A Social Network Analysis of Open Defecation Practices in India

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Abstract

India faces a major public health issue as it has the highest rate of open defecation in the world. Open defecation is associated with significant negative effects such as diarrhea, parasitic worm infections and stunting. Over the past few decades, the Indian government launched multiple campaigns to tackle this issue. Unfortunately, the campaigns have achieved limited success in changing the population's open defecation behaviour. In 2014, the Modi government launched the Swachh Bharat Abhiyan (Clean India Mission) with the aim of eliminating open defecation in five years. As of 2018, however, 44% of Indians still defecate in the open. As a result, it is increasingly important to understand the social and behavioral drivers that motivate open defecation behaviour. The aim of this paper is to study the effects of social networks and social interactions on an individual's open defecation behaviour. The survey data used in this paper is from a three-year long research project conducted by Penn Social Norms Group (Penn SoNG) in association with the Bill and Melinda Gates Foundation. A total of 3370 respondents were surveyed from two Indian states – Bihar and Tamil Nadu. The results of the regression analysis show that visiting religious sites as well as interacting with the village headman increases the likelihood of abstaining from open defecation by approximately 70%. Secondary analyses showed that television and billboard advertisements were particularly effective in reducing open defecation. Finally, this paper also attempts to identify potential trendsetters who can be leveraged in future behaviour change interventions. Hence, the results of the analysis suggest that by harnessing the power of social networks we can significantly influence people's behaviour and ultimately alleviate the negative outcomes of open defecaion in India.

Disciplines

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Reader: Alex Shpenev
ABSTRACT

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The aim of this paper is to study the effects of social networks and social interactions on an individual’s open defecation behaviour. The survey data used in this paper is from a three-year long research project conducted by Penn Social Norms Group (Penn SoNG) in association with the Bill and Melinda Gates Foundation. A total of 3370 respondents were surveyed from two Indian states – Bihar and Tamil Nadu. The results of the regression analysis show that visiting religious sites as well as interacting with the village headman increases the likelihood of abstaining from open defecation by approximately 70%. Secondary analyses showed that television and billboard advertisements were particularly effective in reducing open defecation. Finally, this paper also attempts to identify potential trendsetters who can be leveraged in future behaviour change interventions. Hence, the results of the analysis suggest that by harnessing the power of social networks we can significantly influence people’s behaviour and ultimately alleviate the negative outcomes of open defecation in India.
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Motivation

India accounts for nearly 60% (626 million) of the world’s population that still engages in open defecation, making it the country with the highest rate of open defecation in the world. (UNICEF, WHO, 2012). Given India’s 7.0% GDP growth rate and other well-performing economic indicators, this high rate of open defecation is surprising (World Bank, 2018). Many explanations have been put forth trying to explain why open defecation remains such a widespread problem in India. Economic constraints include both demand and supply factors such as lack of access to latrines, high construction and maintenance costs. Many socio-cultural factors like social norms, cultural beliefs, social relationships have been found to affect an individual’s decision to openly defecate and adopt latrines (Routray et al. 2015; Coffey et al., 2017).

This paper focuses on understanding the relevant place-based networks as well as identifying the reference networks that are the most important to an individual’s decision to own, use a latrine and openly defecate. The survey data used in this paper is from research being done by Penn SoNG in association with the Bill and Melinda Gates Foundation. The motivation behind the research is the persistence of open defecation in India despite recent efforts by the Indian government’s Swachh Bharat Mission, other NGOs and international organisations to suppress it.

The Longitudinal Egocentric Networks and Norms Study (LENNS) was designed to elucidate the social determinants of toilet use and open defecation, with a focus on social norms and networks. It’s a research project spanning over three-years conducted in two Indian states – Bihar and Tamil Nadu. It is designed to identify the social factors that affect an individual’s choice to openly defecate and is divided into three phases. The first being a social network analysis, followed by an
analysis of social norms, and finally based on these findings, an intervention will be designed to encourage latrine usage which will be evaluated through a randomized control trial. It is currently in the third stage of the research.

This paper offers an analysis into how the places that people frequently visit, and how interactions with certain individuals affects their decision to openly defecate. Recommendations are also made about the most effective medium for interventions. The aim of this paper is to provide insight into which locations, people and mediums could be employed in the behaviour change intervention that is currently being formulated by Penn SoNG. This could help make this intervention and subsequent interventions more efficient and cost-effective.

**Background**

*Understanding the Problem*

According to the 1981 Indian Census, close to 99% of rural India defecated in the open. This meant that Indians defecate in open spaces such as in fields, bushes, along railway tracks and roads. According to data from the World Bank, in 1990, 75% of the Indian population defecated in the open, this had dropped to 44% in 2015. However, despite this drop poorer countries such as Bangladesh and Pakistan and even sub-Saharan countries have significantly lower open defecation rates (Figure 1).
The two states where the LENNS survey is conducted appear to be vastly different from one another - Tamil Nadu is one of the fastest growing states in India with a low poverty rate, while Bihar is categorised as a low-income state with relatively slow progress and a high poverty rate (World Bank, 2018). However, it is interesting to note that these two dissimilar states have one thing in common – according to the 2011 census, the rural open defecation rate in Bihar was 82.4% and 78.6% in Tamil Nadu.

