A Sentiment Analysis Model of a Civil Service Performance Evaluation Using a Feminist Framework: a Case Study of Open Government Information in China

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Abstract

The aim of this article is to explore using sentiment analysis to assess the openness of governments and establish a dynamic evaluation mechanism to supervise governments, and consequently improve the administrative law on a feminist basis. I build a sentiment analysis model based on communication between me and governments, discuss the implication of the model, and propose potential improvements to the administrative law in China.

1 Introduction

From the Women's Suffrage Movement in the 20th century to today's MeToo movement, feminism has sought to reshape the way that society functions and people view things. However under the acceleration of technological transformation, hidden and pervasive inequalities, stereotypes, and power relationships become increasingly reinforced due to the gendered tendency of digital media, automation and broader fields of technological research (D'Ignazio & Klein, 2020). Feminists are faced with the challenge to reconnect feminist practices of thinking with the regressively gendered political debates, social norms, and most importantly legal practices (Baer, 2011; Mossman, 1986). As emotion has remained one of the core conceptions of feminism (Ahall, 2018), incorporating emotion into both private and public law might serve as a legal foundation for feminism.

In particular, as a feminist thinker, I see new opportunities for utilizing sentiment analysis, which can be considered as a feminist technology due to its focus on finding emotions in texts, to improve administrative law for better communication between governments and citizens and ultimately establish a feminist jurisprudence. The particular field of law that I will focus on is the *Open Government Information Regulations* in China, as access to information becomes a source of power in the age of big data (D'Ignazio & Klein, 2020).

This project focuses on analyzing content of communication between citizens and government officials using a sentiment analysis model based on Tensorflow. In Section 2, I will talk about my theories. In Section 3, I will explain the case study, present the model, evaluate the results and discuss the implication. In Section 4, I will conclude and propose future directions.

2 Theoretic Background

2.1 Emotion in Feminism

In recent years, feminism has become a heated field where many feminist perspectives pervade (Dicker & Piepmeier, 2016). One of the feminist viewpoints is postmodernism feminism which is rooted in the works of Derrida (Derrida, 1972) and Foucault (Foucault, 1970, 1980, 1998) about postmodernism. During the 1970s and 80s, feminist researchers in this category, including Cixous (Cixous, 1976, 1981), Irigaray (Irigaray, 1985), and Kristeva (Kristeva, 1997), also led the postmodern theory to a critique of patriarchal culture. While their works vary, they share the assumption that language and meaning-systems can structure experience. They agree on certain themes including the rejection of dualism, focus on difference, interest in the role of discourse in constructing gendered relations of power and domination, and denial of normalization. Since language shapes meanings of words in different contexts and discourses, an individual's subjectivity is not coherent but susceptible to construction through discourses. In particular, Irigaray (Irigaray, 1985) rejected the binary oppositions in society, for example, "feminine" vs. "masculine." She stated that women's identity has been positioned as the mirror negation to men. In the 1970s, women who were not white, middle class, nor western started to question the unitary idea of "woman" as a category to unite women of different classes, nationalities, and races. Feminists like Hooks (Hooks, 1981) criticized that traditional feminism was only representative of the white and middle-class women instead of universal women, and such a narrow viewpoint only reinforced class structure since the needs of women of poverty and color had been neglected. With the focus on the destruction of the man-woman dichotomy, postmodern feminists also seek to take more variables such as nationality, class, and race into consideration.

Although the importance of emotion has long been neglected compared to logicity because emotion is usually associated with women and irrationality, emotion and subjective experiences have been one of the focuses of feminist research (Ahall, 2018). Since the 1990s, there has been an increasing amount of research on affect, which refers to emotions and subjective feelings. In Jaggar's early work (Jaggar, 1989), she argued that emotion is important for constructing knowledge and crucial to epistemology. Researchers such as Damasio (Damasio, 1995) and Adolphs (Adolphs et al., 1996) proposed that decision-making depends on emotional processing. Reasoning is related to the state of the body as it uses biological information to make advantageous decisions based on past experiences (Adolphs et al., 1996).

