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Sorting It Out: Contribution-Action Gap in Waste Segregation in Urban India

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DISCUSSION PAPER SERIES

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ABSTRACT

Sorting It Out: Contribution-Action Gap in Waste Segregation in Urban India*

Urban waste management challenges pose significant health and economic consequences. Although source-level waste segregation offers a promising solution, its success depends on household participation. Through a randomized controlled trial in the capital city of Bihar, India, we evaluate how light-touch messaging interventions influence household waste management practices. Our results reveal a stark behavioral disconnect: while interventions increased financial contributions to waste segregation initiatives by 9.6 – 11.7 percent compared to the control group, they failed to improve actual waste segregation practices. This gap between financial support and behavioral change highlights the complexity of promoting sustainable waste management practices in urban households.

JEL Classification: D01, D91, C93, Q53, O13

Keywords: willingness to contribute, household waste management, religious messaging, civic messaging, waste segregation, field experiment, India

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1 Introduction

Rapid urbanization in developing countries has placed immense pressure on waste management systems, creating critical challenges to urban governance. Despite growing infrastructure for sanitary landfills and recycling, many South Asian cities continue to rely on outdated practices like open dumping (Kaza et al., 2018). The consequences are severe: infectious disease spread (Giusti, 2009), increased air pollution from waste burning (Yang et al., 2018), and water contamination—all posing significant threats to public health and the environment (World Health Organization, 2024; Singh and Raj, 2018). Source-level waste segregation offers a promising solution by enabling more efficient processing of recyclable and non-recyclable materials (Kihila et al., 2021; Agbefe et al., 2019). However, these systems' effectiveness depends fundamentally on household participation (Padilla and Trujillo, 2018). *Despite its crucial role, achieving consistent adoption of proper segregation practices remains challenging, particularly where such practices are not yet established. Successfully engaging households is therefore essential for improving urban waste management and mitigating its environmental and health risks.*

This intervention investigates how identity-based messaging affects household waste segregation behavior through a randomized controlled trial in Patna, Bihar, India. We implement two distinct one-minute video interventions designed to motivate household waste segregation at source. The first treatment uses civic-themed video messaging emphasizing national pride and citizenship duties, based on evidence that regional identities influence environmental choices (Fait et al., 2022) and that the alignment of political identities shapes environmental behavior (Kidwell et al., 2013). The second treatment uses religious-themed video messaging with moral appeals, drawing on research demonstrating the effectiveness of religious appeals on economic behavior (Bursztyn et al., 2019; Bulte et al., 2005) and the impact of the importance of religious identity on decision-making (Benjamin et al., 2016). By comparing these two interventions in India's cultural context, where both civic and religious messages are commonly employed to promote public goods, we contribute to understanding how different identity frames can encourage pro-environmental behaviors.

In this intervention, households were randomly assigned to one of three groups: a pure control group ($n = 298$), a civic-themed video treatment group ($n = 357$), or a religious-themed video treatment group ($n = 355$), resulting in a total sample of 1,010 participants. To assess the impact of this intervention, we employed a dual measurement approach. First, we evaluated contributions to a waste segregation organization using an experimentally elicited lab-in-the-

field task. Second, we directly observed waste segregation behaviors over seven alternating days within a two-week period. This approach allowed us to study both the immediate changes in attitudes and the subsequent behavioral impacts of our targeted messaging intervention, providing insights into the potential of a low-cost, tailored messaging strategy to influence pro-environmental practices in urban Indian households.

Our findings reveal several key insights. *First*, both video treatments effectively *increased* contributions to the local waste segregation organization. The civic-themed video increased contributions by approximately 9-10 percent, while the religious-themed video led to an 11-12 percent increase, compared to the control group's mean contribution of INR 41.44 (approximately 0.49 USD). Both treatments show similar levels of effectiveness, with no statistically significant difference between them. To benchmark this estimate, [Kayamo \(2022\)](#) calculates that residents in Ethiopia are willing to pay approximately 0.62 USD per month for improved solid waste management. *Second*, we *do not* find impact of either civic nor religious messaging interventions on actual measures of waste segregation rates. The lack of behavioral change is unlikely to be due to monitoring effects, where households modify their actions when being observed. For instance, control households segregated waste on only one of the seven observed days, indicating that their behavior was consistent with everyday practices.

Despite these low segregation rates, we found high satisfaction with and utilization of the municipal waste collection system (95 percent satisfaction rate and 85 percent using door-to-door collection to dispose unsegregated waste), indicating that poor waste segregation practices cannot be attributed to distrust in municipal services. *Finally*, we find that the effectiveness of pro-environmental messaging varies based on individuals' economic preferences. More patient individuals showed stronger positive responses to both civic and religious videos in terms of financial contributions, though these increases did not translate into actual waste segregation behavior. People with higher *positive reciprocity* were more responsive to the videos in terms of financial contributions, while those with higher *negative reciprocity* and *altruism* demonstrated better waste segregation practices. Additionally, the civic-themed video was particularly effective at increasing contributions among participants with better knowledge of waste collection systems. Interestingly, treatment effects did not vary with other economic preferences such as trust, risk attitudes, and locus of control.

Our study contributes to the literature on strategies addressing waste management in three significant ways. Primarily, we extend the literature on identity based messaging and environmental behavior change. Numerous studies have demonstrated the efficacy of

behavioral interventions in promoting pro-environmental attitudes and behaviors across various contexts (Carlsson et al., 2021; Vlasceanu et al., 2024). For instance, reminders have proven effective in reducing plastic waste (Essl et al., 2021), while normative messages appealing to identity, such as religious or national affiliations, have influenced electricity consumption (Al-Ubaydli et al., 2023). Similarly, messaging strategies have successfully reduced meat consumption, underscoring their potential to alter other environmentally significant behaviors (Carfora et al., 2019), or improved willingness to seek mental health treatment (Lacey et al., forthcoming). Building upon this body of work, our study specifically examines the impact of a low-cost messaging intervention in the under-explored area of waste segregation, thereby filling an important gap in the existing literature and offering policy solutions to sustainable urban development.

Second, our study contributes significantly to the literature on the *intention-action gap* in pro-environmental behaviors, a critical and nascent area of research. This gap refers to the frequent discrepancy between individuals' expressed willingness to engage in pro-environmental actions and their actual behaviors. For instance, while many consumers express a preference for green energy contracts, most remain with default providers for extended periods unless automatically enrolled in new contracts (Gravert, 2024; Kaenzig et al., 2013; Kaiser et al., 2020; Fowlie et al., 2021). These findings underscore the importance of identifying mechanisms to bridge the gap between intentions and real behaviors, with Hoffmann et al. (2024) highlighting various behavioral constraints that hinder this transition. Our study extends this body of literature by documenting a distinct type of gap — a “contribution-action” gap. While previous research has primarily focused on the *intention-action gap*, we expand this discussion by demonstrating that a similar gap exists between experimental elicited environmental behaviours, such as donations, and actual pro-environmental actions. This novel finding emphasizes the need for more comprehensive interventions that target both intentions and real-world behaviors, contributing to a more nuanced understanding of the complexities involved in promoting sustainable practices (Arias and Trujillo, 2020; Margetts and Kashima, 2017).

Third, our study contributes to the growing literature on behavioral interventions aimed at improving waste management. Default nudges, for instance, have been shown to reduce paper waste (Endendijk and Botzen, 2023) and increase recycling while decreasing municipal waste (Akbulut-Yuksel and Boulatoff, 2021). The role of social norms in increasing recycling rates has been explored by Fuhrmann-Riebel et al. (2024) and Czajkowski et al. (2019). In the specific context of waste management in India, Nepal et al. (2022) demonstrated that the

introduction of street waste bins, combined with information campaigns, significantly improved neighborhood cleanliness. Building on these findings, our study contributes to this line of research by testing the efficacy of low-cost, identity-based messaging interventions in encouraging waste segregation. This approach not only complements existing strategies but also offers insights into the potential of targeted messaging in shaping pro-environmental behaviors in diverse cultural contexts.

2 Background

Bihar remains one of India's least urbanized states, with Patna as its primary urban center. The city's population increased from 1.7 million to 2.05 million between 2001 and 2011 ([Ministry of Home Affairs, Government of India, 2022](#)), but this growth has been largely unplanned. Consequently, Patna ranks among the bottom 10 Indian cities in terms of quality of life across various indicators ([Ministry of Housing & Urban Affairs, Government of India, 2018](#)) and as of 2019, the city's 75 wards collectively generate approximately 770 tonnes of household waste daily ([Ministry of Housing & Urban Affairs, Government of India, 2021](#)).

Despite the Patna Municipal Corporation (PMC) being one of India's oldest civic bodies, it only initiated door-to-door waste collection in 2018 ([The Times of India, 2018](#)). Prior to this, residents primarily relied on public dumping sites or discarded waste in open street pits ([Sarmistha, 2021](#)). The introduction of this service coincided with the launch of the national *Swachh Bharat Mission* ("Clean India Mission"), aimed at promoting improved sanitation practices. In October 2018, Patna implemented a citywide initiative for segregated waste collection ([Ministry of Urban Development, Government of India, 2016](#)). According to our interviews with PMC officials, the city now operates 375 waste collection vehicles, equipped with separate compartments for dry and wet waste, across its 75 wards. Each household pays a nominal monthly fee of Indian rupee (INR) 30 (≈ 0.36 USD) for this service. These vehicles are stationed in neighborhood lanes at specific times, usually between 6 a.m. and 12 p.m., with residents informed in advance of the schedule. When the collection van arrives, signaled by a whistle and the municipality's song, residents bring out their segregated waste for collection.