Open defecation is a key public health concern with adverse health effects such as childhood diarrheal, polio and parasitic worm infections. Diarrheal diseases kill 7,00,000 children every year in India – most of which could have been prevented with better sanitation (Spears, 2012). About 43% of children in India suffer from malnutrition and a recent study found that a 10% increase in open defecation was associated with a 0.7 per cent increase in both stunting and severe stunting (Kundan, 2015). Human excreta are a major source of soil pollution, water pollution and contamination of food. The excreta of a sick person are the main source of infection as it contains the disease agent which can be transmitted to a new host through various channels: water, fingers, flies, soil and food (Figure 2).
A common assumption is that poverty and illiteracy are the leading causes of open defecation. However, according to a UNICEF-WHO report (JMP, 2012), India has a GDP per capita higher than 55 of the countries studied but 46 of them have lower open defecation rates than India. Correspondingly, poverty cannot serve as an explanation because the data shows that amongst 21 countries that have a higher proportion of the population living below the poverty line, 19 countries have lower open defecation rate than India. When we look at education levels, according to the Human Development Survey of India in 2012, 32% of rural households with members who hold a bachelor's degree or more, defecate in the open. The Sanitation Quality, Use, Access and Trends (SQUAT) survey that asked respondents why they openly defecate, three quarters said it was pleasurable, comfortable or convenient. Looking at the data based on gender, it found that men associated open defecation with masculinity and part of a morning routine, while women stated that they enjoyed the temporary freedom and sociality that open defecation provides (Coffey et al. 2014).
The survey also found that religious and physical impurity is associated with defecating in the house. Having a latrine near one’s temple and kitchen was considered unclean. The caste system also plays a large role in the prevalence of open defecation. The emptying of pits is a degrading form of labour that is associated with members of the lowest caste, Dalits. Respondents also hold false beliefs about the cost of cleaning the pits as well as the number of times the pits would have to be cleaned. The Census of India (2011) found that Indians either defecate in the open or use the most expensive sanitation options. Nearly 80% of the households using any sort of toilet or latrine use water closets, which was the most expensive option included in the questionnaire. The SQUAT survey also indicated that Muslims were more likely to take up the use of cheap latrines, compared to Hindus (Coffey et al., 2014).

In this way we see that research shows that many factors hinder adoption of latrines such as social norms, beliefs, sanitation rituals and daily routines that vary with caste, gender, age and lifestyle.

**Traditional Policy Approach**

To combat the serious sanitation challenges that India faces, several large-scale campaigns have been waged with a focus on open defecation (Routray et al., 2017). This section provides a brief overview of the multiple policies and programs that the Indian government has implemented over the decades to solve this problem.

One of the first attempts was Central Rural Sanitation Programme (CRSP) in 1986 by the then Prime Minister Rajiv Gandhi. This program provided subsidies for latrine construction for ‘below poverty line’ families and helped in increasing the rural sanitation coverage to 22 per cent by 2001 adding an incremental 1 per cent households with toilet facility every year. (Alok, 2010). An interesting project was Intensive Sanitation Project that was implemented in West Bengal which,
incorporated the concept of mass awareness and mass education to mobilise the youth. It used preachings from renowned saints like Swami Vivekananda and utilised a network of youth organisations with the aim of making them self-reliant (Prabhananda, 2003). With a focus on both below and above the poverty line families it provided low-cost latrines proving that subsidies weren’t the key motivator in sanitation campaigns. 85.62 per cent families who installed the low-cost toilets were satisfied and did not find any foul smell. This project influenced the structure of future government initiatives.

In 1999, the Total Sanitation Campaign (TSC) was launched with the objective of involving different stakeholders like Non-Governmental Organisations (NGOs), panchayats (village governing body) and other members of the community. It was intended as a demand-driven scheme in which, households request money from governments to build latrines themselves. This campaign used a traditional cash incentive where it provided a cash prize to the local government of villages that eliminated open defecation. Similar to prior programs, it focused on latrine construction and spent close to no money promoting community-level latrine use (Boisson, 2014). Over the 10-year life-span of TSC, there was only a 10% decrease in open defecation. 70% of the rural households did not own a latrine by the end of the campaign.

According to the 2011 Census, only 32% of rural India’s households had toilets. In 2012, the government launched Nirmal Bharat Abhiyan (NBA) or “Clean India Campaign” to succeed TSC. It aimed to accelerate the community led strategy of TSC, with a focus on sustainable behaviour change. This method lacked a well-defined implementation strategy and was poorly coordinated at the local government level. There was also a complete absence of any monitoring mechanism to keep a check on the government’s progress (Routray, 2017).
In 2014, Prime Minister Narendra Modi launched the $31 billion Swachh Bharat, or “Clean India,” mission with the aim of making India free from open defecation by 2019. This ambitious plan of constructing 111 million latrines during his five-year term focused more on latrine construction and less on the education required to convince people to change their habits. During his election campaign in 2018, Modi declared that 76% of Indian villages have been declared open defecation free with rural sanitation going up from 38% in 2014 to 94% in 2018. According to the Centre for Science and Environment, these findings reported by the Swachh Survekshan, a government run survey are prone to exaggeration due to poor quality data collection. The speed with which toilets were constructed during this period from 2014-2018 was much higher than past administrations’ efforts. However, mass construction and access to toilets does not necessarily guarantee usage. According to the Accountability Initiative, a Delhi-based research group that tracks government budgets - only about 2% of the Swachh Bharat Mission budget was spent on trying to convince people to use latrines (Kapur & Deshpande, 2018).

**Need for Behavioural Approach**

Aside from the construction of latrines, in order to reduce open defecation rates, efforts encouraging behaviour change need to be undertaken as well. A survey conducted done by the World Bank in five districts in the Indian state of Uttar Pradesh found that 40% of people who had toilets did not use them (Gauri, et al., 2018). The study found that people’s beliefs were closely tied to their perception of what others believed. There was also a significant positive relationship between social norms and latrine ownership. The research suggests that low-cost information campaigns can effectively improve pro-latrine beliefs and shift perceptions of what others find acceptable. Another study conducted in Dharmapuri, a district that has the highest rate of open defecation in Tamil Nadu also found that 54.8% of the respondents chose to defecate in the open.
despite having access to a latrine (Yogananth & Bhatnagar, 2018). Most respondents failed to recognise the health benefits associated with latrine use and not openly defecating. These studies highlight the need for more education campaigns and communication that advocates that a pit-latrine is safe and scientific, easily built, costs less, easy to empty, and the waste can be used as manure.

