Understanding the Narratives and Framing of Air Pollution in Delhi, India

This research seeks to develop an understanding of the framing of the issue of air pollution in Delhi, India. Our research aims to identify people involved and how these policy actors are framing the causes, effects, and solutions for air pollution. With an understanding of how policy actors, including the news media and environmental nonprofits, are framing the air pollution issue, we provide insight into how individuals perceive the issue.

Two innovative approaches are used to explore the framing: (i) a deductive approach that focuses on the stories told via online documents guided by the Narrative Policy Framework (NPF); (ii) an inductive approach of news media coverage of the issue using automated text coding. The combined deductive and inductive approaches as well as insights from the site visit provide a systematic and multi-method research study for understanding air pollution in one of the largest cities in the world.

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Urban sustainability is a complex challenge, especially in developing countries that have infrastructure or administrative capacity concerns when meeting the needs of their rapidly growing populations. Policymakers face complex challenges of addressing climate change coupled with water scarcity, environmental concerns, public health needs, and demand for economic growth. In addressing these multiple and interdependent priorities, sustainability is often sacrificed for immediate gains. In deciding how to prioritize different sustainability goals, policymakers often respond to the opinion of the public and experts. Those opinions can be framed or depicted in the media and publicly consumable documents, which influence the public and policymakers’ opinions (Shanahan et al. 2008). In this paper, we explore the issue of air pollution in one of the world’s most polluted megacities Delhi, India by asking: *How is the air pollution issue in Delhi being framed by the mass media and nonprofit organizations?* This research uses two complementary methods of data collection: a large-n study of newspaper articles that have wide readership and a small-n study of documents published by nonprofit policy activists.

This paper will first review framing theory and its applications. The two methods, automated text coding and the Narrative Policy Framework, are then presented, followed by results and a discussion of the implications of the study. Exploring the frames of an issue through mass media and publicly consumable documents is an innovative way to clarify not only how an issue is being described but also lends understanding to policy actors’ perceptions and priorities. Uncovering the logic behind the construction of information and information processing can lend meaning to state action (Surel, 2000).

# Theory

Frames construct a main storyline that connects a sequence of events or ideas and provides meaning to them (Druckman, 2001). For value-laden issues such as air pollution, the frames guide what the issue is about and bound the controversy, as directed by the narrator’s opinion and agenda. Narratives construct reality by assigning meaning, shaping values, and signaling the importance of assorted concepts and occurrences (Roe, 1994; Stone, 2002; Fisher & Forester, 1993). Studying narratives lends insights into often times value-laden problem and solution definitions held by various policy actors.

For the purpose of this paper, policy narratives are distinct from mass media; here, policy narratives are any documents (such as reports or blog entries) other than mass media that tell a “story with a temporal sequence of events unfolding in a plot that is populated by dramatic movements, symbols, and archetypical characters” (Jones & McBeth, 2010). Mass media and policy narratives do more than present information; they are a strategy for political communication (Druckman, 2001; Stone, 2002). This is especially true for high salience issues because for these issues, public opinion is more likely to influence public policy (Burstein, 2003). Context is a powerful modifier of political judgments because first, individuals interpret and process information differently, and second, the unique nature of political decisions cannot be understood without first understanding the features that characterize the political environment. Therefore, there is a need for “careful content analysis of political and media discourse” to understand the context in which people receive information as frames (Druckman, 2001: 244).

There is an extensive literature surrounding the usage of “frame” versus “narrative”. Frames do not always – although they can – utilize the same structural components of policy narratives (e.g., temporal sequence of events with symbols and characters) and are often nested within mass media and narratives (ibid.). Further, mass media and policy narratives may contain more than one frame. This section first reviews framing theory broadly and mass media applications, then turns to narrative policy analysis through the Narrative Policy Framework.

## Framing

The impact of contextual information relayed as frames has been explored by many researchers within several fields: psychology, political science, economics, business, and organizational theory, among others. Individuals do not just simply rely on past experiences or make logical goal assessments when faced with political decisions. Rather, information processing takes into account the context of a situation (Farnham, 1990; McGraw, 2000). How that information is framed can have significant impact on political decision-making and information processing. By highlighting positive or negative information, the frame can stimulate individuals to focus on that information in particular and impacts their preference.

Framing the same idea in distinctive ways can yield different results.[[1]](#footnote-1) Work by Tversky and Kahneman on Prospect Theory is perhaps some of the best-known research into framing, via risky choice (Tverysky & Kahneman, 1981, 1986). As an example, when a problem is framed in terms of potential gain, individuals tend to act risk-adverse. When a problem is framed in terms of potential loss, individuals tend to act risk-seeking. Framing has a marked impact on how individuals receive and process that problem.

Knoll et al. (2010) explored the impacts of frames, contending that the selection and application of frames in a given context are governed by the importance of the issue for the decision maker. The framing effect may only be impactful for those for which the issue at hand is salient (Knoll et al. 2010).

