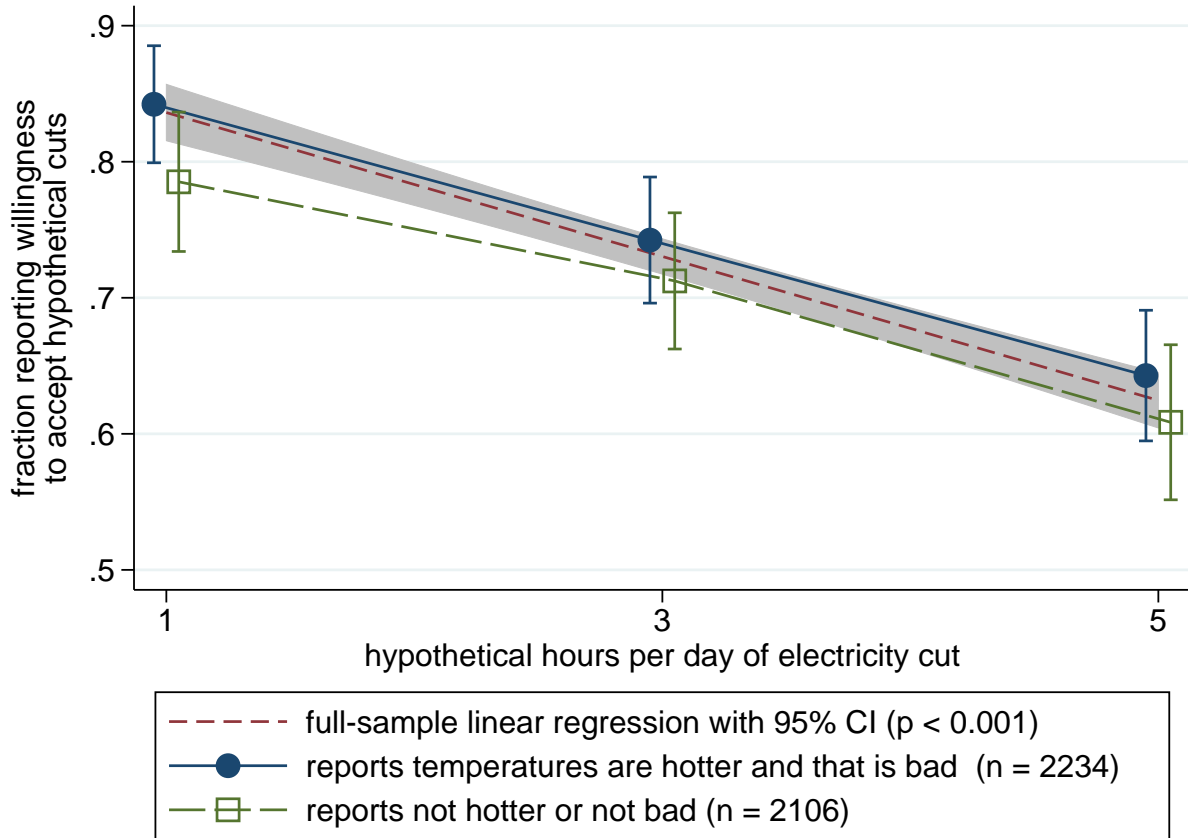


Figure 1: Reported willingness to accept electricity cuts for climate mitigation among survey respondents.  $n = 4,340$ ; full-sample ordinary least squares regression  $p < 0.001$ . Split samples according to reported perception and evaluation of experienced temperature change are different with  $p = 0.047$ . Inference and 95% confidence intervals computed with sample weights and robust standard errors.

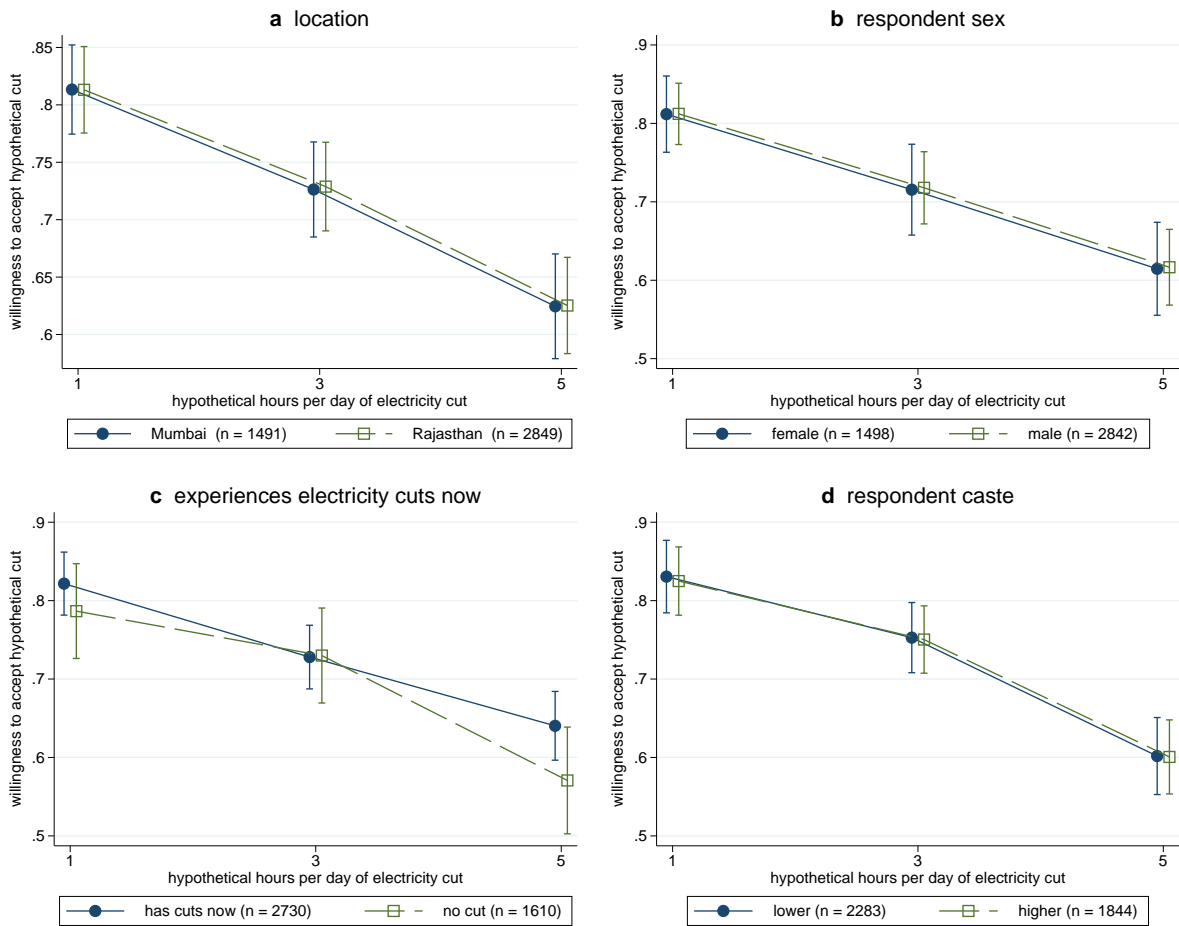


Figure 2: Reported willingness to accept electricity cuts, by survey-reported demographic and descriptive categories. Sample size reported by category.