A survey conducted by the Research Institute for Compassionate Economics (RICE) contradicts the Indian government’s claims that open defecation has been eliminated from certain states (Gupta et al., 2019). It reports that between 42% to 57% of rural people in Uttar Pradesh, Bihar, Rajasthan and Madhya Pradesh over two years of age defecate in the open, with a preferred estimate of 43%. Another finding indicated that 40% of households with a latrine have at least one person who defecates in the open, and 56% of all households have at least one person who defecates in the open in rural areas in these states. When looking at the effect of the Swachh Bharat Mission, it found that in the four states, open defecation fell from about 70% of people in 2014 to about 44% of people in 2018.

An interesting finding is that the RICE study reports that nearly the entire change in open defecation between 2014 and 2018 comes from increases in latrine ownership, rather than from changes in behaviour. This is contrary to other studies but is consistent with the findings from Phase 1 of Penn SoNG’s LENNS survey, which we will see in the results analysis section of this paper.

The study also reports that the Swachh Bharat Mission (SBM) routinely used coercion and threats to achieve toilet construction and use. Coercion included harassment, fines, denial of public benefits, and in some cases even detention by the police. They find that people from two castes – scheduled caste and scheduled tribe were more likely than households from other social groups to
report experiencing coercion. More than half of households in the focus states are aware of some form of coercion in their village. These kind of coercion tactics will not lead to sustained behaviour change.

Collective - behaviour change initiatives that include encouraging the entire community to change their behaviour together have been incredibly effective in other countries. For example, Community-Led Total Sanitation (CLTS) is a widely used participatory approach to stop open defecation that was developed in Bangladesh (Galbraith & Thomas 2009; Kar & Chambers 2008). By generating demand for toilets in a community by triggering feelings of disgust. Under CLTS, those who resist switching away from open defecation are to be shamed into compliance by their neighbours. This campaign has led to a reduction in open defecation rates from 42% in 2003 to 1% in 2016. In India, however, this method was not very effective (Patil et al., 2014).

Another method to change the status quo could be using “trendsetters” (Bicchieri, 2018). When attempting to abandon a pre-existing norm, these individuals are the first to transgress. If their actions are readily observable, it can influence the behaviour of others and lead to change in the social norm. This paper will furnish suggestions about individuals who could potentially serve as trendsetters.

The problem of open defecation in India is incredibly complex and in order to tackle it, we will now attempt to understand the social norms and networks that affect people’s decisions in order to implement effective behaviour change interventions.

**Problem Analysis through a Social Norms Lens**

Why do people do what they do? That is the basic question raised by the theory of social norms that allows us to identify the cause and drivers of human behaviour (Bicchieri, 2006). It is crucial
to understand the reasons that lead people to engage in harmful collective patterns of behaviour as misidentification of the causes can lead to the failed attempts to change the behaviour.

In this paper, the harmful behavior that we aim to understand is the practice of open defecation in the Indian context. To make a shift from harmful practices like open defecation, we must analyse the driving forces and diagnose the behaviour correctly.

The two main drivers of behaviour are norms and networks (Bicchieri, 2018). It is possible for certain networks to lead to the formation of norms. On the other hand, new norms or the abandonment of old ones can lead to networks splitting or being dissolved. In this way, there is a causal influence of norms and networks on each other and on behaviour (Figure 3). A schematic description by Penn SoNG betters helps us understand this relationship and its effect on behaviour net of other factors (accounted for through random error $\varepsilon$). In this paper we will briefly describe the norms that potentially affect open defecation practices. In this paper, the focus will be on the networks that are important to an individual that engages in open defecation.

![Figure 3: Causal diagram showing the dynamics of influence of norms and networks on behaviour (Bicchieri, 2018)]
Understanding Norms

This diagnosis requires a thorough understanding of the various measurable concepts that form the basis of interventions that aim to bring about social change (Bicchieri, 2016).

The first distinction we will look at is the difference between independent and interdependent behaviours. An independent behaviour is when people behave in a certain way regardless of if others behave that way or if others think they should behave that way. An interdependent behaviour on the other hand is when an individual behaves in a certain way due to other people behaving in that way or because other people think they should behave in a certain way. Past research has shown us that open defecation is often an independent behaviour. Individuals defecate in the open not because others in their community are doing so, rather due to the convenience open defecation provides them (Bicchieri & Noah, 2017).

The second distinction is between factual and personal normative beliefs. Factual beliefs are beliefs about how the world is, while personal normative beliefs are beliefs about what people should do. It is possible that factual beliefs are wrong or false. For example, people may believe that open defecation is a fertilizer and not harmful or that children’s feces are safe. Personal normative beliefs are of two types – prudential and non-prudential beliefs. Prudential personal normative beliefs are beliefs about what people should do based on their best interest. For example, a ‘real’ man should not use a latrine. Non-prudential personal normative beliefs are beliefs about what people should do based upon morality or religious beliefs. For example, people should defecate away from their homes to avoid the smell of feces (Bicchieri, 2016).

The third distinction is the one between empirical and normative expectations. Empirical expectations are beliefs about what we expect others to do. For example, the belief that everyone
in the village practices open defecation or that most people don’t build latrines. Normative expectations are beliefs about the personal normative beliefs held by others, that is, what we believe others think we should do. For example, the belief that others in the village think that one should not defecate in the open. Similar to factual beliefs, it is possible that these empirical and normative expectations held by people are either true or false.

The fourth difference we will look at is between conditional preferences and unconditional preferences. Preferences are dispositions to act in a certain way in a certain situation and are linked to choices. Preferences are conditional upon empirical and normative social expectations. A preference is conditional when one prefers to engage in that behaviour due to others engaging in that behaviour (empirical expectations) or if others think they should engage in that behaviour (normative expectations). A preference is unconditional when one prefers to engage in a behaviour regardless of whether others engage in the behaviour or whether others think they should engage in the behaviour (Bicchieri, 2016). For example, if one prefers to engage in open defecation irrespective of if others in the village do so or think they should do so, then that behaviour is an unconditional preference. Further, we will analyse the factor that shapes these preferences and expectations.