2.2 Emotion in Law

The presence and importance of affect in law also receive attention from recent studies (Banes & Blumenthal, 2012). For feminists, their research on emotions aims to promote women's inclusion in the legal system (Baer, 2011). By narrating her emotional experience as a result of a rape and her confusing experience from the criminal justice system, Estrich (Estrich, 1986) argued that the law should take emotions into account. More specifically, she proposed that only physical or verbal resistance were not enough to prove non-consent, but victims' emotions should be also be considered. Feminist scholars also questioned the dichotomy of reason and emotion in law (Baer, 2011). Researchers like Bender (Bender, 1990) and Menkel-Meadow (Menkel-Meadow,

1985) promoted the combination of reasoning and affective perceptions to improve the quality of legal decision-making.

Researchers from other fields including legal theory, psychology, and philosophy also joined the discussion and shifted the focus to the complex role of affect within the law (Maroney, 2006). Nussbaum and Kahan (Nussbaum & Kahan, 1996) argued that emotions should not be considered as simple physiological and mechanistic processes but a cognitivist and evaluative conception. They believed that the evaluative conception of emotions allows examination of the relationship between affect and the norms, which is beneficial for people to understand how individuals are socialized in this context. They also argued that current institutional practices should consider the ways that the norms reflect in individuals' emotional experiences. In *the Passions of Law* (Bandes, 2000) the author established the idea that emotions with cognition lead to more moral, accurate, and just decisions.

Following the exploration of the complex relationship between emotion and law, many researchers have proposed new goals for the law and sought to reform the current institutional practices (Bandes & Blumenthal, 2012).

Below I want to address several aspects where the law fails to consider emotions in its nature, including criminal law and tort law.

Two Conceptions of Emotion in Criminal Law (Nussbaum & Kahan, 1996) discussed the necessity of applying the evaluative conception of emotions in criminal law doctrines, for example, voluntary manslaughter and self-defense.

Voluntary manslaughter — The law does admit the presence of emotion when assessing the offender's state of mind at the moment of committing the crime. In criminal law, emotions like fear, anger and hate are considered when the court decides the legal category of the offense. "Heat of passion" defense is an example of downgrading an offense of murder to voluntary manslaughter as the defendant acts upon affective reactions due to an adequate provocation instead of malice required for murder (Milgate, 1998). However, the distinctions between adequate or non-adequate provocation are vague in current criminal law and are too underinclusive to be categorized (Nussbaum & Kahan, 1996). Modern authorities also consider it to be difficult to specify rigid legal categories in advance since an individual's provoked emotions are too diverse, and they believe that the jury can better decide the adequacy of a provocation than a judge since the jury come from diverse backgrounds (Kadish et al., 1995). However, it is also possible that the decision-makers like the judge and the jury determine the adequacy of the provocation based on whether the law should promote or discourage certain actions or identities (Mison, 1992). Moreover, Nussbaum and Kahan (Nussbaum & Kahan, 1996) argued that it is difficult to distinguish between justification and excuse for voluntary manslaughter. But the evaluative conception of emotions allows the law to track the appropriateness of the intentional killers' emotional motivations.

Self-defense — Although the law permits citizens to use deadly forces when he is faced with an imminent threat to his life, Nussbaum and Kahan (Nussbaum & Kahan, 1996) argued that the affective reactions behind self-defense are more complex than merely instinctive fear or

conflict of rights. Apart from life, people also value honor and dignity as they refuse to be subordinate to other people's wrongful acts or will. They believed that the law should be extended to endorse the evaluation of morally appropriate emotions like dignity (Nussbaum & Kahan, 1996).

Based on the above situations, Nussbaum and Kahan (Nussbaum & Kahan, 1996) believed that the law should respond to shifting social norms and reforms in current practices are necessary to better make judicial decisions.

While performances of repentance serve as a condition for the application of commutation and parole, the assessment of criminals' repentance also remains problematic in criminal law (Geng & Zhang, 2016). For example, in China, criminals' performances of repentance can be objectively reflected in their actions such as completed labor tasks and disciplined performances in prison (Geng & Zhang, 2016). Although the reduction of the criminals' threat to society can be truly shown in their subjective feelings of regret, it is difficult to assess their subjective emotions regarding repentance. Researchers (Geng & Zhang, 2016) proposed that an assessment system is necessary to comprehensively evaluate criminals' repentance, such as a psychological evaluation mechanism or a questionnaire mode.