### Mass Media

Particularly pertinent to the impact of frames on individual decision-making is the role of mass media.[[2]](#footnote-2) The average citizen does not read peer-reviewed journals, policy documents or international treaties; the mass media may be their main – or only – source of information on complex policy issues (Crow, 2011). The link between public opinion and mass media is well established, yet the directionality and nature of that link remains a question (Iyengar, 1991). Recent work has shown how the media impacts political agenda, evaluation and choices, through the use of frames (Sullivan, Rahn, & Rudolph, 2002).

Frames can be impactful not only in influencing public opinion, but also in modifying the salience of an issue (Crow, 2010; Kuklinski, 2002; Sullivan et al., 2002). In the context of environmental issues such as air pollution, salience is highly important to policy actors, who may use mass media to influence salience (or lack thereof) to impact policy agenda and choices by stakeholders. According to Crow (2010), this is a two-stage process. First the media influences citizens, then citizens influence government officials, who are also simultaneously receiving messages from the media (Crow, 2010; Kennamer, 1992). Inherent in this process is a degree of feedback, in which individuals are fed information and make decisions, to push towards elected officials, while those same officials are being fed information as well and making their own policy decisions. In the “high-stakes, high-profile, and highly-contested case-study of climate change…media messages function as important interpreters of climate information in the public arena, and shape perceptions, attitudes, intentions, beliefs, and behaviors” (Crow & Boykoff, 2014: 3-4).

## Narrative Policy Framework

Researchers have begun to study narratives systematically through document analysis. Early work in narrative policy analysis argued that the study of narratives tells a relevant story of current policy debates; based on the premise that complexity and polarization of policy issues are embedded within the narratives (Roe, 1994). Further, it was argued that policy analysis embodies the analysts’ value-laden perspectives (Fisher & Forester, 1993). Thus, the study of documents that express policy analysis can expose analysts’ policy beliefs. Indeed, narratives present the struggle over ideas that comprise political decisions, and political decisions create boundaries around those ideas, which create impacts of public policy on society (Stone, 2002). Studying narratives exposes this web of policy actors’ ideas, policy makers’ decisions, and the people who are affected.

The Narrative Policy Framework (NPF) is one approach to studying narratives. The NPF provides an empirical methodology with theoretical underpinnings on how narratives shape cognition. Developed by Jones and McBeth (2010), the framework provides a working definition of a narrative and a coding scheme for the substance of the narrative. “Policy narratives have (i) a setting or context; (ii) a plot that introduces a temporal element (beginning, middle, end), providing both the relationships between the setting and characters, and structuring causal mechanisms; (iii) characters who are fixers of the problem (heroes), causers of the problem (villains), or victims (those harmed by the problem); and (iv) the moral of the story, where a policy solution is normally offered” (Jones & McBeth, 2010: 340). The plot unfolds in various depictions of causes, effects, and solutions with identification of the relatedness between variables. Explicit in the narratives are the use of characters that improve, exacerbate, or are affected by the policy issue. Policy solutions are offered in each narrative.

# Case Study Background

Megacities, such as Delhi, are important to study given the upward trend of global urbanization (Kraas, 2007) and the governance, space, and resource constraints that megacities currently face. Krass states that “‘poor’ megacities are the ‘absorbing pools’ for the rural migration with large percentages of the population living below the poverty line” (ibid.:13). Indeed, Delhi has experienced a 40% population growth rate in only ten years between 2001-2011 with 14% of its inhabitants currently living below the poverty line (Ahmad, Balaban, Doll & Dreyfus, 2013). Delhi also has one of the highest population densities in the world, without adequate infrastructure to support the population (Gurjar, Butler, Lawrence & Lelieveld, 2008). The majority of academic research on air pollution in Delhi involves measuring air pollution levels, the causes and resulting effects (e.g., Gurjar et al., 2008; Nagpure, Gurjar & Martel, 2014). Broadly, transport pollution is largely represented in research because it contributes to approximately 70% of Delhi’s air pollution, followed by industrial emissions (at 20%) (Government of NCT of Delhi, 2012: 96). Air pollution modeling studies often link to health impacts and call for new policies and norms to address the rising costs of pollution-related health impacts (e.g., Gurjar et al., 2008; Nagpure et al., 2014). Regarding air pollution policy actors, Veron explored motivations for and consequences of Delhi’s air pollution policies with a particular focus on nonprofits and the judiciary involved, noting that these groups initiated the policy action (2006). The key argument of Veron’s work is that the policy discourse has been framed with middle-class bias in both the dominant environmental nonprofit and Supreme Court Public Interest Litigations (PIL). Given the significant levels of air pollution in Delhi – resulting in visual presence and widespread health effects – the issue is of high salience to both citizens and policymakers (Bickerstaff & Walker, 1999).

# Methods

Exploring the frames used by mass media and policy narratives is a step towards discovering how citizens and policy makers process messages, relayed as frames. The descriptive study proposed here utilizes different methods to uncover the frames surrounding the air pollution debate in Delhi, the priorities and perceptions of policy actors are illuminated. Exploring mass media provides insight into the content shaping aggregate reader cognition, while the policy narrative analysis explains one group’s problem, solution, and actor characterization in-depth.