Understanding Networks

The fifth concept in the theory of social norms is of a reference network. This is made up of individuals whose behaviours and beliefs matter to ones’ choice. One’s reference network depends on the situation and type of behaviour being undertaken at that time (Bicchieri, 2016). Social networks are the sets of actors and relational ties that form the building blocks of human social experience. Our beliefs, preferences, expectations and choices are shaped by our networks of social
relationships (Granovetter, 1985). Networks can be used to transmit new information or reinforce existing beliefs. For example, the people who affect one’s choice to openly defecate can vary from their neighbours and the village religious authority to more famous personalities depending on the situation.

In a social network, characteristics of communities like trust and cooperation are a result of the relationships, rather than the individuals. An important aspect of these relationships is their strength (Granovetter, 1973). Strong relationships are characterized by a high frequency of contact or by a high level of emotional intensity. They can be influential in bringing about social change and increasing the number or quality of interactions can strengthen these relationships. If people

Research done in rural India has found a link between community and behaviour. A study showed that individuals were more likely to own a latrine if their social contacts owned latrines and this relationship was stronger among those of the same caste, education and stronger social ties (Shakya, Christakis, & Fowler, 2015). One network perspective is that increasing the density of social relations can also improve the civic culture or “social capital” of a community (Putnam, Leonardi, and Nanetti 1993). Community driven development programs can incorporate this idea of social capital. One strategy involves targeting individuals within a network that can leverage social influence to shift existing behaviour patterns.

To create comprehensive, evidence-based interventions, it is important to first test how social networks and social motivations vary across different settings. In this paper, the focus is on understanding how place-based networks affect an individual’s decision-making process. Place-based or location-based social networks are networks that form not through connections between individuals, but the connections of different individuals to the same location. It also leads to the adding of a location to an existing social network so that people in one network have a shared
location where information can be exchanged (Zheng, 2011; Barca, 2008). Research has shown development interventions should incorporate a place-based approach in their strategies to utilise the potential of the regional assets available (Barca, 2012). Interactions in these location-based social networks can be used to influence an individual’s behaviour and the degree with which an individual is affected could depend on the frequency of their visits to that location.

In this paper, we provide an in-depth analysis of place-based networks in Bihar and Tamil Nadu. This could help design promising policy interventions that harness the influence of certain locations in networks to spur social change.

**Diagnosing Behaviour**

![Figure 4: Diagnostic chart for identifying a collective pattern of behaviour (Bicchieri, 2016)](image)

Using these five concepts, we can identify four types of collective patterns of behaviour – customs, moral norm, descriptive norms, and social norms (Figure 4).
When a behaviour is independent, it can be one of two types of behaviour – a custom or a moral norm. A custom is a habitual pattern of behaviour that people conform to because it meets a need or is useful. Customs rely on factual beliefs and social expectations (empirical and normative) do not matter. In most scenarios, the default assumption is that open defecation is a custom (Bicchieri & Noah, 2016). One may have factual beliefs about openly defecating as it meets one’s basic need and is a convenient option. It is also possible that it facilitates certain useful social interactions. On the other hand, a moral norm, is a behaviour that people conform to because they think it is the right thing to do. Moral norms are generally not relevant to harmful sanitation behaviour like open defecation because most people don’t engage in open defecation because it’s the morally required thing to do.

While open defecation might be a custom, it’s worth analyzing whether it is affected by any other surrounding norms. When a behaviour in interdependent, it can be one of two types of norms – descriptive norms or social norms. A descriptive norm is a collective pattern of behaviour that people prefer to conform to on the condition that most people in their reference network do it. Therefore, these norms are conditional only on empirical expectations and not on normative expectations. With open defecation, however, merely having information about others using latrines would not be enough to bring about a change in behaviour.

On the other hand, a social norm is a pattern of behaviour that individuals conform to given that most people in their reference network conform to it and most people in their reference network believe they should conform to it as well. In this way, social norms are affected by both empirical and normative expectations. Social norms often rely on informal sanctions like praise, gossip, social embarrassment and isolation. In India, past research has shown that norms surrounding
gender, purity, caste affect the sustainability of sanitation programs (Coffey et al., 2017). It is possible to use social norms to exert social pressure to get people to stop openly defecating.

The social expectations of certain social networks could influence one’s behaviour. For example, people can be told that open defecation is not an accepted practice by their reference network, and it is strongly disapproved of by them (Bicchieri & Noah, 2016). Identification of the appropriate reference network for latrine use is a critical step prior to attempting to change existing norms.

**Measurement of Behaviour**

The most critical step of the social norm theory is measuring the beliefs, behaviours, and expectations held by the concerned individuals. It is only with an understanding of these factors can we begin to formulate successful interventions. We will briefly go over the methods that were utilized by the survey conducted by Penn SoNG to collect information about each of the concepts discussed above.

The first step is to measure the reference network, and this can be done through three methods – the full network approach, the snowball approach and the egocentric approach. The method chosen by them is the egocentric approach. This method is cheap and is useful in collecting information on who influences the specific respondent or at least who the respondent perceives as having an influence on them (Bicchieri & Noah, 2016). The next step is behaviour measurement, which can be done through two approaches – monitors and self-reports. This survey uses the self-report method as it is relatively cheaper, easy to administer and easy to scale.

Information was collected about the basic socioeconomic characteristics like health, and caste; household information like ownership status; and toilet ownership and usage information. The survey also asked specific questions to measure respondents’ preferences, empirical expectations,
normative expectations, and beliefs. For example, factual beliefs about the latrines, consequences of latrine use and open defecation.

Given the focus of this paper on networks, we will mainly utilize the egocentric network data. Prior to this survey, there was only anecdotal evidence and a few peer-reviewed articles about the networks and the surrounding norms that are relevant to latrine usage. This network survey data provides information about social norms and the reference networks that affect an individual’s decisions about latrine use and open defecation. The three main aspects we will analyse include the data about individuals with whom respondents interact, locations that respondents frequently visit as well as individuals’ respondents respect the most.