Similarly, in the tort of infliction of emotional distress, the assessment of emotion remains an issue of dispute. In the workplace, it is not uncommon for employees to suffer from anguish, fright, or grief which directly result from their employers' intentional or reckless actions such as discrimination or verbal abuse (Austin, 1988). However, the difficulty associated with emotional damages is to distinguish where the defendant exceeds the limit and to discern the level of the plaintiff's emotional distress on a unitary standard. For example, elusive and vague terms defined in the Tort Law of the United States, such as "extreme emotional distress" and "the defendant's conduct was outrageous" lead to "entirely different things to different judges" (Fraker, 2008), which results in diverse decisions in different contexts.

2.3 Feminism and Law

In *Feminism and the Power of Law* (Smart, 1989), Smart argued that the power of the law only disqualifies women's experience and knowledge and ignores their concerns only because the law is a reflection of the masculine culture. MacKinnon held similar views as she rejected the male view of sex in the rape law. She claimed that the rape law does not protect women because it is male-gendered (MacKinnon, 1991). She also promoted a feminist or ungendered jurisprudence which can truly represent women and women's experience (MacKinnon, 1991). As discussed in the previous section, there is the need to establish a mechanism to assess or quantify emotions in the scope of the law. The reforms in the law associated with emotions can potentially push towards the construction of feminist jurisprudence, as emotion is one of the core conceptions in feminism.

2.4 Quantification of Emotions in the Private Sector

The private sector has already incorporated the quantification of emotions in recent years, using technologies such as sentiment analysis (Dave et al., 2003). Sentiment analysis is a fast-developing technology to systematically identify and quantify affective information by using natural language processing, content analysis, computational linguistics and biometrics. During

2000s, there has been an outbreak of sentiment analysis which focuses on product reviews published by customers on the internet (Dave et al., 2003). Nowadays, many companies are using this technology on various topics including customer review, content on social media, and so on for various purposes.

Companies including IBM, Intel and Twitter have started to use sentiment analysis in the 2010s based on employees' internal blogs, posts on internal social networking sites, and surveys to extract key words, analyze employees' sentiment, and discover issues that employees have strong opinions about (King, 2015). By identifying and responding to these issues, these companies seek to maintain good communication with their employees in order for better retainment.

Unilever started to track customers' reviews since 2018 and updated this approach in 2020 by extending its technology to sentiment analysis (Unilever, 2020). By analyzing reviews and ratings that are published on different sites across its markets, Unilever recognizes key words, identity common themes, and create scores for products. Using the insights, Unilever is able to create products with good quality and deliver good customer experience. For example, Unilever identified lots of leakage issues with its home care products in China and it then redesigned the packages.

In the field of marketing, sentiment analysis is widely used to associate customers' emotions with customer satisfaction and potential future sales. Researchers (Park et al., 2018) have conducted research to analyze major topics, tourists' emotions and hot spots in Disneyland with social media analytics and geographic information system analysis. Studies like this one propose new frameworks for marketers to understand their customers better.

After seeing the successes of utilizing sentiment analysis in the private sector, I want to extend the use of such technologies to the public sector, especially the administrative law, and focus on the issue of administrative bureaucracy and transparency during the process of requesting open government information.

3. Case study

In this case study, I will use sentiment analysis and detect emotions in communication between me and the Departments of Education of 34 municipalities in China. I will apply a model based on Tensorflow on dialogue data collected from our phone calls.

3.1 Background

According to Article 27 of *Open Government Information Regulation* published on April 4 2007 and revised on May 15 2019 (Open Government Information Regulation of the People's Republic of China (2019 Revision), 2019), in addition to the government information voluntarily disclosed by governments, citizens, legal persons, or other organizations may request relevant government information from the local people's governments at all levels. According to Article 28,

such administrative agencies shall establish and improve their channels for requesting government information.

According to this regulation, there are two parts during the typical process for citizens, legal persons and other organizations to request government information. Firstly, the requester makes requests to the open government information work office of the administrative agency by completing an application form and submitting it via email, letter, fax, online website, or in person. Such application forms require the requester to provide his personal information (name, identity, contact information), the title, document number or other characteristic descriptions of the government information, and means and channels for accessing the information. Secondly, after receiving the request, the administrative agency shall give guidance and notify the requester of supplements and corrections within seven working days from the date of receipt of the request if the request contains ambiguous content. If the administrative agency is capable of making a reply on the spot, it shall do so. If it could not, it shall reply within 20 working days from the date of receipt of the request.