PMC reports that despite this infrastructure, waste segregation remains limited, with only 39 percent of households in a typical ward practicing segregation in 2019 ([Ministry of Housing & Urban Affairs, Government of India, 2021](#)). This disparity between available

infrastructure and its actual utilization highlights a critical challenge for policymakers, who believe that sustainable improvement necessitates a shift in public attitudes and participation ([Times of India, 2019](#)). During our pilot field visits, many residents noted a lack of awareness programs prior to the launch of the segregated waste collection service, suggesting this may have hindered adoption.

The study area for this randomized controlled trial (RCT) comprises 14 wards selected from Patna's 75 wards. Importantly, all 14 wards had fully operational door-to-door waste collection services, to establish a consistent baseline for all participating households. Only households with full access to the waste collection infrastructure provided by the PMC, including collection vans with separate compartments for wet and dry waste, were included in the sample, ensuring that each participant has the means to segregate waste.

3 Experimental Design

3.1 Sample Recruitment, Randomization, and Timeline

Sample Recruitment: We conducted the study in 14 wards of Patna Municipality, selected in consultation with PMC officials and a local NGO that assisted with implementation. Our focus was on geographically concentrated wards in lower-income areas.¹ Before proceeding, we verified that the PMC vans operating in our survey locations were equipped with separate compartments for dry and wet waste.

Data collection was carried out by surveyors from DAI Research and Analytics.² For household selection, we sampled every fifth household in lanes chosen based on their proximity to the stationary vans' daily locations. We obtained consent from 1,021 households for the baseline survey, with participants spending an average of 33 minutes completing the baseline survey and 17 minutes on the endline survey.

To minimize attrition, we asked participants to provide consent only if they were willing to participate in the follow-up survey. This approach proved effective, as we successfully followed up with 1,010 participants who form our analysis sample.³ While the survey did not provide guaranteed compensation, participants had the opportunity to enter an incentivized lottery for

¹More details on the sample are given in Section 3.5.

²A team of 17 interviewers conducted the baseline and endline surveys between 10 AM and 9 PM. Additionally, a separate team of 3 interviewers on motorcycles conducted the visual inspection exercise.

³The analysis sample for visual waste segregation outcomes consists of 1,004 participants, as 6 respondents either refused to show their waste buckets or were unavailable during all 7 visual inspection visits.

contributing to an NGO.⁴

Randomization: Following the baseline survey, participants were randomly assigned to either the control group or one of two messaging treatment groups. Participants were informed that their household waste bins would undergo visual inspection every alternate day for approximately two weeks, yielding seven rounds of observational data on waste segregation practices. While participation in the inspections was voluntary, and respondents had the option to decline showing their bins, the majority consented to the process (6 respondents either refused to show their waste buckets or were unavailable during all 7 visual inspection visits). The inspections started the day after the baseline survey for most of the respondents, though in some cases, they started two to three days later due to participant availability. Importantly, once the inspections began for a household, they were conducted consistently every other day until all seven observations were completed. The survey team worked in coordination with the PMC to align the inspection schedule with the waste collection van timings in the respective lanes.

Timeline: [Figure 1](#) provides an overview of our study design. We collected survey data using SurveyCTO in two stages: a baseline survey from July 11 to August 1, 2023, and an endline survey from July 31 to August 18, 2023. Additionally, we gathered observational data on actual waste segregation behavior between these two survey periods.

3.2 The Intervention

[Akerlof and Kranton \(2005\)](#)'s theoretical framework posits that individuals derive greater utility when their actions align with the norms associated with their chosen identities. Consequently, identity-based interventions hold significant potential for influencing pro-environmental behavior, particularly in contexts where civic or religious identities are deeply embedded. Empirical evidence supports this theoretical perspective across various domains. In the financial sector, [Bursztyn et al. \(2019\)](#) demonstrated that moral appeals rooted in religion significantly influence debt repayments in Indonesia. Similarly, in laboratory settings, [Benjamin et al. \(2016\)](#) found that making religion salient strengthened religious identity and affected economic choices.

In the realm of environmental behaviors, research has shown the efficacy of identity-based

⁴We initially included an incentivized measure of time preference in the baseline but excluded it from analysis due to implementation errors in payout timing for some observations. Nevertheless, participants earned an average of INR 111 from this exercise. The average lottery earnings were approximately INR 17 in both baseline and endline, while the average NGO contribution was approximately INR 7 in both surveys.

interventions. For example, regional identities have increased the willingness to pay for green electricity (Fait et al., 2022), religious and national identity increase electricity conservation (Al-Ubaydli et al., 2023), identity-linked products are more likely to be recycled as disposing of such items is perceived as a threat to one's identity (Trudel et al., 2016), and aligning appeals with political ideology have shown to promote sustainable actions (Kidwell et al., 2013). These findings collectively suggest that interventions framed around identity - whether civic or religious — could significantly influence waste segregation behaviors. This approach could be particularly relevant in India, where religious and patriotic imagery is frequently employed to promote public goods, such as reducing public spitting or urination.

Given this context, we designed two treatments to investigate the impact of civic-themed and religious-themed messaging on waste segregation practices. Participants were randomly assigned to one of three groups: a pure control group ($n = 298$), a civic-themed video treatment group ($n = 357$), or a religious-themed video treatment group ($n = 355$), resulting in a total sample of 1,010 participants.

Our study aims to contribute to the growing body of literature on identity-based interventions in environmental behavior, while also providing practical insights for policymakers seeking to improve waste management practices in culturally diverse settings.

Civic-themed Video Messaging Intervention (T1)

This intervention comprised a one-minute video emphasizing that environmental protection through activities such as waste segregation is an individual's civic duty. The video's introductory screens highlighted the fundamental duties of citizenship, framing environmental stewardship as a civic responsibility. Subsequent screens provided detailed instructions on segregating waste into dry and wet components, accompanied by common examples of each waste type. This approach aimed to reinforce the concept of waste segregation as both a practical task and a civic obligation, potentially increasing participants' motivation to engage in this environmentally beneficial behavior. A total of 357 participants were assigned to this treatment group.

Religious Messaging Intervention (T2)

This intervention consisted of a one-minute video explaining that environmental protection through activities like waste segregation is part of an individual's religious duties. In contrast

to the Civic Messaging video, we framed pro-environmental actions in the subsequent screens as activities supported by the respondents' religion, with references to Muslim and Hindu holy texts.⁵ The message was tailored to match each respondent's reported religion. As in the Civic Messaging video, respondents were then shown details and examples of waste segregation. For additional reinforcement, we provided respondents with calendars featuring relevant video screens.⁶

Messages with religious appeal can have significant cultural relevance in a religious society, where faith often provides moral and ethical guidance, promotes trust in authority, reinforces social norms, and serves as motivation for behavioral change (for example, by appealing to a sense of duty). For example, religious imagery is commonly used in India to curb public urination and spitting.⁷ We finalized the religious message treatment after consultation with our implementing partners.⁸ A total of 355 participants were assigned to this treatment group.

Control Group (C)

Out of 1,010 households, 298 were randomly assigned to the control group (C), in which no information was provided.

3.3 Construction of Variables

3.3.1 Outcome Variables

Our primary outcomes for measuring waste segregation behavior are the following:

Contribution to waste segregation NGO: After presenting the treatment videos, we introduced participants to a lottery with a one-in-six chance of winning INR 100. Prior to conducting the lottery, participants were given the opportunity to pledge a portion of their potential winnings to "*Diksha*", a local non-governmental organization (NGO) that focuses on waste management and other pro-environmental initiatives.⁹ Specifically, participants were asked to specify what percentage of the INR 100 they would donate if they won.

To address the limitations of self-reported environmental behavior data, we adopted this

⁵99.8 percent of our sample identified as either Hindu or Muslim.

⁶See Appendix A for more details on the video content and calendar design.

⁷Bursztyn et al. (2019) explored the role of moral appeal through religious messaging in the context of credit card repayments in Indonesian banks.

⁸English translations of the scripts used in the videos are available in Appendix B.

⁹More details can be found here: <https://dikshafoundation.org/sustainable-and-inclusive-urbanization-in-patna/>.

'lab in the field' approach for measuring willingness to contribute. This incentivized method helps mitigate over-reporting bias, which is common when measuring socially desirable behaviors such as pro-environmental actions. We implemented this lottery task in both baseline and endline surveys to ensure consistent measurement across time periods.

Observed segregation behavior: Following the baseline survey, respondents were informed that survey team members would visit them during waste disposal times to inspect their waste bins. Each household received seven visits between the baseline and endline surveys. Since waste collection occurs within a brief window when collection vans visit designated lanes, our surveyors first obtained the van schedules from PMC officials. They then identified which surveyed households to check the following day, allowing for efficient coordination between baseline surveying and visual inspection activities.

Surveyors assessed waste segregation status by visually inspecting the contents households brought to the collection van. Waste presented in a single bucket or bag was classified as unsegregated. Our outcome measure is the total number of days a household separated waste during the baseline period. We excluded observations where households were unavailable, refused to show their waste, or reported no waste generation. This direct observation of segregation behavior provides the most robust measure of our messaging interventions' effectiveness, offering concrete evidence of changes in household waste management practices.

Beyond the incentivized contribution elicitation, we measured two self-reported outcomes at both baseline and endline. The first assessed households' engagement in other pro-environmental behaviors beyond waste segregation. We presented respondents with a list of twelve common activities and asked them to indicate which ones they performed.¹⁰ This yielded a count of pro-environmental behaviors that our treatments could potentially influence.

The second self-reported outcome measured respondents' beliefs about others' waste segregation behavior. Specifically, we asked them to estimate what percentage of other survey

¹⁰The options were: Carry your own cloth bag whenever you go shopping, carry your own water bottle whenever you leave your house, turn off electrical appliances whenever you leave a room, switch off the fridge during longer holidays, unplug or switch off electronic devices instead of using them on stand-by, use paper bags instead of plastic bags, check efficiency labels when buying household electronics, change from an old fridge to a modern fridge (with grade or electricity consumption), change light bulbs to energy-saving lighting, give newspapers and other paper waste for recycling, give plastic waste produced at home for recycling, separate waste into food waste and other types of waste materials at home.

participants practiced waste segregation, offering four response categories.¹¹ We measured this variable at both baseline and endline.