Results and Analysis

Descriptive Statistics

In this section, an overview of basic socio-economic characteristics such as gender, age, caste, religion, house ownership, latrine ownership and health status are provided. This PennSoNG survey data consists of a total of 3370 respondents from two states in India – Bihar and Tamil Nadu. A total of 3370 respondents were surveyed - 1702 respondents from Bihar (50.5%) and 1668 from Tamil Nadu (49.5%).

Demographic Characteristics

The survey population was between the ages of 16-65. Looking at the distribution by gender, women make up of 55.1% of the respondents in Bihar and 47.1% of the respondents in Tamil Nadu. A majority of the respondents identified as Hindus – 73.6% in Bihar and 85.4% in Tamil Nadu. 26% of the population in Bihar and 7.9% of those in Tamil Nadu identified as Muslim. In
Tamil Nadu, 6.5% identified as Christian. Next, we look at the social class which is divided into four main categories – general, scheduled class, scheduled tribe and OBC (other backward classes). In Bihar, 49.6% of the respondents identify as OBC and 23.3% identify as Scheduled Caste. In Tamil Nadu, 39.8% stated that they are a part of the General category, 39.1% belong to Scheduled Caste and 17.2% identify as OBC.

**Economic Factors**

Looking at homeownership status, we see that 96% of the population in Bihar owns the house they are currently living in, while that’s 77.6% of the population in Tamil Nadu. 20.2% of Tamil Nadu’s respondents are renting their current accommodation. 89.8% of the respondents in Bihar and 99.3% in Tamil Nadu have electricity supply. 53.7% of the respondents in Bihar and 32.9% in Tamil Nadu have access to water in their dwellings. In Tamil Nadu, 43.3% of the population gets access to water from elsewhere. When asked if their health status was better or worse than two years ago, most of the respondents (54.2%) reported that it was about the same. With regards to life satisfaction, 26.3% claimed that they were very satisfied and 66.8% claimed that they were satisfied.

**Latrine Ownership and Open Defecation**

A little over half the respondent population in Bihar (54.3%) and Tamil Nadu (59.4%) are the sole owners of latrines or share them with other households. The rest of the respondents do not own a latrine (Figure 6). When respondents were asked about access to a community toilet, 88.9% of Bihar and 49.8% of Tamil Nadu lacks access to one (Figure 5).

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1 Scheduled Castes, Scheduled Tribes and OBC are officially designated groups of historically disadvantaged people
43.7% of respondents in Bihar and 32.3% of those in Tamil Nadu stated that the last time they had to defecate, they openly defecated (Figure 7). When respondents were asked about where they openly defecated, 55.6% of the respondents in Bihar stated that they defecate in someone else’s field, while 45% in Tamil Nadu said that they used public open spaces of railway tracks (Figure 8). On average, it took them 17 minutes to walk to where they openly defecated.

In terms of religion, previous work has found that rural Muslims are more likely to have and use toilets compared to rural Hindus (Geruso & Spears, 2015; Coffey et al., 2017). In Bihar, Hindu
respondents had a lower proportion of those who reported that they openly defecated compared to Muslims. While in Tamil Nadu, Muslims were less likely to openly defecate compared to Hindus and Christians.

In terms of gender, this survey shows that men (37.2%) and women (38.9%) are equally likely to openly defecate. This is contrary to prior research that found that men are more likely to openly defecate compared to women (Coffey et al., 2014). According to 32.7% of respondents in Bihar and 47.5% of respondents in Tamil Nadu, defecation locations vary for men and women. We also see that 37.4% of women state that they have someone accompany them when they openly defecate, with 40% citing safety and 30.2% citing socializing as a reason for this. This finding ties in with past data from the SQUAT survey, which showed that women reported enjoying the temporary freedom and sociality that open defecation provides (Coffey et al., 2014).

One of the main findings from this survey is that those who own a latrine are less likely to openly defecate. When we compare latrine ownership against open defecation, we see that 93.1% of those who don’t have a latrine openly defecate, while 76.3% of those who own one don’t openly defecate. This is an interesting observation, because this result is contrary to prior research which shows that despite owning a latrine, people reported that they did not use it (Coffey et al., 2014, 2017; Clasen 2014; Routray et al, 2015).

This is consistent with the claim that the primary driver of latrine use is latrine ownership. When respondents were asked why they openly defecate, 93% in Bihar and 60% in Tamil Nadu stated the lack of access to a latrine was the main reason. It is important to note that it is possible that this observed finding is influenced by prior behaviour change campaigns or that latrines were constructed mainly by individuals who are more likely to use toilets compared to others. Further
research is needed to explain the discrepancy in this finding and prior research before any causal relationship is inferred. This high correlation between latrine ownership and usage suggests that one potential strategy to reduce open defecation could be to formulate interventions focused on latrine construction.

Inferential Statistics

This analysis is divided into 3 parts – first we look at the locations that respondents visit the most, and then we analyse the interactions between respondents and the individuals with whom they interact with the most frequently. Finally, we look at effectiveness of past interventions and communication strategies.

Analysing Location Based Networks

Here, the focus is on understanding place-based networks. Specifically, we look at the relationship between open defecation rates and the frequency with which respondents visit certain locations. We also look at whether the respondent’s gender plays a role in determining the locations they frequently visit and how that affects their likelihood to openly defecate. In the survey respondents were asked how many times in the last month they had been to certain locations and we attempt to analyse this data. The method used to conduct this analysis is the logistical regression method since the outcome of interest (open defecation) is binary.
The first regression we run is between temple visits and whether respondents openly defecate or not. This shows us that there is a significant relationship between the two at the 0.001 level (Table 1). The negative coefficient (-0.025) highlights that a negative relationship exists which is interpreted as the expected change in log odds for a one-unit increase in the number of visits to the temple. The odds ratio was calculated by exponentiating this value and next the probability was calculated. We see that for one visit to the temple, we expect to see a 39.5% increase in the probability of an individual not openly defecating.