Two approaches were used to uncover the framing of the air pollution issue in Delhi, India: (i) an inductive approach of news media coverage of the issue via automated text coding using a large-n dataset and (ii) a deductive approach that focuses on the stories told via online documents guided by the NPF using a small n dataset. The small- and large-n datasets were not intentional; the reality is that mass media outputs are numerous and nonprofit outputs are minimal in comparison, and research approaches appropriate for the characteristics of the two datasets were chosen. Focusing on narratives by nonprofits and not trade associations or industry groups, for example, was not intentional either; these are simply the type of organizations that predominantly authored, published, and hosted web-based documents on the air pollution issue, as discussed below. In addition, different audiences are targeted by the two document samples, encouraging the use of different methods to capture the nuances of these narrative strategies.

Both analytical strategies – automated text coding and NPF – were guided by coding for parent and child nodes. The parent nodes were developed based on the premise of the NPF; stories have plots that unfold with causes, effects, solutions, and characterization (i.e. actors). The child nodes capture nuances within the parent codes. To illustrate, in the child node, actors are further categorized as Heroes, Victims, and Villains. The parent category, Causes, was further categorized into child categories - Environment, Household/Business Consumption, Industrial Production, Infrastructure, Transport, and Urbanization. Similarly, the parent category, Effects, was reduced to Economy, Environment, Health, Social Impacts, and Visual Aesthetics to reveal more nuances in the frames. Lastly, the parent category, Policy solutions, was sorted into Administrative Capacity and Enforcement, Market Solution, New Infrastructure/Planning, Regulation, Research and Information, Implement Current Goals, and Voluntary Action. These categories were developed inductively by analyzing a selection of documents.

## Automated Text Coding

In this study, insights into mass media issue framing are captured by analyzing word frequencies, word co-occurrences, and concept frequencies. To find documents for the automated text analysis, a broad search revealed mass media sources available via online access. Requirements for English language and online accessibility constrained the choice of mass media sources, which resulted in using the newspapers Hindustan Times, Indian Express, The Economic Times, The Financial Express, and the Times of India. LexisNexis and WestLaw Academic were searched for articles in 2012-2013 using the same Boolean logic terms: “Delhi” AND “air pollution”. The results were compared and duplicates eliminated. Inclusion in the sample was fairly broad; as long as the article mentioned air pollution and Delhi as areas of discussion, the article was included. However, if Delhi was only mentioned as the site of a meeting at which another jurisdiction was the topic, the article was excluded. The final sample contained 235 articles, the composition of which is roughly commiserate with the daily circulation and readership of the newspapers (“Presseurop: The Best of the European Press”, 2012).

**TABLE 1. Mass Media Sample**



The sample was then uploaded to the automated text content analysis software, AutoMap. AutoMap is an advanced text mining system that can extract a semantic network of concepts and their relation to each other (Carley, Columbus, & Landwehr, 2013). The texts were processed to 1) remove noise words and irrelevant concepts and 2) combine similar concepts, such as “automobile” and “cars” to automotive.[[3]](#footnote-3) Remaining relevant concepts were then inductively funneled into categories based on the research question and NPF. For example, the concept “Delhi Pollution Control Board” is categorized first as Actor, then specifically as Government & Authority; “haze” is categorized as Visual Aesthetics; “emphysema” is categorized as Health (refer to Appendix 1 for a full list of categories). A semantic network was then generated to reveal co-occurrence of concepts. Co-occurrence is “controlled by the distance between word occurrences: two vertices are connected if their corresponding lexical units co-occur within a maximum *N* words,” by selecting a window size (Mihalcea & Tarau, 1998: 3). Guided by work on text ranking and information retrieval used for benchmarking in language models, primarily within the field of web search relevance, proximity within a window size of 10 was used (ibid.).[[4]](#footnote-4) That is, words within 10 words of each other were captured as co-occurring.

The semantic network was then uploaded into network analysis software UCINET to analyze the co-occurrences and network attributes. Proximity, measured as co-occurrence, “suggests a relationship between terms when entities of interest coexist within a certain scope of the text” (Chang, Popescu, & Arthur, 2013: 5). Co-occurrence can indicate cohesion within a given text, interpreted as a narrative frame (Carley et al., 2013; Chang et al., 2013; Mihalcea & Tarau, 1998).