3.3.2 Independent Variables and Heterogeneity

Our baseline survey gathered comprehensive data through a household waste management questionnaire administered to adult household members, regardless of gender or household head status. While respondents were not exclusively heads of households, we ensured response consistency by interviewing the same individual in both baseline and final surveys. Following informed consent, we collected data on the following dimensions:

Demographic variables: The survey began by collecting demographic information. We recorded age in years and created binary indicators for several characteristics: gender (1 if female), marital status (1 if married), caste (1 if from reserved categories), religion (1 if Muslim), and employment status (1 if unemployed).¹² We also measured household size (number of members), education level (1 if below 5th standard), and monthly household income (1 if below INR 10,000).

Economic preferences: Following the main survey, participants completed a series of questions measuring their economic preferences. Research suggests that beyond economic incentives, individual preferences—such as pro-social attitudes, risk tolerance, and ability to delay gratification—significantly influence behaviors like household waste segregation (Lades et al., 2021). We therefore included validated self-assessment measures of positive and negative reciprocity, altruism, patience, trust and risk attitudes, following the methodology developed by Falk et al. (2018). We also measured participants' trust in various societal institutions.¹³ These preference measures allow us to examine how treatment effectiveness varies based on individuals' pro-social inclinations.

Measure of religiosity: We assessed respondents' religiosity through a comprehensive set of questions designed to capture multiple dimensions of religious beliefs and practices. The assessment included: (1) self-rated religiousness on a five-point scale, (2) engagement with religious issues in the past month, (3) beliefs about religious exclusivity (whether they

¹¹The options were: 1 - less than 25 percent of others segregate waste; 2 - (25-50) percent of others segregate waste; 3 - (50-75)% of others segregate waste; 4 - (75-100) percent of others segregate waste. Thus the outcome is a categorical variable with higher values indicating stronger beliefs about others practicing waste segregation.

¹²Reserved categories include SC (Scheduled Castes), ST (Scheduled Tribes), and OBC (Other Backward Classes), which represent socio-economically disadvantaged groups in India.

¹³The trust index was constructed using participants' self-reported trust levels on a five-point scale for different authorities: courts/judges, the Prime Minister, police, members of Parliament, religious leaders, and community leaders.

consider their religion to be the only true one), (4) daily prayer frequency at home, and (5) frequency of participation in religious services at places of public worship. Additionally, following [Adida et al. \(2023\)](#), we included questions to measure religious motivation from six distinct perspectives.¹⁴ This thorough assessment of religiosity was specifically designed to examine potential heterogeneous effects of the religious video treatment.

Measures related to knowledge of environment, attitude and information: We constructed three key indices to measure environmental awareness and attitudes. First, we developed a pro-environmental attitude index that combines questions about environmental attitudes, awareness, and perceptions of government action, adapted from [Goldberg et al. \(2019\)](#). Second, we created an information index to capture participants' baseline knowledge about and satisfaction with Patna's institutional waste removal system.¹⁵ Third, we developed a waste segregation attitude index based on responses to three agreement-scale questions.¹⁶ These indices help us understand how subjective environmental knowledge and attitudes may influence the effectiveness of our treatments.

Controls for baseline outcomes: At baseline, we also measured participants' contributions to NGOs, their self-reported engagement in pro-environmental practices, and their beliefs about others' willingness to segregate waste. To assess potential response bias, we included questions measuring social desirability, adapted from [Crowne and Marlowe \(1960\)](#) and [Reynolds \(1982\)](#).¹⁷

3.4 Endline

After the intervention, we administered a streamlined endline questionnaire to measure the impact of our messaging treatments. This survey included both the incentivized elicitation of contribution and self-reported outcomes to assess changes in the targeted behaviors.

¹⁴Detailed descriptions of these measures are provided in [Appendix C](#).

¹⁵This index incorporates five components: (1) knowledge of proper garbage disposal locations; (2) frequency of waste disposal; (3) understanding of waste processing destinations; (4) satisfaction with current waste removal system; and (5) awareness of municipal bin provision. For detailed information, see [Appendix C](#).

¹⁶Participants indicated their level of agreement (strongly agree to strongly disagree) with these statements: (1) Waste separation at source is good for the environment; (2) I feel shameful if I do not separate my household waste when my neighbors are aware of my action; and (3) I feel shameful if I do not separate my household waste even if nobody is aware of my action. See [Appendix C](#) for additional details.

¹⁷Details about index construction and the specific questions used can be found in [Appendix C](#).

3.5 Sample Description

The descriptive statistics of our sample are presented in [Table 1](#). Panel A reveals the demographic characteristics of our 1,010 respondents: 70 percent are female, 80 percent are married, and the average age is 34 years. A significant majority (89 percent) belongs to socio-economically deprived groups, while Muslims constitute 11 percent of the sample. The average household comprises six members, and only 8 percent of respondents report being unemployed. Educational attainment is relatively low, with 56 percent having completed no more than 5th standard, and 40 percent reporting monthly household income below INR 10,000 (approximately 120 USD). The baseline contribution to the NGO averages INR 40.58 (Panel D).

Panels B and C present indices measuring individual preferences and other control variables related to religiosity, environmental knowledge, attitudes, and information. These survey-generated indices are standardized relative to the control group mean, as detailed in [Appendix C](#), and are expressed in standard deviations from that mean.

3.6 Baseline Balance

We present balance test in [Table 2](#). Panel A reveals an imbalance in marital status, which we subsequently include as a control variable. Panel B shows standardized self-assessed preferences (expressed in standard deviations from the control group mean, as detailed in [Appendix C](#)), with no significant imbalances between groups. Panel C reports religiosity, pro-environment index, and social desirability bias measures, which are also balanced across groups. Panel D presents baseline levels of outcome variables, showing an imbalance in the Contribution outcome, with higher baseline levels in the control group. Consequently, we include this variable as a control as well.

3.7 Pre-Analysis Plan

For complete transparency, we adhere to our Pre-Analysis Plan (PAP), which is available and timestamped at [RCT ID: AEARCTR-0011841](#).

In our pre-analysis plan (see [Appendix D](#)), we pre-specified two main outcome measures: self-reported intention to segregate, measured at baseline and endline, and observed waste segregation behavior from visual inspection data. We exclude the self-reported outcome from

the analysis because due to a technical error, the question was omitted from the baseline questionnaire. We therefore proceed only with the observed segregation outcome outlined in section 3.1 of our pre-analysis plan. Additionally, we were unable to include the ‘spillover to neighboring households’ variable specified in Section 3.2, as it proved prohibitively costly to implement. Our final analysis focuses on four key outcomes: (1) observed segregation behavior; (2) incentivized willingness to contribute; (3) self-reported count of other pro-environmental behaviors; and (4) self-reported beliefs. We place greater emphasis on the first two outcomes as they are observed and incentivized, making them less susceptible to social desirability bias.¹⁸

At baseline, we also collected comprehensive information about household waste disposal practices and facilities. This included data on household waste disposal locations, timing and frequency of disposal, available storage space for waste, knowledge of and satisfaction with existing waste removal systems, and attitudes towards waste segregation.

The PAP specifies the variables to be analyzed, index construction, our approach to multiple inferences, planned empirical specifications, and our strategy for tracking and handling attrition. While our empirical analysis follows the PAP, we also report additional exploratory analyses to assess outcomes not initially specified, which provide a better understanding of the mechanisms underlying our main findings.¹⁹

4 Empirical Specification

Our primary outcomes of interest are incentivized elicitation of contribution to the NGO, and observed waste segregation behavior. Therefore, our main estimation equation is:

$$Y_{i,t=1} = \beta_0 + \beta_1 \text{Civic Video Treatment} + \beta_2 \text{Religion Video Treatment} + \beta_3 Y_{i,t=0} + \beta_4 X_i + \epsilon_i \quad (1)$$

In our model, Y_i represents the outcome of interest for household i . The treatment variables are binary indicators: *Civic Video Treatment* equals 1 if the household received the civic message treatment, and *Religion Video Treatment* equals 1 if the household received the religious message treatment, with the control group serving as the reference category. $Y_{i,t=0}$ denotes the pre-treatment outcome variable, capturing baseline measures such as

¹⁸Results for the self-reported variables are available upon request.

¹⁹A recent paper by Banerjee et al. (2020) discusses the costs and benefits of adhering to PAP and recommends that the final research paper be written and judged as a distinct object from the “results of the PAP”.

contribution, beliefs, and existing pro-environmental behaviors. X_i is a vector of control variables that encompasses demographics, religiosity, preferences, pro-environmental behaviors, and social desirability. Throughout our analyses, we report heteroskedasticity-robust standard errors.²⁰

The coefficients of interest, β_1 and β_2 , capture the effects of the interventions. To account for potential inconsistencies among survey administrators, we include enumerator fixed effects in Equation 1 for our main outcomes as a robustness check. Given that our preferred specification includes numerous covariates, we conduct an additional robustness check using the double LASSO method, a regression technique optimized for control selection from large covariate sets (Belloni et al., 2014). The results of this analysis are reported in Table A.1.²¹

5 Results

We present the results for our observed and incentivized measures from Equation 1 in Table 3. For each outcome, we provide estimates both without and with controls [columns (1) and (3), respectively], as well as specifications that include both controls and enumerator fixed effects [columns (2) and (4)].²²

5.1 Treatment Effects on Contribution to Waste Segregation Organization

We report the main effect of the two treatments on contributions to waste segregation organization in Table 3. Our analysis of incentivized contributions to a local NGO reveals economically and statistically significant treatment effects. The civic video intervention increased contributions by 9.4 percent relative to the control group mean of INR 41.44 (column 1), with the effect remaining robust at 8.5 percent after controlling for enumerator fixed effects (column 2). The religion video treatment yielded similar results, generating increases of 11.4 and 11.7 percent in columns (1) and (2), respectively. Tests for equality of treatment effects, reported in Table 3, indicate no statistically significant differences between the two interventions.