An overview of the temple data shows us that on average people visit the temple three times and the 3rd quartile shows us that 75% of the people visit a temple 4 times a month. Based on this information, we calculate the odds ratio and probability for people in the 3rd quartile. For four visits to the temple, we expect to see a 72.3% increase in the probability of an individual not openly defecating.
In the second regression, we interact gender and temple visits to see the collective effect of both variables on open defecation (Table 2). An interaction effect is a multiplicative or additive effect that estimates to what extent the effect of one independent variable is dependent on or moderated by another independent variable. This interaction analysis therefore provides insight into how temple visits are moderated by another extrinsic force - gender. Interaction effects provide a more nuanced analysis into how each variable collectively influence whether respondents openly defecate. If we look at the first-order effect, we see that the coefficient of temple visits remains consistent with our initial regression analysis.

The higher-order effects are what we’re interested in for this model, show us that the interaction between gender and temple visits have a significant relationship. For one visit to the temple, we expect to see a 38.4% increase in the probability of a man not openly defecating. Given that 75% of the people visit the temple 4 times a month, a 71.4% increase in the probability of a man not
openly defecating. On the other hand, for a woman who visits the temple once, there is a 40.8% increase in the probability of her not openly defecating. Similarly, with 4 visits, there is a 73.4% increase in the probability of a woman not openly defecating.

Temple and Religion

Hindus visiting Temples

Given that a majority of our respondents are either Hindu or Muslim, we look at how followers of each religion are affected by their visits to temples and mosques. First, we look at Hindus and run a logistical regression between visits to Hindu temples and open defecation. We find that there is a significant relationship at the 0.01 level in this analysis. Similar to our first regression, we see that for one visit to a temple, we expect to see a 39.1% increase in the probability of a Hindu not openly defecating. Again, the 3rd quartile shows us that 75% of Hindus visit a temple 4 times a month. For four visits to a temple, we expect to see a 71.9% increase in the probability of a Hindu not openly defecating. We also look at whether adding gender in this analysis affected the results, however, there were no significant results for that interaction.

Muslims visiting Mosques

Further, we consider the number of times Muslims visit mosques and how that affects open defecation. There is a significant relationship at the 0.05 level for this regression. Similar to our first regression, we see that for one visit to a mosque, we expect to see a 42.3% increase in the probability of a Muslim not openly defecating. An overview of the mosque data shows us that on average as well as in the 3rd quartile, Muslims who visit the mosque four times a month. For four
visits to a temple, we expect to see a 74.6% increase in the probability of a Muslim not openly defecating.

Upon interacting visits to the mosque with gender in this analysis, we see that there are multiple significant relationships. If we look at the first-order effect, we see that the coefficient of gender (0.572) is significant at the 0.05 level. Looking at the higher-order effect, we see that the coefficient of the interaction between gender and mosque visits has a significant relationship at the 0.001 level. We calculate the odds ratio and probability to see that for one visit to the mosque, we expect to see a 39.6% increase in the probability of a Muslim woman not openly defecating. Given that in the 75% of Muslims visit a mosque 4 times a month, we calculate the odds ratio and probability for these people. For four visits to the mosque, we expect to see a 72.4% increase in the probability of a Muslim woman not openly defecating.

Other Locations

A similar regression analysis was conducted looking at open defecation against the other locations asked about in the survey. The interaction effect of gender with these various locations was also studied. No significant relationship was found for visits to community meetings, the market place, the place where they play cards, drinking place or government meetings.

Significant relationships were found for three locations – movie theatres, funerals, and street play (naatak) locations. For movie theatres and funerals, there was no significant relationship between visits and open defecation, however, upon adding the interaction with gender we see a significant relationship at the 0.05 level. For one visit to the movie theatre, a 43.5% increase is expected in the probability of a women not openly defecating. For one visit to a funeral, a 34.7% increase is
expected in the probability of a women not openly defecating. It is important to note that the mean and quartiles for visits to both these locations in a month are close to zero, therefore, we cannot make any inferences about how the frequency of their visits affects open defecation.

There is a significant relationship between visits to street plays and open defecation at the 0.01 level. For one visit to a street play, a 40.7% increase is expected in the probability of an individual not openly defecating. There was no significant relationship when gender was interacted in this analysis. Like the other two locations, the mean and quartiles for visits to street plays in a month are close to zero so no further analysis was done with these variables.

In summary, according to this analysis, temples and mosques were the most frequently visited locations in the network. One potential recommendation is that any future interventions aiming to bring about behaviour change could incorporate these locations in their outreach strategy.

**Analysing Number of Interactions**

An attempt has also been made to understand which, individuals’ respondents interact with most frequently and how that affects open defecation. The respondents are asked how often they speak to their landlord, village headman, religious/traditional authority, police officials, political party mediators and NGO representatives. An interaction with gender was also made to see if that affected the frequency with which visits took place.
Village Headman

The most significant relationship was with the village headman (Table 3). There is a significant relationship at the 0.01 level between those who visit the village headman at least once a week. The odds ratio and probability are calculated to see that for one meeting with the village headman, a 47.2% increase in the probability of an individual not openly defecating is expected. If they visit the headman at least once a week, that means they visit him/her at least 4 times in a month. For four visits to the headman in a month, a 78.1% increase in the probability of an individual not openly defecating is expected.

Next, we will look at the higher order effects in this interaction with gender. For men who visit the village headman at least once a week, the relationship is significant at the 0.05 level. Since once a week means that they make a minimum of 4 visits in a month, we see that for four visits, a 70.6% increase in the probability of a man not openly defecating is expected. A significant relationship at the 0.05 level is seen when gender is interacted with the visits to the headman once a month.
For men with one visit to the headman in a month, a 41.2% increase in the probability of not openly defecating is expected. For women with one visit to the headman in a month, a 26.9% increase in the probability of not openly defecating is expected.