## Narrative Analysis

To find documents to analyze using NPF, keywords were searched in Boolean logic, “air pollution” AND “Delhi” using Google Chrome. From the search results, a list of 14 Indian-based organizations that host documents on their websites was generated. Inclusion rules were created, requiring that documents must contain some mention or reflection on the air pollution issue specific to Delhi, be published and hosted by Indian-based sources between January 1, 2012 and December 31, 2013, include downloadable as well as web-based published material in .pdf and .html formats, and finally, exclude newspapers. Each entire website and/or knowledgebase of the organizations’ online presence was searched. The search resulted in 46 documents from eight organizations. Four publications were excluded due to duplication and irrelevance to the study. Additionally, five documents by government authors were excluded in order to create a comparison between two distinctly different narrators – mass media and nonprofits. The nonprofit was not required to have written the narrative; but they had to be hosting it, which indicates that the narrative aligns with their policy beliefs. Nonprofits, along with the judiciary, are particularly influential around air pollution in Delhi (Veron, 2006). This resulted in 37 publications for analysis.

Next, guided by NPF theory and informal interviews conducted in Delhi in summer 2013, the following questions were crafted and a general code form was created (see Appendix 2 for full code form):

*1) Which character types (hero, victim, villain) are portrayed and by whom?*

*2) What are the causes and effects of air pollution?*

*3) Does the document offer policy solution(s)? At what level of government is the policy pollution proposed?*

A few of the codes warrant explanations. There is a subtle difference between transport and urbanization codes (see Appendix 3 for definitions of each code). When the narrator explicitly quoted transport measures as a cause without citing people, the text was coded as transport. Urbanization specifically refers to the increasing number of people that live in Delhi, which results in an increasing number of mobility devices. Infrastructure refers only to the physical system needed to operate society, such as electricity needed to operate mobile phone towers, solid waste disposal, and air traffic. The environment refers to climate conditions, which are known to cause changes in air pollution levels. Gaining clarity on these definitions resulted in high inter-coder reliability. Inter-coder reliability was tested on nine documents (20% of the sample), generating results above the recommended 85% for the percent agreement test and above .40 for the Cohen’s (1960) Kappa test using Freelon’s (2013) reliability calculator, ReCal.

Results

## Mass Media

Data analyses for the mass media include word frequencies, parent category frequencies, and correlations between actors and parent category frequencies. After processing the newspaper texts, approximately 1,600 words remained that were relevant to the issue of air pollution in Delhi. Table 2 shows the most frequently used 25 words, which account for 42.31% of the total 1,600 relevant words (total occurrence within articles was 5,578).

TABLE 2. Highest Frequency Words Compared to the Relevant Words[[5]](#footnote-5)



Words relating to transportation – such as automobile, fuel, bus, and road – are highly prevalent. Health words – such as disease, lung, and breathe – also have multiple occurrences within the top 25 most frequently used words in articles about air pollution in Delhi. Conclusions about the causal or directional relationship cannot be made from automated text analysis, but high usage of transport and health words within mass media communication on air pollution is not surprising. Words indicating jurisdiction – such as city, state, and country – are used with regularity. Scientist is the most frequently used actor word; others are government, children, and agency. Negative frame words – such as problem and cost – cannot be explicitly linked to definite frames, but those words are relatively highly occurring nonetheless, indicating that there may be recognition of potential problems related to air pollution. Finally, “firecracker” occurs with relatively high frequency, which may be a result of the marked increase in smog following the annual celebration of the religious festival Diwali in November, during which firecrackers are set off, coupled with the seasonal weather conditions that tend to trap the released sulphur (Singh, 2013).

Using words relating to transport and health as well as jurisdiction and actors are indicative of the frames discussing the issue of air pollution, its causes and effects, and actors and level of jurisdiction. No words relating to solutions – such as fine or monitoring – are found among the most frequently used words, which could indicate that the mass media frame is not currently associating solutions with the air pollution issue, at least not within a 10 word window size.

Categorization was then applied, assigning the relevant words into 19 concepts. However, unlike NPF coding where the manual coder is able to assign valiance to a term, such as “cause” or “effect,” automated text coding is not able to decipher the author’s intended usage of a word within a given window; therefore conclusions cannot be drawn regarding intent.[[6]](#footnote-6) Table 3 shows the frequency of all concepts.

TABLE 3. Concept Frequency within Mass Media Sample[[7]](#footnote-7)



As with the simple word frequency, concepts of transport and health are the highest occurring. Words of Household/Business Consumption – such as stove, kitchen, restaurant, and garbage – follow, with nearly the same relatively frequency across texts as Environment words – such as vapor, winter, atmosphere, and climate. Solutions are more prevalent in this analysis; by grouping Solution words – such as technology, law, policy, and prohibit – their relative importance within the mass media sample is better revealed. By developing parameters for the air pollution frame through the concepts, nuances such as solutions are brought forward. The Supreme Court, which has played a prominent role in implementation of the recent Bus Rapid Transit policy, is noted through the concept frequency but would have otherwise been lost in the analysis since its relative occurrence across all concepts is low.