²⁰As the treatments for this study were randomized at the individual level, clustering is not necessary in this context according to the literature (Cameron and Miller, 2015).

²¹Due to our parsimonious set of primary outcomes and heterogeneity analyses, we do not adjust for multiple hypothesis testing.

²²To account for potential systematic differences in survey administration, we include enumerator fixed effects in Equation 1 and report these results in columns (2) and (4) of Table 3. Our findings remain robust to the inclusion of these fixed effects.

Our findings provide an interesting contrast to [Bulte et al. \(2005\)](#), who demonstrate that context and framing significantly influence stated preferences and willingness to pay in their field experiment on environmental valuations in the Netherlands. While they find that stated values vary substantially based on how environmental problems are framed, our results suggest that different motivational frames yield comparable effects on actual contributions.

Our work contributes to the emerging literature on individuals' willingness to support environmental causes. [Andre et al. \(2024\)](#) document widespread willingness to contribute to climate action across 125 countries, finding that 69 percent of the global population would sacrifice 1 percent of personal income to combat global warming. Similarly, [Sherif \(2021\)](#) shows that targeted interventions to promote specific pro-environmental behaviors can increase willingness to pay for a broad range of environmental activities. Our results complement these studies by highlighting that different motivational framing can be equally effective in encouraging environmental contributions, suggesting some pattern in how individuals respond to appeals for environmental support.

5.2 Treatment Effects on Waste Segregation

The empirical evidence reveals notably low baseline waste segregation behavior, with control group households reporting segregation activities approximately once per day on average. Neither the civic nor religious treatment interventions generated statistically significant changes in observed segregation practices [columns (3) and (4) of [Table 3](#)].²³ These null effects on actual behavior align with a growing literature documenting the gap between environmental preferences and actions, particularly evident in studies of green energy adoption ([Gravert, 2024](#); [Kaenzig et al., 2013](#); [Kaiser et al., 2020](#); [Fowlie et al., 2021](#)).

Importantly, the limited behavioral response cannot be attributed to mistrust or under-utilization of municipal waste services. Baseline data indicate widespread satisfaction with existing waste removal systems, with 95 percent of respondents reporting they are “satisfied” or “highly satisfied”. Moreover, approximately 85 percent of households rely on door-to-door waste collection rather than unauthorized disposal methods like roadside dumping. This high baseline utilization of formal waste services suggests that barriers to improved segregation practices likely stem from other behavioral factors rather than

²³We also estimated an alternative specification using the double LASSO method, which optimizes the selection of control variables when the set of covariates is large ([Belloni et al., 2014](#)). The results, reported in [Table A.1](#), show that the impacts of the civic and religion treatments on the outcomes are very similar in magnitude and significance to those in [Table 3](#).

infrastructure constraints or institutional mistrust.

The disconnect between *stated preferences* and *observed behaviors* highlighted by our results reinforces the need for multifaceted interventions that address various psychological and practical barriers to sustainable practices (Arias and Trujillo, 2020; Margetts and Kashima, 2017). Future research should explore how complementary policy tools could help bridge this *intention-action gap* in waste management behaviors.

5.3 Heterogeneity

In this section, we examine how pro-environmental behavior relates to economic preferences by analyzing differential treatment impacts across various baseline preference measures. Pro-environmental behaviors typically involve present costs for future benefits, suggesting that our videos might resonate more strongly with naturally patient individuals—a notion supported by existing research. For instance, Fuerst and Singh (2018) found that more patient individuals in India were more likely to invest in energy-efficient appliances. Consistent with this expectation, we find that both the civic and religious videos had stronger effects on more patient respondents' contribution behavior (Table 4, Panel A), though we observe no impact on actual segregation behavior, which is arguably a more challenging outcome to influence.

Our analysis reveals several other preference-based patterns. Respondents with higher positive reciprocity showed stronger positive responses to the videos in terms of contributions (Table 4, Panel B). Additionally, those with higher levels of negative reciprocity and altruism demonstrated increased actual waste segregation behavior in response to the treatments (Table 4, Panels C and E). We also found that the Civic Video treatment was particularly effective in increasing contributions among respondents with higher baseline knowledge of institutional waste collection systems (Table 4, Panel D). Notably, we did not find significant treatment effects related to other economic preferences such as trust, risk attitude, or locus of control, nor did we observe strong correlations with characteristics like pro-environmental attitude or religiosity (Table A.2).

These findings suggest that baseline preferences play a nuanced role in determining treatment effectiveness, and different types of pro-environmental behaviors—whether financial contributions or direct waste management efforts—may be associated with distinct economic preferences (Lades et al., 2021).

6 Discussion

Our findings reveal that low-cost interventions highlighting civic and religious duties effectively increased one-time donations to an environmentally focused NGO in a developing country. However, these same interventions had no significant impact on daily waste segregation practices—a more consistently measured behavioral metric. This disparity in outcomes underscores potential limitations in using such low-cost strategies.

While previous studies, including [Bosshard et al. \(2024\)](#), have focused primarily on self-reported measures or intentions rather than actual behaviors, our research combines incentivized willingness to contribute with observational data on waste segregation. This methodology enables us to bridge the gap between intended and actual behavioral engagement. Importantly, our approach highlights the challenges in measuring real-effort pro-environmental behaviors and questions the validity of using financial contributions as proxies for sustained environmental action.

Our heterogeneity analysis enriches the growing literature on economic preferences and pro-environmental behavior. We find that one-time contributions correlate more strongly with pro-social preferences and information access than with regular waste segregation activities. This discrepancy might stem from the sustained effort required for waste segregation, making it less responsive to simple, low-cost interventions. Moreover, our brief video treatments may have fallen short in conveying the high-impact nature of waste segregation compared to one-time contributions.

These findings carry significant implications for public policy strategies targeting various pro-environmental behaviors. Notably, everyday behaviors demanding sustained effort are less susceptible to influence through low-cost messaging, despite their potential for substantial environmental impact. Future policy-oriented research should therefore explore a broader range of strategies to effectively promote these high-impact, sustained behaviors.

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7 Tables and Figures

Table 1: Summary Statistics

Variable	N	Mean	Std. Dev
(1)	(2)	(3)	
<i>A. Demographics</i>			
Age (years)	1010	33.60	10.87
Female	1010	0.70	0.46
Married	1010	0.79	0.41
Reserved	1010	0.89	0.32
Muslim	1010	0.11	0.32
Unemployed	1010	0.08	0.27
Household Size	1010	6.18	2.48
Education	1010	0.56	0.50
Income	1010	0.40	0.49
<i>B. Preferences</i>			
Social Desirability Bias	1010	0.06	1.03
Religiosity Index	1010	-0.03	1.01
Patience	1010	-0.01	1.00
Trust in authorities	1010	-0.04	1.04
Internal Locus of Control	1010	0.01	0.97
Risk	1010	-0.09	1.04
Negative Reciprocity	1010	-0.01	1.01
Positive Reciprocity	1010	0.04	0.98
Altruism	1010	-0.01	0.99
<i>C. Other Controls</i>			
Pro-environment Index	1010	-0.01	1.01
Information Index	1010	0.04	0.99
Attitude Index	1010	-0.01	1.05
<i>D. Baseline Outcomes</i>			
Contribution	1010	40.58	27.73
Count of Other PEBs	1010	5.08	2.25
Belief	1010	1.58	0.85

Note: The statistics in Panel A are all proportions between 0 and 1, other than Age (in years) and Household Size. The statistics in Panels B and C are all expressed in standard deviations from the Control group mean. Reserved indicates SC (Schedule Caste) ST (Scheduled Tribe) and OBC (Other Backward Classes) respondents who are socio-economically deprived individuals in India; Education indicates proportion of respondents with education below 5th standard; Income indicates proportion of respondents with monthly income below INR 10 thousand; Social desirability (SD) score is a measure of the respondent's propensity to give socially desirable answers as explained in [Appendix C](#); Religiosity Index is created by aggregating standardized responses of relevant survey questions as described in [Appendix C](#); Internal Locus of control, Self Reported Risk, Self Reported Negative and Positive Reciprocity and Altruism indices are standardized measures of self-assessment as explained in [Appendix C](#); Trust in Authorities, Pro-environment Index, Information Index and Attitude Index are created by aggregating standardized responses of relevant survey questions as described in [Appendix C](#). Contribution is the% amount contributed from lottery payout worth INR 100 to a local NGO working on waste management in case of a win; Baseline Count of Other PEBs (Pro Environmental Behaviors) is the count of self-reported pro-environmental actions taken by a respondent; Baseline Belief captures respondents' assessment of others' willingness to segregate waste. It is a categorical variable having 4 values (1 - less than 25% of others segregate waste; 2 - (25-50)% of others segregate waste; 3 - (50-75)% of others segregate waste; 4 - (75-100)% of others segregate waste) * $p < .10$, ** $p < .05$, *** $p < .01$.