Other Interactions

For landlords, there is a significant relationship at the 0.01 level for those who visit their landlord less often than once a month and at the 0.05 level for those who visit at least once a month. There was no significant relationship with the gender interaction. However, since there are very few respondents who answered this question, no further analysis was done with this variable. For religious authority, police officials, political party mediators and NGO representatives most of the respondents stated that they had never spoken to one.

This information helps understand which organisational actors play a key role in a specific community and who might be best suited to lead the charge in behaviour change interventions.

Analysing Intervention Data

Respondents were asked if there had been any interventions in their community encouraging them to wash their hands or use latrines – 95.7% stated that there had been no interventions. When asked specifically if they had participated in the Modi government’s Swachh Bharat Abhiyan (Clean India Mission) – 91.8% stated that they had not participated in the government’s efforts (Figure 9). Upon running a logistical regression with open defecation and conducted interventions, it can be seen that there is a significant relationship at the 0.01 level. If interventions were conducted, the probability of individuals not openly defecating increased by 26.2%
Informal strategies can also be effective for changing norms. The use of mass media such as advertisements is one such for spreading information about behaviour change. This analysis aims to help identify the most efficient mediums of communications.

Respondents were asked if they had ever seen advertisements promoting latrines and 57% responded positively stating that they had. Running a regression shows us that there is a highly significant relationship between open defecation and viewing latrine advertisements at the 0.001 level.

Table 4: Logistical Regression Model with Open Defecation and Viewed Advertisement

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Open Defecation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seen Advertisements</td>
<td>-0.811***</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.044</td>
</tr>
</tbody>
</table>

Observations: 3,370
Log Likelihood: -2,175.017
Akaike Inf. Crit.: 4,354.033
level. If an individual sees an advertisement on latrines, the probability of them not openly defecating go up by 29.8% (Table 4).

Next, we will look at the different mediums of advertisements used and analyse their effect on open defecation behaviour. Namely, the mediums that were asked about are radio, newspapers, billboards and television. Of those who said they have seen advertisements promoting latrines, 90% of the respondents had not heard radio advertisements and 75.6% had not seen advertisements in the newspaper. Both television and billboard advertisements were popular mediums of communication. 40.4% of the respondents had seen billboard advertisements and upon running a regression, we see that there is a significant relationship between open defecation behaviour and billboard advertisements at the 0.001 level. The probability of not openly defecating for individuals who saw billboards advertisements increases by 35.1%. When we look at television advertisements, 92.1% of the respondents had seen television advertisements related to latrines (Figure 10). Of those who had seen them, 93.8% did not openly defecate, and 88% did openly defecate.

Table 5: Logistical Regression Model of Open Defecation and Viewed Television Advertisements

<table>
<thead>
<tr>
<th></th>
<th>Dependent variable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Defecation</td>
<td></td>
</tr>
</tbody>
</table>

|                      |                      |                      |                      |
|----------------------|----------------------|----------------------|
| Seen TV Advertisements| -0.735***            | (0.171)              |
| Constant             | -0.185               | (0.163)              |

<p>| | |</p>
<table>
<thead>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>1,920</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-1,161.404</td>
</tr>
<tr>
<td>Akaike Inf. Crit.</td>
<td>2,326.809</td>
</tr>
</tbody>
</table>

Figure 10: Bar Plot of Open Defecation by viewed TV Advertisements
A logistic regression with open defecation and viewed television advertisements shows us that there is a significant relationship at the 0.001 level (Table 5). For an individual who has seen a television advertisement, the probability of not openly defecating increase by 28.5%.

This analysis shows us that television and billboard advertisements would be the most efficient medium with which to communicate with these respondents and this information can be used during the formulation of the behaviour change intervention by Penn SoNG.

**Identifying Trendsetters**

Sunstein (1996) coined the term “norm entrepreneur” for those individuals who are highly-central to a social network or have a high status in society. According to this research, these people can play a critical role in effecting social change. Four methods are recommended to make their dissatisfaction clear – they could signal their own commitment to change, create coalitions, make defiance to norms seem less costly and lastly, they could make compliance with new norms seem or be more beneficial. If successful, they create what he calls “norm cascades” or “norm bandwagons” that could lead to collective change. Political actors could also serve as these “norm entrepreneurs” and voice their private dissatisfaction with an existing norm in order to bring about social change on a large-scale.

Bicchieri and Funcke (2018) call individuals who have a low threshold for norm abandonment and are the first transgressors of the norm “trendsetters”. The actions of these individuals can lead to a cascade of behaviour change as people want to emulate the behaviour of these trendsetters. By speaking out about the merits of a certain behaviour and endorsing it, it can provoke conversations that can lead to the creation of a new norm. We attempt to identify these individuals who could
serve as trendsetters based on our data. For this, we look at people who respondents respect the most outside of their community and conduct an exploratory text analysis of their responses.

In Phase one of their research, Penn SoNG found that in response to the question about who they respect the most in their community, people are most likely to think of family members (Bicchieri et al., 2017). When more specific questions regarding toilet use were asked, fewer names were generated, suggesting that despite government programs, conversations regarding toilet use and open defecation are not as prevalent as expected.

Then, the respondents were asked who they respect most outside of their community and this is the question of interest for this analysis. A graphical representation of the responses is presented below in the form of a word cloud (Figure 1). This is a form of visualisation that is based on word frequencies and greater prominence is given to names that appear more frequently. The larger the word, the more common the word in the document. We can see that the most respected person by far is Prime Minister Narendra Modi, who is by far the second most followed politician in the world on social media. The other names that follow are mainly politicians – Jayalalitha, who was the Chief Minister of Tamil Nadu; Nitish Kumar, who is the current Chief Minister of Bihar and Maruthur Gopala Ramachandran (M.G.R) who was the Chief Minister of Tamil Nadu in the past. Actors were also widely well-respected, and they include Ajith Kumar, Vijay and Rajinikanth who are famous Tamil actors.
A look at the people respondents respect second most shows us an interesting result (Figure 12). The second most respected people were all cricketers. India’s love for cricket has always been incomprehensible, garnered by frenetic exuberance, during the India - Pakistan match in the 2019 World Cup 229 million Indians tuned in, the semifinal attracted around some 320 million viewers indicating the sheer intensity and attractiveness towards the sport. Much like the sport the people behind it fetch a lot of veneration too. The man who topped the list is the current captain of the Indian cricket team Virat Kohli, deemed to be the mascot of 21st century cricket, according to Autumn World in 2016 averaged on 12 lakh conversations on twitter in one month alone also to be titled as the 8th most famous sportsman in the world. He was followed by former captain Mahendra Singh Dhoni and another famous cricketer Sachin Tendulkar, who in 2014 received
India’s Highest civilian honour - The Bharat Ratna. These individuals were also popular names in the first question about who is respected the most. They were followed by a famous Bollywood star Amitabh Bachan, who was ranked no.1 in the YouGov Influencer Index of Indian celebrities in 2018 and the Tamil actors mentioned above.