A semantic network can be used to represent frames as relationships between concepts, represented by co-occurrence of terms within a given window. Figure 1 illustrates the co-occurrences between actor concepts – University & Research Agencies, Government & Authority, Nonprofit, Supreme Court, Industry, and People – and the remaining concepts. The figure demonstrates that actors play different roles within mass media frames of the air pollution issue. The Environment concept co-occurs with all but one actor (Nonprofit). For two actors, Industry and the Supreme Court, Environment is the only concept with which they co-occur, although note that the number of co-occurrence is relatively low. Government & Authority is primarily associated with Transport, but also with Environment; however, Government & Authority is not associated with Solution. Solution is associated only with University & Research Agencies, as is Urbanization. The frame surrounding University & Research Agencies associates research with solutions, urbanization and consumption, which could be construed as a more scientific frame.

FIGURE 1. Concept Co-Occurrence within Actor Type



Health, a highly occurring concept, only co-occurs with Nonprofit and People, which could imply that the effects of air pollution are heavily associated with specific groups (People) and emphasized by specific groups (Nonprofit). The same actors also see the only co-occurrences with other actors. In contrast with the more scientific University & Research Agencies frame, the frames surrounding Nonprofit and People appear to be more human-related, co-occurring with other actors, visual aesthetics and environment. People as a concept co-occurred most often with other concepts, representing one-third of the total co-occurrences (see Table 4).

TABLE 4. Total Co-Occurrences of Actor Type with Remaining Concepts



Words associated with transportation and health are most commonly occurring, whereas solution-oriented words are relatively absent in the individual word analysis but appear prominently when the individual words are grouped into parent categories. Additionally, scientist, government, child, and agency are frequently used actor words. Problems and costs are also highly occurring. The co-occurrences between actor types and categories reveal that people are generally frequently associated with air pollution frames.

## Narrative Policy Framework

Unlike the automated text coding used in the mass media portion of the study, hand coding of nonprofits’ narratives reveals a more nuanced story of causes, effects and solutions for air pollution in Delhi, which will be presented in this section. Across all documents, the nonprofits frame transportation (70%) as the leading cause of air pollution in Delhi, health impacts (81%) as the most commonly cited effect, and new infrastructure and planning (73%) as the most commonly advocated solution (Table 5). The Environment (30%) is commonly cited as a cause of air pollution due to climatic and seasonal conditions that exacerbate air pollution levels.

Human health is discussed both broadly and specifically in the narratives, as the narratives cite general health issues (such as respiratory and cardiovascular diseases, premature mortality, cancer, eye irritations) as well as specific data (such as city and pollution rankings, health risk rankings, mortality and morbidity data). In addition, qualitative analysis of the coded text reveals that the economic burden to society caused by human health issues is frequently cited as an effect of air pollution (19%). The visual aesthetics characterized by haze and fog are also cited as effects (14%).

TABLE 5. Documents Coded for Narrative's Portrayal of Causes, Effects, and Solutions for Air Pollution



The documents framed actors as heroes, victims, and villains: heroes who seek to solve the problem, villains who exacerbate it, and victims who suffer. Qualitative analysis of the coded text revealed the context in which the actors were discussed. Government and authority had the largest representation of the actor categories, divided across frames as heroes (54%) but also as villains (38%), which typically focused on their ability or inability to enact solutions for air pollution (Table 6). Government agencies frequently cited were the Delhi Pollution Control Committee (DPCC) and Ministry of Forests and Environment (MoFE).

The Supreme Court was coded distinctly from the more general government and authority category and was framed as a hero in 22% and as a villain in only 3% of the documents. The nonprofits commonly praise the Supreme Court for passing environmental directives, such as Compressed Natural Gas (CNG) fuel use and Bus Rapid Transit (BRT) systems. Similarly, universities and research agencies are frequently framed as heroes (24%) for releasing studies that expose the air pollution issue; however, some studies are rejected by the environmental nonprofits when they do not align with their policy beliefs. For example, the Central Road Research Institute (CRRI) released a study indicating that survey respondents wanted to repurpose the BRT for cars. Similarly, nonprofit Nyaya Bhoomi, otherwise known as Nonprofit Organization of Transport Agents and Bulk Carriers, was also framed as a villain for wanting to abolish the BRT.

For the most part, industry, primarily representing automobile and petroleum interests, is framed as a villain. In one narrative, however, industry is framed as a hero and as a villain within the same article. In this instance, the narrator praised one of the industry’s studies calling for more public transport then criticized a second study that the industry had published. The second study was calling to eliminate the BRT, claiming that up to 97% of survey respondents did not want the BRT. The nonprofit argued that the survey population was not representative of bicycle and pedestrian commuters.

Wealthy people and car owners are framed as villains, as some narrators associate car owners with affluence, privilege, and selfishness, while poor people, vulnerable populations, transit users and pedestrians are framed as victims. This points to the value-laden aspect of the frames, whereby economic inequality and environmental justice issues underpin the frames. For example, the nonprofits exposed the issue of relocating industries to Delhi’s periphery, in areas occupied by poorer citizens, and that those who cannot afford cars, or even bus fare, are most at risk of air pollution. Lastly, the public is framed as a villain in one instance for not letting the government effectively implement its policies. More commonly, the general public, non-wealthy people, vulnerable populations, pedestrians, and transit users are framed as victims of air pollution.