Table 2: Balance on Observable Characteristics

Variable	Control (1)	Civic Video (2)	Religion Video (3)		Difference	
				(1)-(2)	(1)-(3)	(2)-(3)
<i>A. Demographics</i>						
Age (years)	33.829 (0.633)	32.846 (0.553)	34.163 (0.596)	0.983 (0.840)	-0.335 (0.870)	-1.317 (0.813)
Female	0.695 (0.027)	0.706 (0.024)	0.713 (0.024)	-0.011 (0.036)	-0.018 (0.036)	-0.007 (0.034)
Married	0.829 (0.022)	0.790 (0.022)	0.763 (0.023)	0.039 (0.031)	0.065** (0.031)	0.027 (0.031)
Reserved	0.876 (0.019)	0.908 (0.015)	0.879 (0.017)	-0.032 (0.025)	-0.003 (0.026)	0.029 (0.023)
Muslim	0.114 (0.018)	0.134 (0.018)	0.093 (0.015)	-0.020 (0.026)	0.021 (0.024)	0.041* (0.024)
Unemployed	0.104 (0.018)	0.064 (0.013)	0.070 (0.014)	0.040* (0.022)	0.034 (0.022)	-0.006 (0.019)
Household Size	6.245 (0.145)	6.106 (0.131)	6.186 (0.131)	0.139 (0.195)	0.059 (0.196)	-0.079 (0.185)
Education	0.530 (0.029)	0.580 (0.026)	0.577 (0.026)	-0.050 (0.039)	-0.047 (0.039)	0.002 (0.037)
Income	0.426 (0.029)	0.384 (0.026)	0.403 (0.026)	0.042 (0.039)	0.023 (0.039)	-0.019 (0.037)
<i>B. Preferences</i>						
Self Reported Patience	-0.000 (0.058)	-0.031 (0.053)	-0.007 (0.052)	0.031 (0.078)	0.007 (0.078)	-0.024 (0.075)
Trust in Authorities	0.000 (0.058)	-0.054 (0.056)	-0.065 (0.056)	0.054 (0.081)	0.065 (0.081)	0.011 (0.079)
Internal Locus of Control	0.000 (0.058)	0.038 (0.048)	-0.003 (0.053)	-0.038 (0.076)	0.003 (0.078)	0.041 (0.072)
Self Reported Risk	-0.000 (0.058)	-0.116 (0.056)	-0.132 (0.056)	0.116 (0.080)	0.132 (0.080)	0.017 (0.079)
Self Reported Negative Reciprocity	-0.000 (0.058)	-0.013 (0.055)	-0.006 (0.053)	0.013 (0.080)	0.006 (0.078)	-0.008 (0.076)
Self Reported Positive Reciprocity	0.000 (0.058)	0.080 (0.051)	0.046 (0.052)	-0.080 (0.077)	-0.046 (0.078)	0.034 (0.073)
Self-reported Altruism	-0.000 (0.058)	0.013 (0.052)	-0.052 (0.053)	-0.013 (0.078)	0.052 (0.078)	0.066 (0.074)
<i>C. Other Controls</i>						
Pro-environment Index	-0.000 (0.058)	0.018 (0.059)	-0.059 (0.047)	-0.018 (0.083)	0.059 (0.075)	0.077 (0.076)
Information Index	-0.000 (0.058)	0.062 (0.053)	0.040 (0.053)	-0.062 (0.078)	-0.040 (0.078)	0.022 (0.074)
Attitude Index	-0.000 (0.058)	0.034 (0.056)	-0.070 (0.057)	-0.034 (0.080)	0.070 (0.081)	0.104 (0.080)
Social Desirability Bias	-0.000 (0.058)	0.034 (0.055)	0.147 (0.055)	-0.034 (0.080)	-0.147* (0.080)	-0.113 (0.078)
Religiosity Index	-0.000 (0.058)	0.013 (0.053)	-0.106 (0.054)	-0.013 (0.079)	0.106 (0.079)	0.119 (0.076)
<i>D. Baseline Outcomes</i>						
Contribution	43.758 (1.668)	39.608 (1.473)	38.901 (1.409)	4.151* (2.226)	4.857** (2.184)	0.706 (2.038)
Count of Other PEBs	4.997 (0.132)	5.132 (0.116)	5.096 (0.121)	-0.135 (0.176)	-0.099 (0.179)	0.036 (0.167)
Belief	1.570 (0.049)	1.527 (0.043)	1.637 (0.048)	0.044 (0.065)	-0.066 (0.068)	-0.110* (0.064)
N	298	357	355			

Note: Columns 1 to 3 show sample means for the denoted subgroups, standard errors are given in parentheses. The next three columns show the difference of the mean of each variable between subjects from pairs of subgroups. The statistics in Panel A are all proportions between 0 and 1, other than Age (in years) and Household Size. The statistics in Panels B and C are all expressed in standard deviations from the Control group mean. Reserved indicates SC (Schedule Caste) ST (Scheduled Tribe) and OBC (Other Backward Classes) respondents who are socio-economically deprived individuals in India; Education indicates proportion of respondents with education below 5th standard; Income indicates proportion respondents with monthly income below INR 10 thousand; Social desirability (SD) score is a measure of the respondent's propensity to give socially desirable answers as explained in [Appendix C](#); Religiosity Index is created by aggregating standardized responses of relevant survey questions as described in [Appendix C](#); Internal Locus of control, Self Reported Risk, Self Reported Negative and Positive Reciprocity and Altruism indices are standardized measures of self-assessment as explained in [Appendix C](#); Trust in Authorities, Pro-environment Index, Information Index and Attitude Index are created by aggregating standardized responses of relevant survey questions as described in [Appendix C](#). Contribution is the % amount contributed from lottery payout worth INR 100 to a local NGO working on waste management in case of a win; Baseline Count of Other PEBs (Pro Environmental Behaviors) is the count of self-reported pro-environmental actions taken by a respondent; Baseline Belief captures respondents' assessment of others' willingness to segregate waste. It is a categorical variable having 4 values (1 - less than 25% of others segregate waste; 2 - (25-50)% of others segregate waste; 3 - (50-75)% of others segregate waste; 4 - (75-100)% of others segregate waste) * $p < .10$, ** $p < .05$, *** $p < .01$.

Table 3: Impact of Treatments on Outcomes

	Contribution		Waste Segregation from Visual Inspection	
	(1)	(2)	(3)	(4)
Civic Video Treatment	3.976** (2.023)	3.514* (2.051)	-0.044 (0.126)	0.008 (0.122)
Religion Video Treatment	4.726** (2.118)	4.864** (2.116)	-0.037 (0.125)	-0.007 (0.119)
Observations	1010	1010	1004	1004
<i>Equality of treatments</i> [p-value]				
Civic Video = Religion Video	[0.711]	[0.504]	[0.955]	[0.897]
Control Outcome Mean	41.443		1.027	
Controls	yes	yes	yes	yes
Enumerator FE	no	yes	no	yes
R^2	0.224	0.252	0.067	0.187

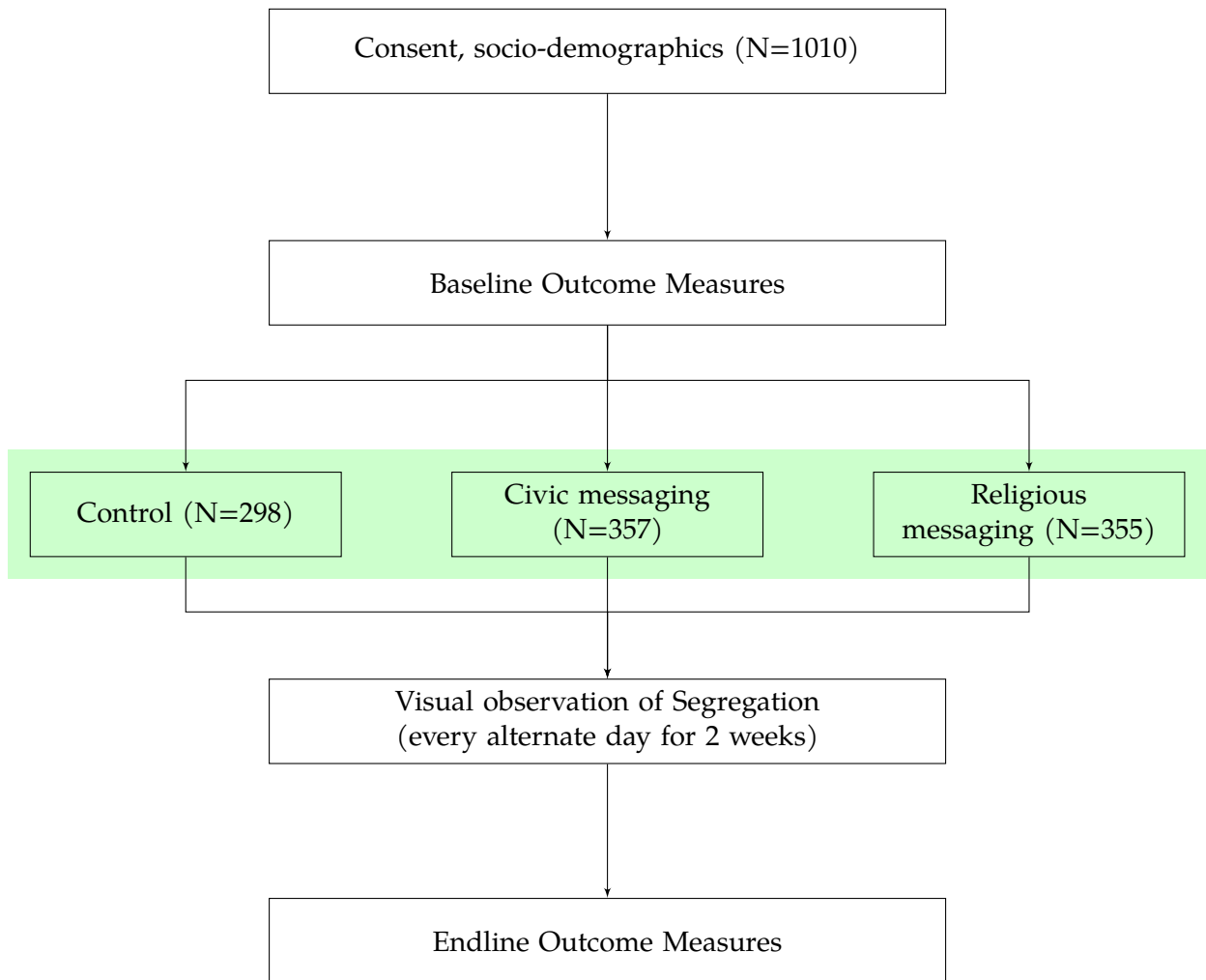
Note: “Civic Video Treatment” and “Religion Video Treatment” are dummies equal to 1 if the respondent was assigned to civic or religious messaging intervention respectively; 0 otherwise. The dependent variable “Waste Segregation from Visual Inspection” is the total count of days the household was observed to practice waste segregation from total 7 visits. The “Contribution” variable measures the *endline* amount contributed from lottery payout worth INR 100 to the NGO in case of a win. Columns 1 and 3 present regression results from equation 1 by including a set of controls. Controls include- demographics (age, gender, marital status, reserved dummy, religion, employment, household size, education and income), indices of preferences (patience, trust, locus of control, risk, positive and negative reciprocity, altruism), indices of pro-environmental behavior, religiosity and social desirability, index of baseline knowledge on institutional setup and waste segregation, index of attitude towards waste segregation, baseline levels of contribution, count of other PEBs and belief. Columns 2 and 4 include controls and enumerator fixed effects. Robust standard errors in parentheses; p-values reported in square brackets. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 4: Heterogeneity