From this analysis, we see that the most influential people fall into three categories – politicians, cricketers and actors. These individuals could serve as “norm entrepreneurs” (Sunstein, 1996) and “trendsetters” (Bicchieri, 2018) who leverage their status and recognition to become powerful sources of change.

**Policy Implications**

Phase two of the LENNS project found that while progress has been made by the government’s Swachh Bharat initiative and international organisations like UNICEF, open defecation rates in rural areas are still high with 45% of the respondents stating that they only openly defecated in the past week. Coverage also remains an issue for poor and marginalised populations and latrine usage given ownership still has room for improvement. 63% of the respondents in their sample owned a
toilet and almost half of the rural respondents (47%) did not own a toilet (Bicchieri et al., 2018). There was also a clear divide in urban and rural toilet access suggesting that continued efforts are required, especially in rural areas. Other issues include false beliefs about the expense associated with emptying out their own pit can serve as a barrier to construction and usage (Coffey & Spears, 2017). Efforts that rebrand the soak pit as inexpensive and not dirty in order to make it acceptable for everyone are essential.

From the government’s standpoint, the reported use of coercion tactics to encourage latrine uptake should be investigated as well (Gupta et al., 2019). One step in the right direction is the change in the government’s measure of open defecation. The measure in the past had been the number of latrines constructed. The SMB guidelines state that they will use the improved approach of focusing on monitoring toilet use, not just construction.

The structure of networks influences how information spreads and place-based networks could play an important role in behaviour change. They could be used to spread information about latrine construction programs, correct beliefs about the cost of construction, and discouraging open defecation. Network members may be informed about this information through direct communication, observation or advertisements. Based on the findings of this analysis, a few recommendations can be made regarding the best communication strategy for the upcoming LENNS intervention.

In terms of locations, our analysis of place-based networks found that temples and mosques are frequently visited by both men and women. 75% of the respondents made four visits and we saw that for four visits, the probability of an individual not openly defecation went up by approximately 70%. This tells us that using these locations in behaviour change interventions could be beneficial.
Future research could try to analyse if individuals have strong ties with others who frequently visit these locations and if so, leverage those connections as well.

Next, we looked at individuals respondents interact with most and found that there was a significant interaction between open defecation and visits to the village headman. Both men and women stated that they visited the village headman at least four times a month and we found that for an individual who visits the village headman four times, the probability of the not openly defecating increase to 70%. We also conducted a text analysis to understand who respondents respect the most out of their social network and found that the most respected man was Narendra Modi. He was followed by other politicians like Jayalalitha and Nitish Kumar. In terms of who respondents respect the most after these politicians we found that cricketers like MS Dhoni, Virat Kohli and Sachin Tendulkar were the most respected. This shows us that community leaders at the village level and politicians, crickets and certain actors at the national level can have a significant positive impact on an individual’s choices. They can serve as “norm entrepreneurs” (Sunstein, 1996) and “trendsetters” (Bicchieri, 2018) who mobilise the masses and spread behaviour change.

Data regarding participation in Swachh Bharat campaigns and other interventions was also analysed and we saw that the rates of participation were incredibly low. From this we can infer that the success of these interventions will be limited unless steps are taken to increase awareness levels through methods such as campaigns. Our research also analysed advertisement data and found that the most successful medium of advertisements is the television, followed by billboards and posters. All these insights can be utilised by Penn SoNG as they design the intervention for Phase three of their research project.
The LENNS intervention design approach will leverage theory and evidence to guide decisions. The use of norms and a network-centric design to change open defecation behavior in India makes it a unique endeavour. Following the intervention, the effectiveness will be studied through a randomised control trial in Bihar and Tamil Nadu. If the incorporations of this paper’s recommendations in the LENNS intervention leads to significant behaviour change, this could have a substantial effect on future sanitation program efforts. Government policies and programs such as Swachh Bharat could be refined to integrate these aspects in their interventions.

**Conclusion**

“Human sociality is like a river running through society; it is a current constantly shaping individuals, just as flowing water shapes stones in a riverbed. Policy makers can either work with these social currents or ignore them and find themselves swimming upstream.” (World Bank, 2014)

In the past, most of the standard economic policies that we reviewed focused on using subsidies and other incentives to eliminate open defecation. They failed to account for social factors like one’s beliefs, social norms and networks that play an influential role in eliciting desired behaviour patterns. Under the Swachh Bharat Mission, the Modi government is focusing more on behaviour change to improve sanitation practices compared to any past administration. India is currently implementing one of the world’s largest collective behaviour change movements for rural sanitation. This seems appropriate given that India still has one of the largest rates of open defecation in the world. The scale at which this campaign to eliminate open defecation has been carried out is unprecedented.
With the findings from this paper, we hope to contribute to both Penn SoNG’s upcoming intervention as well as the literature on social networks and trendsetters in the Indian context. Penn SoNG’s research is the first study assessing and addressing the social determinants of open defecation through social networks and social norms in Indian communities. It will have an invaluable impact on designing cost-effective social interventions. Only when existing policies like Swachh Bharat recognise the power of social norms and influence will India finally achieve its goal of eliminating open defecation.
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