Table 6. Types of Actors Characterized in Narratives



Causes, effects, and solutions for air pollution are often discussed in the context of characters. Cross tabulation is a statistical method used to explore correlations between variables. In this study, the cross tabulations were constructed to explore how the actor types are expressed in relationship to the causes, effects, and solutions. 54% of the documents present the government and authority as actors who are trying to fix the air pollution problem. This actor group is associated with all solutions, and mostly with regulation, new infrastructure and planning, and administrative capacity and enforcement (Table 7). This actor group is least associated with market solutions. Media and wealthy people and car owners were not considered heroes in any of the documents. Industry was entirely associated with new infrastructure and planning, but with an *N* of only 1. New infrastructure and planning is similarly correlated with all other heroes, perhaps indicating stakeholder engagement in new plans and policies.

Table 7. Cross Tabulation of Heroes to Solutions



The only actor type presented as victims were general public, pedestrians, and transit-users, coded as Non-wealthy People (Table 8). Health effects were primarily correlated with this victim category, followed by visual aesthetics such as haze and fog. Multiple documents expressed the economic burden of health problems that result from air pollution, which is captured by the economy code.

**Table 8. Cross Tabulation of Victims with Effects**



Transport is consistently expressed as a cause of air pollution, holding many associations with actors (Table 9). However, the Supreme Court, University and Research Agencies, and Non-wealthy People had only an *N* of 1. Government and Authority, on the other hand, had an *N* of 23 and Industry had an *N* of 5, with both actor types being associated with various causes of air pollution.

**Table 9. Cross Tabulation of Villains with Causes**



# Discussion

In this section, automated text coding and NPF results are compared to explore the similarities and differences between mass media and nonprofit frames, supported by qualitative analysis of NPF-coded text. Additionally, NPF results guide the extrapolation of automated text coding results to infer word associations (e.g. as causes or effects).

## Transportation and health

Although conclusions from automated text coding cannot be drawn regarding intentionality of words used in the mass media sample, frequency results from the automated text coding indicating that air pollution frames heavily feature transport and health words are borne out in the in-depth NPF analysis.[[8]](#footnote-8) Transport as a leading cause and health as a dominant effect are already well recognized in academic literature and government reports, so the high occurrence of frames relative to these issues is not surprising. However, exploring these concepts within the context of correlated words provides insight into how the issue is framed. For example, transport is most highly associated with Government & Authority in the automated text coding and most actor groups are correlated with causes pollution and the solution for new infrastructure and planning, which, in the narratives, is predominantly transportation-oriented.

## Government and Authority

The NPF analysis found that Government & Authority is characterized as both a hero and a villain; coupled with the automated text coding results that mass media frames the government without solution words, supporting NPF results that government is often cited for its lack of progressive action while maintaining the solution for effectively implementing current goals. For example, in an article published by the Centre for Science and the Environment’s (CSE) magazine Down to Earth, the narrator wrote, “While India has substantially expanded air quality monitoring capacity to generate data for particulate matter, its capacity to monitor a range of air toxic is still very weak” (2013). Governments consistently presented as heroes by the narrators perhaps points to narrators wanting to maintain trust and reciprocity with the government by praising their good work before offering proposals for the next set of actions.

## Solutions

In the automated text coding, University & Research Agencies highly co-occurred with Solutions in the automated text coding. In the NPF results, solution words correlated with Government & Authority, Non-profits, Supreme Court, and University & Research Agencies. Each actor category showed high correlation with specific solution categories. For example, the specific solution for Research & Information is primarily fulfilled by university and research agencies, but also through air pollution monitoring administered by government agencies (e.g., Delhi Pollution Control Committee). The solution for New Infrastructure & Planning is spread across most actor groups, indicting that each are involved, perhaps through stakeholder engagement in workshops, as extrapolated from the qualitative analysis of coded text.

The second and third most proposed solutions are Regulation and Administrative Enforcement & Capacity, respectively. Surprisingly, Regulation is correlated with most actor categories. Regarding administrative enforcement and capacity, the qualitative analysis of coded text reveals that the nonprofits propose a) inspecting polluting industries, b) establishing, monitoring and enforcing emissions standards, c) implementing air quality and management plans, and
d) improving coordination between government departments. Public private partnerships were not mentioned much in the narratives, which is surprising since Delhi has turned to the private sector to operate the bus system since the early 1990s, and buses fulfill close to half of all travel demand in Delhi (Tiwari 2002: 97). This could indicate environmental nonprofits’ satisfaction with the privately operated bus system, or it may simply not be a priority for the nonprofits.

## People

The NPF analysis found people to be framed as victims within the narratives, and automated text coding revealed that people are most prevalent in co-occurrences with other concepts. This indicates that narrators draw on many strategies to frame people in the story of air pollution. In general, the narrators express issues of economic inequality in the context of wealthy car owners as villains for which transport planning centers around, juxtaposed against the non-wealthy population who are victims of the rich's actions. Finding that discourse has centered around reducing vehicular pollution, a middle class and above issue, and relocating industries outside of the city into areas with poor settlements supports Veron’s (2006) argument that environmental discourse has been framed as a middle-class issue.