	Contribution	Waste Segregation from Visual Inspection
	(1)	(2)
Panel A: Patience		
Civic Video Treatment x Patience	5.571*** (2.002)	0.018 (0.121)
Religion Video Treatment x Patience	5.699*** (2.155)	-0.122 (0.123)
Civic Video Treatment	3.563* (2.040)	0.008 (0.122)
Religion Video Treatment	4.862** (2.106)	-0.010 (0.119)
Patience	-3.711** (1.532)	0.102 (0.096)
Panel B: Positive Reciprocity		
Civic Video Treatment x Positive Reciprocity	3.313 (2.093)	0.141 (0.123)
Religion Video Treatment x Positive Reciprocity	4.328** (2.058)	0.295** (0.117)
Civic Video Treatment	3.488* (2.054)	0.009 (0.122)
Religion Video Treatment	4.805** (2.110)	-0.013 (0.119)
Positive Reciprocity	-3.697** (1.516)	-0.059 (0.091)
Panel C: Negative Reciprocity		
Civic Video Treatment x Negative Reciprocity	0.918 (2.034)	0.308** (0.122)
Religion Video Treatment x Negative Reciprocity	0.936 (2.199)	0.393*** (0.123)
Civic Video Treatment	3.503* (2.054)	0.004 (0.122)
Religion Video Treatment	4.859** (2.118)	-0.008 (0.119)
Negative Reciprocity	-2.373 (1.559)	-0.290*** (0.094)
Panel D: Information		
Civic Video Treatment x Information	4.421** (2.033)	-0.018 (0.107)
Religion Video Treatment x Information	0.223 (2.314)	-0.080 (0.108)
Civic Video Treatment	3.298 (2.046)	0.007 (0.122)
Religion Video Treatment	4.960** (2.125)	-0.005 (0.120)
Information Index	-3.907** (1.642)	0.048 (0.079)
Panel E: Altruism		
Civic Video Treatment x Altruism	-0.901 (2.172)	-0.047 (0.113)
Religion Video Treatment x Altruism	-2.941 (2.246)	0.279*** (0.106)
Civic Video Treatment	3.464* (2.051)	0.014 (0.122)
Religion Video Treatment	4.725** (2.117)	0.009 (0.120)
Altruism	1.741 (1.654)	-0.037 (0.086)
Observations	1010	1004
Control Outcome Mean	41.443	1.027
Controls	yes	yes
Enumerator FE	yes	yes

Note: "Civic Video Treatment" and "Religion Video Treatment" are dummies equal to 1 if the respondent was assigned to civic or religious messaging intervention respectively; 0 otherwise. The dependent variable "Waste Segregation from Visual Inspection" is the total count of days the household was observed to practice waste segregation from total 7 visits. The "Contribution" variable measures the *endline*% amount contributed from lottery payout worth INR 100 to the NGO in case of a win. Controls include- demographics (age, gender, marital status, reserved dummy, religion, employment, household size, education and income); indices of preferences (patience, trust, locus of control, risk, positive and negative reciprocity, altruism); indices of pro-environmental behavior, religiosity and social desirability; index of baseline knowledge on institutional setup and waste segregation; index of attitude towards waste segregation; baseline levels of contribution, count of other PEBs and belief. Columns also include enumerator fixed effects. Robust standard errors in parentheses; p-values reported in square brackets. * $p < .10$, ** $p < .05$, *** $p < .01$

Figure 1: Experiment Flow



Note: Figure presents an overview of the experiment flow. The green box indicates randomization.

Appendices

Contents

A	Additional Figures and Tables	28
B	Scripts of Treatment Videos and Calendars	30
B.1	Civic Treatment Video	30
B.2	(Hindu) Religion Treatment Video	30
B.3	(Muslim) Religion Treatment Video	31
B.4	Calendars	32
C	Data Appendix	33
C.1	Construction of Indices	33
D	Copy of Pre-analysis Plan	38

A Additional Figures and Tables

Table A.1: Impact of Treatments on Outcomes - Double LASSO Method

	Contribution		Waste Segregation from Visual Inspection	
	(1)	(2)	(3)	(4)
Civic Video Treatment	3.953* (2.053)	3.417* (2.075)	-0.029 (0.129)	0.011 (0.122)
Religion Video Treatment	4.537** (2.146)	4.646** (2.134)	-0.030 (0.127)	0.009 (0.119)
Observations	1010	1010	1004	1004
<i>Equality of treatments</i> [p-value]				
Civic Video = Religion Video	[0.772]	[0.542]	[0.996]	[0.989]
Control Outcome Mean	41.443		1.027	
Controls	yes	yes	yes	yes
Enumerator FE	no	yes	no	yes

Note: In both Panels A and B, “Civic Video Treatment” and “Religion Video Treatment” are dummies equal to 1 if the respondent was assigned to civic or religious messaging intervention respectively; 0 otherwise. In Panel A, the dependent variable “Waste Segregation from Visual Inspection” is the total count of days the household was observed to practice waste segregation from total 7 visits. The “Contribution” variable measures the *endline*% amount contributed from lottery payout worth INR 100 to the NGO in case of a win. In Panel B, the “Count of Other PEBs” captures the count of self-reported pro-environmental actions taken by a respondent in *endline*. The “Belief” captures respondents’ assessment of others’ willingness to segregate waste in *endline*. It is a categorical variable having 4 values (1 - less than 25% of others segregate waste; 2 - (25-50)% of others segregate waste; 3 - (50-75)% of others segregate waste; 4 - (75-100)% of others segregate waste). Controls are selected by the double LASSO method (baseline contribution and marital status are always included to account for imbalance). Columns 2 and 4 also include enumerator fixed effects. Standard errors in parentheses; p-values reported in square brackets.
* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.2: Other Heterogeneities

	Contribution (1)	Waste Segregation from Visual Inspection (2)
Panel A: Risk		
Civic Video Treatment x Risk	-0.467 (2.025)	0.052 (0.109)
Religion Video Treatment x Risk	1.012 (1.979)	0.036 (0.115)
Civic Video Treatment	3.422* (2.054)	0.010 (0.123)
Religion Video Treatment	4.958** (2.130)	-0.007 (0.120)
Risk	-0.235 (1.565)	-0.085 (0.083)
Panel B: Trust		
Civic Video Treatment x Trust	1.575 (2.004)	-0.108 (0.123)
Religion Video Treatment x Trust	-0.703 (2.011)	-0.138 (0.119)
Civic Video Treatment	3.568* (2.053)	0.006 (0.122)
Religion Video Treatment	4.781** (2.112)	-0.012 (0.119)
Trust	-0.947 (1.557)	0.021 (0.098)
Panel C: Locus of Control		
Civic Video Treatment x LOC	1.717 (2.044)	0.055 (0.122)
Religion Video Treatment x LOC	1.076 (1.854)	0.108 (0.106)
Civic Video Treatment	3.470* (2.052)	0.009 (0.122)
Religion Video Treatment	4.859** (2.119)	-0.007 (0.119)
LOC	-0.941 (1.404)	0.040 (0.081)
Panel D: Religiosity Index		
Civic Video Treatment x Religiosity Index	-1.241 (2.034)	0.006 (0.122)
Religion Video Treatment x Religiosity Index	-1.741 (2.004)	0.054 (0.101)
Civic Video Treatment	3.516* (2.052)	0.009 (0.122)
Religion Video Treatment	4.785** (2.132)	-0.003 (0.120)
Religiosity Index	4.123*** (1.532)	-0.002 (0.079)
Panel E: Pro-environment Index		
Civic Video Treatment x Pro-environment Index	-1.178 (1.699)	-0.012 (0.152)
Religion Video Treatment x Pro-environment Index	1.027 (1.867)	0.079 (0.165)
Civic Video Treatment	3.515* (2.054)	0.007 (0.122)
Religion Video Treatment	4.919** (2.113)	-0.003 (0.121)
Pro-environment Index	0.488 (1.368)	0.108 (0.115)
Observations	1010	1004
Control Outcome Mean	41.443	1.027
Controls	yes	yes
Enumerator FE	yes	yes

Note: "Civic Video Treatment" and "Religion Video Treatment" are dummies equal to 1 if the respondent was assigned to civic or religious messaging intervention respectively; 0 otherwise. The dependent variable "Waste Segregation from Visual Inspection" is the total count of days the household was observed to practice waste segregation from total 7 visits. The "Contribution" variable measures the *endline*% amount contributed from lottery payout worth INR 100 to the NGO in case of a win. Controls include- demographics (age, gender, marital status, reserved dummy, religion, employment, household size, education and income); indices of preferences (patience, trust, locus of control, risk, positive and negative reciprocity, altruism); indices of pro-environmental behavior, religiosity and social desirability; index of baseline knowledge on institutional setup and waste segregation; index of attitude towards waste segregation; baseline levels of contribution, count of other PEBs and belief. Columns also include enumerator fixed effects. Robust standard errors in parentheses; p-values reported in square brackets.