Although it is clearly stated in the administrative law that citizens can request open government information, it is not always easily accessible in reality. In my personal experience with requesting government information from the Department of Education, several problems have hindered me from obtaining the information and these problems might be universal to a lot of people.

Firstly, the application processes can be overly complicated. Typically the Department of Education accepts applications via email, mail, fax, or online application. However, 6 out of the 34 municipalities in China do not accept applications online and 1 municipality only accepts applications via mail or fax. Even if an online application is available, the application form can be inconvenient. Application websites require requesters to register an account to access the form. Sometimes there is a word limit in the application form which is too short to explain my needs fully. Some municipalities even require citizens to provide specific file numbers of documentation related to the information that they need, which can be difficult to find for citizens without deep knowledge of the open information government system. All such inconveniences cause citizens to spend unnecessary time on the application processes.

Besides, the communication between government officials and citizens can be discouraging. In my personal experience, after I submitted the application forms, government officials usually made phone calls to inform me of the result of my application. In our conversations, some officials talked in an impatient manner and paltered with my questions. Some even asked me to cancel my application. This problem actually presented the greatest hindrance to my accessibility to information. Their irresponsible behaviors or negative attitudes made me feel that I was not respected and my demand was not paid attention to. These negative emotional reactions greatly discouraged me from further requesting information. They also led to my distrust in the officials' and governments' capabilities to serve the citizens.

Therefore, in this case study, I want to explore how emotions can help governments to better communicate with citizens and how administrative laws should make improvements to address this issue.

3.2 Data Collection

My methodology to collect data was to request the same pre-specified information from the 34 provincial-level education departments in China. Benchmarking to the U.S. Department of Education, I chose 5 topics provided by the U.S. Department of Education but seldom provided by provincial education departments in China, which include the following:

1. *Campus security information* refers to the number of cases of crimes which have happened on university campus during 2017 and 2020;
2. *Student loan information* refers to the total amount of loan offered by governments, annual repayment ratios, and demographics of students who have received such loans during 2017 and 2020;
3. *Government funds distribution* refers to the types of universities and projects that government funds have been allocated to during 2017 and 2020;
4. *Teacher demographics* refers to teachers' average salaries and benefits, education backgrounds, and gender ratios in universities during 2017 and 2020;
5. *Students demographics* refers to students' ethnicity, race, disability, family income range, and gender during 2017 and 2020.

I recorded and transcribed the content of phone calls between me and government officials during the process of requesting government information.

3.3 Model Setup

I will use Tensorflow to perform sentiment analysis on the datasets, which are responses given by the government officials in our phone calls.

Firstly, after I collect the responses, I divide the sentences into two groups (positive or negative) and label each sentence with a value from 1 or 0 (1 for positive or 0 for negative) according to my emotional reaction in response to government officials' communication. Positive sentences are defined to be responses that make me feel positive and that the response are efficient and helpful during communication. They mainly include making explanations, asking questions or stating facts in a clear and polite manner with reference to specific articles from administrative law or government documentation. Cases are that the government officials refuse to disclose certain information but explain their reasoning clearly and provide the specific articles to support their arguments. I still label these sentences as positive as the officials' responses show their good attitudes which makes me feel respected, even if the result of the response is negative. On the contrary, negative responses are replies that influence my emotions negatively. Examples include the following:

- The officials' behaviors are impolite, for example, interrupting me abruptly, sneering, speaking with an ironic tone or impatiently, and so on;
- The officials are perfunctory in their responses and attitudes, such as not answering my questions directly, refusing to provide further explanation, or speaking without any support of government regulations or documentation;
- The officials make proposals that exploit loopholes in the administrative processes to reduce their workload, for example, asking me to withdraw my applications on my end so that they do not need to push forward my requests.

The above responses make me feel not respected and paltered with, and consequently discourage me from further requesting government information, which violate the ultimate purpose of the communicating with government officials.

Secondly, cleaning of the sentences includes removing punctuation marks. As Chinese words typically consist of two or more characters, I use Jieba to divide sentences into lists of meaningful words and tokenize these lists. As the sentences vary in length, I set the length to be the mean token length plus two standard deviations. Under the assumption that the lengths of tokens follow normal distribution, the length that I use (75 in this case) covers approximately 95% of the samples. I build an embedding matrix which is [numwords, embeddingdim] (Li et al., 2018; Qiu et al., 2018). numwords is the number of words that I use in the dataset and in this case I set it to 50000. Embeddingdim is 300 (Li et al., 2018)

Finally, I split my dataset into train and test sets and use GRU to build my model. When the sentences are inputted, the model will output the prediction of the sentiment of the sentence, which is a coefficient between 0 and 1. If the coefficient is between 0.5 and 1, the sentence is considered to be positive and otherwise it is negative.