## General observation

Different actors play different roles in the frames, whether in the narratives or mass media. Some actors, such as universities and research agencies, are associated with exploring more broadly the concepts related to air pollution, while government may be more focused on description of the issue itself. As written in a recent article from the Hindustan Times,

The CSE [Centre for Science and Environment] made light of the Delhi government’s attribution of smog to the winter season only and pointed out the real reason – a manifold increase in pollution levels. It warned that after the initial smog cover lifted, it would come back stronger as the factors responsible for the phenomenon continued to persist. (“Blame Game Over Thick Smog Cover”, 2013).

In this article, the government frame is associated with a basic description of increased air pollution as a result of seasonal conditions, but the nonprofit group CSE frame is associated with exploring various and enduring causes of the problem.

# Conclusion

Policy narratives become entrenched within issue domains and the resulting decision-making stabilizes around existing patterns of description. This is relevant to the reoccurring focus on transportation as the leading cause and health as the dominant effect of air pollution. This study sought to reveal the less articulated causes, effects, and solutions, as well as the interrelatedness between causes, effects, solutions, and characterization.

This research can inform a wide range of actors – from international aid to local organizations – in Delhi’s air pollution policy subsystem. Situated in urban sustainability and narratives/media framing literature, some findings from this study may be generalizable to air pollution subsystems in other contexts, most likely in developing countries with severe air pollution issues. It is especially questionable if new infrastructure and planning would be the most cited solution in developed countries, over regulation, market solutions, or voluntary mechanisms. Each policy subsystem is unique in its institutional, political, social and economic context so additional studies would need to be conducted in different contexts to compare and contrast priorities and perceptions on air pollution.

Air pollution discourse was explored for a critical urban issue in one of the world’s most populated and polluted megacities. A novel, systematic social science research method to analyze a policy subsystem was applied. The methods are feasible even when the researcher is far from the study setting and replicable in other study settings, which grant high comparative potential across cities and topics. Future research efforts could focus on applying the same methods to various samples to explore comparability. Samples could be drawn from different sources to explore framing strategies used by various political affiliations or drawn from different regions to explore framing strategies utilized by various populations. Mass media and other narratives continue to influence the frames of discourses, which bounds the arena for future climate adaptation and mitigation interventions (Boykoff, 2010). Failing to establish how an issue is being framed limits the potential for action by ignoring the existing communication strategies of the mass media and other policy actors.

# Appendix 1: Parent Categories for Mass Media Sample



# Appendix 2: NPF Code Book



# Appendix 3. NPF Questions and Definitions of Each Code

* Who is portrayed as each actor type? Individuals and organizations acceptable. Look at the role the actor plays in the document.
	+ **Hero/Fixer:** actor(s) who plan to or fix, solve, assist, or seek to resolve past, current or future problem. Need to possess intention and/or agency.
	+ **Villain/Problem Causer:** actor(s) who create, cause, contribute, instigate, exacerbate, or plan to contribute to the problem. Need to possess intention and/or agency.
	+ **Victim:** actors(s) who suffers, is targeted, is effected by the problem and/or Villain. Need to possess intention and/or agency.
	+ **Other:** Those that proposing or taking actions that are not categorized by the Villain, Hero, Victim definitions.
* What are the causes of air pollution?
	+ **Economy/business:** Economic development plans taken at the expense of environment. Example, the drive for economic improvement is causing pollution.
	+ **Infrastructure:** The physical system needed to operate society, including water and power lines, and public institutions including schools, post offices, and prisons. Exclude transportation systems.
		- Including resource consumption by government buildings
	+ **Government:** Function of government (not physical buildings). Example, government has unsuccessful or no plans and policies. Note, if transport policy, code as Transport, not Government. If the narrative places blame on government inaction in general, then code as Government.
	+ **Environment:** Climate conditions, weather, climate change. Example, increased fog causes an increase in air pollution.
	+ **Transport:** Cars, buses, transportation planning and policy, mobility.
	+ **Household/business consumption:** Example, leaf burning.
		- Indoor pollution such as cooking or generators
	+ **Urbanization:** Increasing number of people that live in Delhi, includes increasing number of cars that result from the increasing number of people, only if the car growth is explicitly linked to population growth. Otherwise, code car growth as Transport.
	+ **Industrial Production:** Pollution created from industrial processes and/or released from industrial plants. Includes power station related emissions.
	+ **Other**: Religious holidays. Example, Diwali (firecrackers).
* What are the effects of air pollution?
	+ **Health**: Injury, illness, disease.
	+ **Environment**: Climate change, environmental degradation, unhealthy air to breath with air as the subject, not respiratory illnesses.
	+ **Economy**: Cost of air pollution.
	+ **Social Impacts**: Livability.
		- Must be explicitly stated, for example, cultural significance deteriorated
	+ **Visual aesthetics:** Smog looks ugly, discoloration of architecture.
	+ **Built Environment**: Human-made surroundings that provide the setting for human activity, ranging in scale from buildings and parks or [green space](http://en.wikipedia.org/wiki/Open_space_reserve) to [neighborhoods](http://en.wikipedia.org/wiki/Neighbourhood) and cities that can often include their supporting infrastructure, such as water supply, or energy networks.
		- Planned space, urban planning.
	+ **Other**
* Does the document offer policy solution(s)? If so, what are they?
	+ **Regulation**: Legal regulation only. Must be a written instrument containing rules adopted or proposed to be adopted by governmental authority.
	+ **Administrative Capacity and Enforcement**: Government. Implementation phase of regulation/policy.
	+ **New Infrastructure/Planning**: Example, development of new transportation systems or second generation action plan.
	+ **Research and Information**: Reports, data.
	+ **Status Quo:** Maintain and/or meet the goals of existing plans and policies; Public Interest Litigation (PIL).
	+ **Market Solution**: Example, taxes, credits and financial incentives.
	+ **Voluntary**: Public or private sector needs to do something voluntarily. No regulation is involved.
	+ **Public/Private Partnership (PPP)**: A public-private partnership (PPP) is a government service or private business venture that is funded and operated through a partnership of government and one or more private sector companies. PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project involving the public and private sector. Example, private sector takes over operation of a bus line.
	+ **Other**