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

B Scripts of Treatment Videos and Calendars

B.1 Civic Treatment Video

Screen 1 Are you a good citizen?

Screen 2 As citizens, it is our fundamental duty to protect and improve the natural environment.

Screen 3 One way to do this is to practice waste segregation. Waste segregation is the sorting and segregation of waste for recycling and easy disposal of waste. This is done by the use of color-coded dustbins.

Screen 4 The green dustbin is for wet and biodegradable waste, such as kitchen waste, such as rotten eggs, fruits, vegetables and peels, coconut shells, tea bags, leftover food, garden waste, etc.

Screen 5 The blue dustbin is meant for dry and non-biodegradable waste. Materials like plastic, cans, newspapers, lights, bottles, gift wrappers, cardboard, tetra pack packaging etc. are to be thrown in this dustbin.

Screen 6 Segregate your waste to reduce pollution! Thanks for watching this video.

B.2 (Hindu) Religion Treatment Video

Screen 1 Are you a good Hindu?

Screen 2 Hindu religious texts consider the environment as an extension of God.

Screen 3 Hinduism teaches us to behave respectfully towards Mother Earth by ensuring that our activities do not harm her.

Screen 4 One way to do this is to practice waste segregation. Waste segregation is the sorting and segregation of waste for recycling and easy disposal of waste. This is done by the use of color-coded dustbins.

Screen 5 The green dustbin is for wet and biodegradable waste, such as kitchen waste, such as rotten eggs, fruits, vegetables and peels, coconut shells, tea bags, leftover food, garden waste, etc.

Screen 6 The blue dustbin is meant for dry and non-biodegradable waste. Materials like plastic, cans, newspapers, lights, bottles, gift wrappers, cardboard, tetra pack packaging etc. are to be thrown in this dustbin.

Screen 7 Segregate your waste to reduce pollution! Thanks for watching this video.

B.3 (Muslim) Religion Treatment Video

Screen 1 Are you a good Muslim?

Screen 2 Islamic texts preach cleanliness of the environment.

Screen 3 Islam teaches us that cleanliness is half faith. According to the teachings of Islam, man should avoid the misuse of natural resources and should stay away from any work that will destroy and spoil the environment.

Screen 4 One way to do this is to practice waste segregation. Waste segregation is the sorting and segregation of waste for recycling and easy disposal of waste. This is done by the use of color-coded dustbins.

Screen 5 The green dustbin is for wet and biodegradable waste, such as kitchen waste, such as rotten eggs, fruits, vegetables and peels, coconut shells, tea bags, leftover food, garden waste, etc.

Screen 6 The blue dustbin is meant for dry and non-biodegradable waste. Materials like plastic, cans, newspapers, lights, bottles, gift wrappers, cardboard, tetra pack packaging etc. are to be thrown in this dustbin.

Screen 7 Segregate your waste to reduce pollution! Thanks for watching this video.

B.4 Calendars

गीला और सूखा कचरा करवाएंगे अलग,
घर-घर में स्वच्छता का जलाएंगे अलख.

DRY WASTE

सूखा कचरा

WET WASTE

गीला कचरा

SAVE the PLANET

2023

-JANUARY-
M T W T F S S
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-FEBRUARY-
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-MARCH-
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(a) Civic Video Treatment

गीला और सूखा कचरा करवाएंगे अलग,
घर-घर में स्वच्छता का जलाएंगे अलख.

DRY WASTE

सूखा कचरा

WET WASTE

गीला कचरा

माता भूमि: पुनो अहं पृथिव्या: ॥
जन्मदिन-१५.११.१९

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(b) (Hindu) Religion Video Treatment

गीला और सूखा कचरा करवाएंगे अलग,
घर-घर में स्वच्छता का जलाएंगे अलख.

DRY WASTE

सूखा कचरा

WET WASTE

गीला कचरा

"पाकीज़गी आधा ईमान है।"- हज़रत मुहम्मद

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-MARCH-
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-APRIL-
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-MAY-
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-JUNE-
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-SEPTEMBER-
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(c) (Muslim) Religion Video Treatment

C Data Appendix

C.1 Construction of Indices

We constructed indices for religiosity, social desirability, pro-environment behavior and individual preferences. These are the average of the relevant standardized variables, as listed in below. The procedure is as follows-

- Individual variables are coded such that the positive direction always corresponded with “higher” outcome for all sub-components of the aggregate index, 0 otherwise.
- Each individual variable is normalized by subtracting the overall sample mean and dividing by the control group standard deviation. The index is then generated by averaging over relevant components.
- The final index is then re-scaled such that the control mean is 0 and the standard deviation is 1.

C.1.1 Preferences

Patience, reciprocity, altruism and risk are self-assessed measures of preferences. These variables are measured following [Falk et al. \(2018\)](#):

- *Patience* is computed using response to “Please tell me, in general, how willing you are to give up something that is beneficial for you today in order to benefit more from that in the future, using a scale of 0 to 10 below (0 indicates you are completely unwilling to do so, and 10 indicates you are very willing to do so.) (answer choices: completely unwilling to do so 0/ 1/ /very willing to do so 10).”
- *Altruism* is measured by response to “Please tell us how willing you are to give to good causes without expecting anything in return, using a scale of 0 to 10 below (0 indicates you are completely unwilling to give, 10 indicates you are very willing to give) (answer choices: completely unwilling to give 0/ 1/ / very willing to give 10).”
- *Positive reciprocity* is measured by response to “Please tell us when someone does you a favour, how willing you would be to return it , using a scale of 0 to 10 below (0 indicates you are completely unwilling to do, 10 indicates you are very willing to do) (answer choices: completely unwilling to do 0/ 1/ / very willing to do 10).”

- *Negative reciprocity* is reverse-coded. It is based on response to “Please tell us how willing you are to punish someone who treats you unfairly, even if there may be costs for you, using a scale of 0 to 10 below (0 indicates you are completely unwilling to do so, 10 indicates you are very willing to do so) (answer choices: completely unwilling to do so 0/ 1/ /very willing to do so 10).”
- The *risk index* is computed using response to “Please tell us, in general, how willing or unwilling are you to take risks, using a scale of 0 to 10 below (0 indicates completely unwilling, and 10 indicates very willing to take risks.) (answer choices: completely unwilling 0/ 1/ /very willing 10)”

Locus of control index (a personal belief about whether outcomes of behavior are determined by one’s actions or by forces outside one’s control) is the internal sub-scale of the KMKB measure of locus of control (Kovaleva, 2012). It comprises of a five-point Likert response scale, ranging from positive to negative pole, for the statements:

- I like taking responsibility
- I find it best to make decisions myself, rather than to rely on fate
- When I encounter problems or opposition, I usually find ways and means to overcome them

Trust measures the extent to which respondents trust the following societal authorities. The item is reverse-coded to reflect a higher value relates to higher trust. It comprises of a four-point response scale, ranging from- trust completely (1)/ trust somewhat (2)/ do not trust very much (3)/ do not trust at all (4), for the following:

- Courts/Judges and Magistrates
- Prime Minister
- Police
- Members of Parliament
- Religious leaders
- Community leaders

C.1.2 Other Indices

The *pro-environment* index is constructed by aggregating responses to three questions (all reverse-coded to match the positive direction with increase in outcome)-

- How much do you know about global warming? (answer choices: I know a lot about it./ I know something about it./ I know just a little about it./ I have never heard of it./ Don't know/no response)
- Please tell me how much you agree or disagree with the following statement: I have personally experienced the effects of global warming. (answer choices: Strongly agree/ Somewhat agree/ Somewhat disagree/ Strongly disagree/ Don't know/can't say)
- Do you strongly favor, somewhat favor, somewhat oppose, or strongly oppose the government taking steps to address global warming? (answer choices: Strongly favor/ Somewhat favor/ Somewhat oppose/ Strongly oppose/ Don't know/ no response)

The *Information* index is constructed by aggregating responses to the following questions-

- Where do you dispose the household garbage? (in the roadside garbage bin/ in the apartment garbage bin/ by the side of the road/ in an empty space near the house/ waste collectors from the municipality do the door-to-door waste collection/ Other)²⁴
- (reverse-coded)How often do you dispose of your household waste? (answer choices: everyday (1)/ once in every 2-3 days (2)/ once in every 4-5 days (3)/ once in every 6-7 days (4)/ irregularly (5)/ never (6)/ don't know (-999))²⁵
- Where do you think the household waste is taken by the municipality? (descriptive question with the option don't know)²⁶
- (reverse-coded)Satisfaction level about the present municipal waste removal system (answer choices: Very satisfied (1)/ Somewhat satisfied (2)/ Somewhat dissatisfied (3)/ Very dissatisfied (4))²⁷
- Does your municipalities/corporation provide you with sorting buckets/bins for waste separation? (answer choices: No / Yes)²⁸

²⁴response coded into a dummy = 1 if answer is "waste collectors from the municipality do the door-to-door waste collection", 0 otherwise

²⁵responses reverse-coded into a continuous variable, with the don't know option coded as missing.