3.4 Evaluation

Out of the dataset of 248 sentences, I label 158 sentences to be positive whereas the model predicts 204 sentences to be positive. The following are examples where my opinions and predictions of the model differ.

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[ '[Silence] I don't know what you think, but if you are in a hurry to write this paper [silence], is it necessary to get the thing in early August? ', TRUE, 0.6262503]
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In this response, the government official questions my need in an impatient manner and stops talking twice. In a way, he urges me to stop my application and just accept that no information will be provided. This response makes me feel forced, which negatively impacts my satisfaction with the communication. The model predicts a coefficient of 0.6262, which is considered to be positive. The erroneous prediction might result from the lack of negation in the response. Text wise the response seems that the official simply asks for my opinion but in the context it seems aggressive. Hence it is understandable for the model to give a positive prediction solely based on the text.

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[ 'The first question you asked is that the data on the total amount of state student loans received by Beijing college students provided each year, right? Firstly, because Beijing has two types of colleges and universities, one is ministry-affiliated colleges and the other is municipal colleges. There are more than 30 affiliated colleges and universities. They all cooperate with banks on their own. They are not under our supervision. Then we are only responsible for the national student loans of some municipal colleges, so we can't provide the data you mentioned, that is, the total amount of this loan, we don't have this data now.', False, 0.30860615]
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In this response, the government official provides a detailed explanation of the types of colleges in Beijing, and explains the reason that the information cannot be provided. I consider this response to be positive as the official explains with patience and details, even if she is not able to provide the information. However, the model predicts a coefficient of 0.3086 which is negative. The decision might be made because text wise the response is a negation. I also notice such error in other long sentences which I consider positive but the model predicts negative. It might be due to the length of the sentences and the model might need more long sentences in its train dataset to offer a more accurate prediction.

3.5 Implication

3.5.1 Emotional Value

Emotional value, defined as people's perceived utility derived from the products' capacity to arouse feelings or affection (Sheth et al., 1991). Nowadays, to boost their competitiveness, companies have paid increasing attention to design and user experience, which can influence customers' behaviors and increase their emotional values (Sheth et al., 1991). The superiority of emotional value compared to functional value, the perceived utility derived from functional and utilitarian performance, has been discussed especially by the marketing and consumer goods industries (Kato, 2021). Some research show that functional superiority can be defeated by emotional value that appeal to customers' sensibilities (Kato, 2021). Studies also show that emotional value can contribute more to corporate brand image than functional value (Pinochet et al., 2018),

In the context of this case study, functional value can be viewed as citizens' perceived utility derived from governments' capabilities to fulfill their needs. Do governments disclose the information that I need? How timely can they do that? These are the questions that citizens concern in terms of functional value. In contrast, emotional value is citizens' perceived utility derived from governments' capabilities to arouse feelings. Do government officials show me respect? Do they really care about my needs? Citizens are concerned with their experience when they seek help from governments.

In the past, the time, method and content of government information disclosure were largely determined by governments unilaterally, which made citizens at the downstream of the information chain and passive receivers of decisions made by governments (Kuong, 2019). There was an information asymmetry between governments and citizens and consequently the communication between these two parties tended to be unidirectional. Hence, citizens were naturally inferior to governments in the power relationship. Since 1990s, in China there have been a large number of conflicts and disputes between society and governments, which require governments to intervene (Sun, 2003). However, passive intervention pervades as many studies have seen the inefficiency of government intervention (Tian, 2012; Wu, 2007). Usually citizens need to petition for several times and attract the attention from government leaders to solve their problems. Only when issues cause problems to governments they would be taken seriously (Ying, 2000). Moreover, when governments handle disputes, their ultimate aim is to get things settled. In order to solve the disputes, governments might use multiple methods in a mixed way instead of following the regulations solely (Ying, 2000; Zhao, 1997). For instance, when dealing with disputes of rural land contracts, it is possible for governments to follow the contracts and protect

the interests of the contractors. It is also possible for governments to break contract rules in order to calm villagers' anger (Zhang, 2003). The above situations show that governments attach more importance to citizens' functional value, getting things done, than emotional value. When solving disputes, governments might intervene passively and waste time due to inefficiencies, or they might use rough methods to solve issues as quick as possible. Either way they neglect citizens' emotions during the processes.