# Appendix 4. NPF Coding Rules

* **Coding Rule – What to Code**
	+ Code all relevant words, phrases and/or sentences in the document, even if the coding is redundant.
	+ Only code when the content explicitly fits into a node.
		- For example, only code Solution - Level of Government when the content explicitly states the level.
	+ Code titles, subtitles and picture captions, but not the images
* **Coding Rule – Level of Analysis**
	+ Code at the document level.
	+ Code the actors, causes, effects and solutions that pertain to air pollution.
* **Coding Rule – Data Entry**
	+ If there are multiple entries for a question (character types, cause/effect, etc.), alphabetize the entries.
	+ Coding sources
		- Code national labs as Other.
		- Code Down to Earth as Media.
* **Coding Rule – Actors**
	+ Meeting participants are actors, but not heroes, victims or villains so code as Actor - Other.
	+ In Supreme Court cases, the petitioner is a hero and respondent is a villain.
	+ Do not include non-humans (e.g., policies, personified symbols, animals). Has to be persons or groups being portrayed as a hero, villain, victim but use Other. They have to have agency – the ability or intention to act.
* **Coding Rule – Technology and Power Stations**
	+ Code solution using technology as Solution – Other.
	+ Power station-related issues should be coded as Causes – Industrial Production.
* **Coding Rule – Coding Supreme Court cases**
	+ In Supreme Court cases, the petitioner is a hero and respondent is a villain.
	+ A Public Interest Litigation is coded as Solution – Status Quo.
* **Coding Rule – Even solutions that are not working should be coded.**
	+ For example, a weak study that results in allowing private vehicles on BRT lanes is coded as Solutions – New Infrastructure & Planning and Research & Information.

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1. Although there is a wide body of work on framing theory, this paper will review only applications that are within a political context. [↑](#footnote-ref-1)
2. “Priming” is also used to describe the delivery of contemporary information from the mass media. Druckman discusses the nuances to the studies exploring framing versus priming (2001), which center around the dependent variable of the study. For the descriptive intent of this research, the concepts of framing and priming can be used interchangeably. [↑](#footnote-ref-2)
3. Word sense disambiguation was avoided by employing a manual review of the entire concept list of the text sample and eliminating any value-laden descriptive concepts, such as “harmful” or “suffer”. [↑](#footnote-ref-3)
4. A sensitivity analysis was performed with varying window sizes. The window size was both doubled and halved, with variance as low as 0.33% and at most 15.69%. For this application, variance sensitivity is sufficient to test the stability of the results (Homma& Saltelli, 1996: 14). The proportions of the concept co-occurrence did not change. [↑](#footnote-ref-4)
5. “Delhi”, “India”, and “pollution” were removed from the sample as these were the original search terms. Keeping these words in the counts would have skewed the analysis. [↑](#footnote-ref-5)
6. For example, within a window size of 10, the following sentence could occur: “Busses contribute to air pollution”. This would prompt a co-occurrence. However, the following sentence could also occur: “Busses do not contribute significantly to air pollution”. This would also prompt a hit, but the meaning is entirely different. The word “bus” can be categorized as “Transport”, but cannot be assumed to be a “cause” frame within the narrative. [↑](#footnote-ref-6)
7. The concept “People” is comprised of: public, non-wealthy, vulnerable people, pedestrians, and transit users. [↑](#footnote-ref-7)
8. The samples used for the automated text coding and NPF are from different sources with various political affiliations and organizational goals, which impacts the narrator’s framing strategy. Therefore, comparative conclusions must be taken lightly. [↑](#footnote-ref-8)