²⁶response coded as a dummy = 1 if respondent was able to give a location, 0 if the answer was 'don't know'

²⁷Response reverse-coded into a continuous variable

²⁸response coded into a dummy = 1 if answered yes, 0 otherwise

The *Attitude* index is constructed by aggregating responses to the following questions-

(Reverse-coded) To what extent do you agree or disagree with the following statements?
(answer choices: strongly agree/ agree / undecided / disagree / strongly disagree)

- Waste separation at source is good for the environment
- I feel shameful if I do not separate my household waste when my neighbors are aware of my action
- I feel shameful if I do not separate my household waste even if nobody is aware of my action

The *religiosity* index is constructed by aggregating responses to the following questions-

- (Reverse-coded) Please evaluate your own feelings of religiousness-are you: Very religious; Moderately religious; Slightly religious; Not at all religious; Anti-religious.
- Thinking about the past month, did you think about religious issues? Yes, No, Can't say/ don't remember ²⁹
- (Reverse-coded) Do you believe that your religion is the only true religion? Strongly agree / Agree / Neither agree nor disagree / Disagree / Strongly disagree
- How often do you pray at home on a typical day? (I don't pray at all/ once / twice / 3 times/ 4 times/ 5 times/ 6 times/ 7 times/ 8 times/ 9 times/ 10 times/ more than 10 times) ³⁰
- Thinking about past week, how often did you take part in religious services at a place of public worship outside home? (0 / 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 / more than 10 times) ³¹
- To what extent do you agree or disagree with the following (1 (highly disagree)/ 2/ 3/ 4/ 5 (highly agree))
 - My religion is important to me because it helps me in times of personal or financial need.
 - My religion is important to me because following the advice of my religion is the right thing to do.

²⁹response coded into a dummy = 1 if yes, 0 otherwise

³⁰response coded into a dummy = 1 if prays daily, 0 otherwise

³¹response coded into a dummy = 1 if took part 1 or more times, 0 otherwise

- My religion is important to me because that is where I find my family close friends, and/or business partners.
- My religion is important to me because it makes it easier for me to reach decisions about complicated things.
- My religion is important to me because I was born into it and/or brought up that way.
- My religion is important to me because I identify as Hindu/Muslim.

The *social desirability bias* index is a 13-question short form of Crowne and Marlowe (1960) module developed by Reynolds (1982). The following questions were asked at baseline with two answer choices: agree (1) or disagree (2). The social desirability score sums how many of the responses are the socially desirable one. A low score means a lower tendency to give answers that have social desirability bias.³²

1. It is sometimes hard for me to go on with my work if I am not encouraged.
2. I sometimes feel resentful when I don't get my way.
3. On a few occasions, I have given up doing something because I thought too little of my ability.
4. There have been times when I felt like rebelling against people in authority even though I knew they were right.
5. No matter who I'm talking to, I'm always a good listener.
6. There have been occasions when I took advantage of someone.
7. I'm always willing to admit to it when I make a mistake.
8. I sometimes try to get even rather than forgive and forget.
9. I am always courteous, even to people who are disagreeable.
10. I have never been irked when people expressed ideas very different from my own.
11. There have been times when I was quite jealous of the good fortune of others.
12. I am sometimes irritated by people who ask favours of me.
13. I have never deliberately said something that hurt someone's feelings.

³²Final responses are coded as dummy=1 if agree, 0 otherwise. Statements 5, 7, 9, 10 and 13 are reverse-coded.

D Copy of Pre-analysis Plan

Pre-Analysis Plan for Sorting it Out: Waste Segregation in Urban India

Ahana Basistha Vishal Narayan Nishith Prakash Raisa Sherif

August 15, 2023

This document outlines the analysis plan for the evaluation of the randomized control trial to improve attitudes towards waste segregation, observed waste segregation behaviour and elicited willingness to pay for pro-environmental actions among households.

1 Experimental Design

Poor urban waste management has severe negative effects on health and economic outcomes. An effective approach to address this issue is the implementation of waste segregation at source, followed by adequate processing of the separated components. Co-opting households' participation in segregating waste is essential to the success of such systems. We conduct a randomized control trial among households in Patna Municipal Corporation in the state of Bihar, India, to examine the effects of behavioural interventions on household waste segregation.

Step 1: Baseline Survey: We survey the households on existing waste handling practices, environmental attitudes and awareness levels and religion and religiosity measures of the households. Descriptive social norms on pro-environmental behaviors, especially on waste segregation are also measured. In order to check if there are spillovers from the interventions to non-target behaviours, we implement a lab in the field measure of eliciting contributions to other environmental behaviours. Such a lab elicitation overcomes some of the challenges of self-reported data on environmental behaviors. Participants are more likely to over-report when asked about behaviors that are deemed desirable, and pro-environment behaviors fall into these categories where there is a potential expectation to engage in more.

Step 2: Treatment conditions: After the baseline survey is executed, we randomize the households into three conditions, each consisting of approximately 300 households, making the total sample size around 900-1000 households. The three conditions are as follows: (i) Control, (ii) Messaging promoting civic duties through a 1 minute video, and (iii) Religious messaging through a similar 1 minute video. Additionally, treatment households will receive a customized calendar corresponding to their respective treatment condition. Throughout the study, we will continuously measure household segregation across all treatments.

Messages with a religious appeal can have cultural relevance in a religious society, where religion provides moral and ethical guidance, promotes trust in authority, reinforces social norms, and also serves as motivation for initiating behavioral change (for e.g., by appealing to a sense of duty).¹ We finalize the religious message treatment after discussing with our implementing partners.

Step 3: At the endline, we implement a shorter version of the baseline questionnaire, including the willingness to pay elicitation.

2 Implementing Partners

This project is being supported by several senior bureaucrats from the Bihar Government, in particular, Animesh Parashar (IAS) who is currently Commissioner, Patna Municipal Corporation, and Rajiv Ranjan (Consultant).²

3 Outcomes

3.1 Primary Outcomes

Our primary outcomes for measuring waste segregation behavior directly, are the following-

¹For example, use of religious imagery to curb public urination/spitting is common in India. Further, Bursztyn et al. (2019) has explored the role of invoking moral appeal through religious messaging in the context of credit card repayments in banks of Indonesia.

²Additionally, we partner with Diksha Foundation (<https://dikshafoundation.org/sustainable-and-inclusive-urbanization-in-patna/>)- an NGO working towards encouraging pro-environmental practices in vulnerable areas of Patna- to whom the donations are to be made from the incentivised earnings.

1. Intention to segregate (self-reported): We measure the intention using the following question:
In the coming week, how likely is it that you are going to practice waste separation at least once? (very likely/ somewhat likely/ neutral/ somewhat unlikely/ very unlikely)
2. Segregation behaviour (observed): This will be observational data collected through the Patna Municipal Corporation

3.2 Secondary Outcomes

In addition to our primary outcomes of interest, we will also collect data on important secondary outcomes that may be impacted by the treatments. We are interested in two such outcomes, listed below-

1. Willingness to pay for environmental behaviours: We measure this using the incentivised lottery task implemented in the baseline and endline.
2. Spillover to other self reported PEBs: We measure at the baseline and at the endline using the following questions:

Please tick actions that you have done at least once in the past week (Select all that apply):

- (i) Carry your own cloth bag whenever you go shopping
- (ii) Carry your own water bottle whenever you leave your house
- (iii) Turn off electrical appliances whenever you leave a room
- (iv) Switch-off the fridge during longer holidays
- (v) Unplug/Switch off electronic devices instead of using them on stand-by.
- (vi) Use paper bags instead of plastic bags.
- (vii) Check efficiency labels when buying household electronics
- (viii) Change from an old fridge to a modern fridge. (with grade/or electricity consumption)
- (xi) Change light bulbs to energy-saving lighting
- (x) Give newspapers and other paper waste for recycling
- (xi) Give plastic waste produced at home for recycling
- (xii) Separate waste into food waste and other types of waste materials at home

3.3 Exploratory Outcomes

We are also interested in exploring the impact, if any, of our treatments on the subjects' beliefs about others' behaviors and potential spillover to other households. For this purpose, we will include the two variables listed below-

1. Participants' beliefs about other households' willingness to segregate waste.
2. Spillover to neighbouring households (conducted at endline).

4 IRB Details

Following are the IRB details:

IRB number: IRB00012768; FWA00030191; IORG0010769; OMB No. 0990-0278

Date of Approval: 11th November, 2022

5 Empirical Strategy

The intention to segregate and the actual segregation behaviour are measured after the baseline is executed. We will estimate the following OLS specification:

$$Y_i = \beta_0 + \beta_1 \text{MESSAGE} + \beta_2 \text{RELIGIOUS MESSAGE} + \beta_3 + \beta_4 X_i + \epsilon_i \quad (1)$$

where,

Y_i is the outcome of interest for household i

$\text{MESSAGE} = 1$ if the household is in the constitutional message treatment

$\text{RELIGIOUS MESSAGE} = 1$ if the household is in the religious message treatment

X_i is a vector of control variables including age, gender, caste, education, religion and income

The coefficients of interest are β_1 and β_2 that capture the effect of the interventions.

We will estimate the following equation using an OLS specification, where our outcome variables of interest are - (i) willingness to pay for environmental behaviour, and (ii) spillover to other self reported PEBs. These variables are measured both at the baseline and at the endline.

$$Y_{i,t=1} = \beta_0 + \beta_1 \text{MESSAGE} + \beta_2 \text{RELIGIOUS MESSAGE} + \beta_3 Y_{i,t=0} + \beta_4 X_i + \epsilon_i \quad (2)$$

5.1 Heterogeneous Treatment Effects

We propose to estimate the heterogeneous treatment effects by interacting the treatment status with our choice of variables. We are primarily interested in examining the heterogeneous effects with respect to: religiosity, environmental attitude, awareness, baseline status of waste management service, baseline level of preferences such as pro-sociality, locus of control, and risk.

5.2 Multiple Hypothesis Testing

A common concern when using more than one outcome is the increased likelihood of erroneous inferences as more inferences are made. To address the possibility of false positives arising from multiple hypothesis testing, we will compute the false discovery rate (FDR) and report the sharpened q-values (Benjamini et al., 2006). When we explore the outcomes beyond our core results, we will group hypotheses under the appropriate hypothesis test category and compute and present FDR corrected q-values for all hypothesis tests within a given category.

6 Mechanisms

We check two potential channels through which religious messaging impacts the intention to segregate and actual segregation behaviour: (i) time preference (captured through an incentivised as well as a self-reported measure) and (ii) appeal to authority (self-reported).

References

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