However in recent years, the emergence and development of omni media lead to changes in the way that information is produced, disseminated and received, which add new characteristics to the current process of government information disclosure (Kuong, 2019). Information dissemination becomes decentralized, feedback-focused, multi-directional and interactive and governments attach importance to citizens' feedbacks (Xu, 2011). In the same time, citizens become more eager to obtain access to government information and they tend to demand that governments should disclose information in an efficient and timely manner, especially in cases of emergent public events (Kuong, 2019). If governments lack capabilities in responding to citizens' demand, which are manifested in irrational strategies like perfunctory prevarication, selective responses, and direct avoidance, citizens are likely to question and criticize such behaviors (Kuong, 2019). Such phenomena demonstrate that citizens do not only care about getting needs fulfilled but also how governments fulfill their needs.

3.5.2 Gap between Regulations and Implementation

Although the purpose of *Open Government Information Regulation* is to promote citizens' access to government information and transparency in governments, cases are that government officials might abuse or misuse the regulation. According to Article 37 of *Open Government Information Regulation*, when part of the information requested contains content that shall be withheld, the administrative agency shall provide the rest of it which may be disclosed to the public. According to Article 38, if the information requested needs to be processed or analyzed based on the existing government information, the administrative agency may withhold such information (Open Government Information Regulation of the People's Republic of China (2019 Revision), 2019). In my communication with government officials, some have stated that they cannot provide the information requested because they need to do calculation with their data, which is allowed by the regulation. Statistics also show that the percentage of total disclosures out of the total number of applications have decreased from 80% in 2004 to 40% in 2013 in Shanghai (Xiao, 2014). The proportion of partial disclosures has been low with an average of 3.06% from 2004 to 2013 and the proportion shows a downward trend by year even though the government of Shanghai has paid increasing attention in government information disclosure in this time interval (Xiao, 2014). These phenomena show that when implementing the regulation, government officials might abuse the regulation to reduce their workload or they misuse the regulation by applying them in extremely strict manner without flexibilities.

Moreover, the current supervision mechanism is that administrative agencies need to release annual reports on their open government information work, which is stated in Article 49 of the regulation. However, in my communication with government officials, some have encouraged

me to cancel applications or to ask other administrative agencies so that they do not need to process further my applications and my applications will not be recorded in the annual reports.

Hence, it is necessary for the regulation to make improvements to address these issues. For instance, administrative agencies should convert the non-existent information into existence or internally process existing data to promote total disclosures (Xiao, 2014). It is also necessary to promote internal communication between different administrative agencies and simplify internal processes to reduce the possibility of shirking responsibilities (Xiao, 2014).

4. Conclusion and Future Directions

This paper explores the use of sentiment analysis to analyze communication between governments and citizens and presents a possibility of assessing government officials' emotional reactions as a mechanism to supervise governments' services.

There are already cases that natural language processing and deep learning are applied to citizen service hotlines in China. But the applications are mainly automatic responses to questions, categorizing questions and automatic dispatching cases (Department of Big Data of China, 2019). There remains space for more advanced methods for governments to better serve and communicate with citizens. By adopting sentiment analysis models, there exists new opportunities for improved administrative regulations on a feminist basis. There is a possibility to establish an evaluation mechanism which collects data on communication between citizens and governments and assess the extent that government officials respond to citizens' needs. Such mechanism offers opportunities to evaluate the openness of governments on a dynamic basis and can provide evidence for citizens to supervise the work performed by governments.

Still there are issues to be studied further. The texts in this case study are conversational and consequently the linguistic results without context of conversations can be different from participants' own perception of the interaction. Participants' emotions influence each other to a large extent. It is also common for citizens to interact with several government officials at one time. Reinforcement learning in multi-agent networks will be my step of research to address the interactive and dependent nature of communication between citizens and governments. Studies have shown the effectiveness of reinforcement learning in deriving scalable algorithms in networked systems (Lin et al., 2020).

Moreover, conversations are logically and sequentially connected where decisions made are naturally influenced by previous dialogues. I will also explore hierarchical reinforcement learning to find more efficient solutions for sequential decision making problems (Wen Zheng et al., 2020).

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