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# The uninformed budge yet the misinformed buck: performance information and citizen satisfaction

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## ABSTRACT

This article examines the impact of performance information on citizen satisfaction in the context of an environmental information disclosure programme in the U.S. Through a survey experiment on a nationally representative sample, it finds that the impact depends on disconfirmation, which is the difference between performance information and citizens' prior perceptions. However, the impact extends only to the uninformed, who do not have strong prior perceptions, but not to the misinformed, who confidently hold incorrect perceptions. With the misinformed consisting a large portion of the population, the findings have important implications for the use of performance information in public management.

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**KEYWORDS** Expectancy-disconfirmation model (EDM); transparency; performance information; citizen satisfaction; survey experiment

## Introduction

Citizens' evaluation of government performance shapes civic and political behaviours and is a cornerstone of democracy (Carpini and Keeter 1996). If citizens' perceptions of government performance are aligned with objective measures, their behaviours will increase government accountability and incentivize bureaucrats to improve the performance. However, decades of research shows that citizens have limited and often incorrect knowledge of government performance (e.g. Brown and Coulter 1983; Li and Konisky 2023; Van Ryzin 2004). An unwavering calling from the research is that citizens should be better informed, and governments should become more transparent.

Echoing this calling, the wave of 'transparency' reform has swept across many parts of the world (Adeoye and Ran 2023; Cucciniello, Porumbescu, and Grimmelikhuijsen 2017; Li 2023). Every level of government has made massive efforts to publish performance information about qualities of public services, in hope of a more informed citizenry, better bureaucratic accountability, and more effective democratic control of government (Kim 2023). Fulfilling the hopes partly relies on the assumption that citizens can use performance information for better judgement and decisions. But the assumption may not always hold. While some

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studies find citizens do respond to information cues, they also show that citizens' acceptance and interpretation of performance information are often biased by, for example, partisanship and anti-public sector sentiment (e.g. Baekgaard et al. 2020; Brunner, Robbins, and Simonsen 2023; James and Van Ryzin 2016; Jilke 2018; Lee and Kim 2023; Li 2022; Marvel 2015).

One important consideration in studying the impact of performance information is the direction and degree of disconfirmation (Noda 2021). The concept of disconfirmation, which is the difference between performance information and citizens' prior perceptions of performance, derives from the Expectancy-Disconfirmation Model (EDM) (Van Ryzin 2004, 2013) – the dominant model to explain citizen satisfaction. The EDM posits that citizen satisfaction with government performance not only depends on the experienced public service quality but also on how the experiences compare to prior expectations. If the experiences are better than prior expectations, they will increase satisfaction, and vice versa for worse-than-expected experiences. The same logic applies to the impact of performance information provision. If performance information is better than perceived performance, it likely will increase citizen satisfaction, and if it shows actual performance is worse than perceived performance, it will decrease citizen satisfaction.

Failing to model disconfirmation in the examination of the impact of performance information will create several ambiguities. For example, when citizens are presented with performance information, it may generate positive disconfirmation for some individuals while negative disconfirmation for others, and the effects of opposite disconfirmation will cancel each other out, leading to underestimation of the impact. Moreover, many previous studies find citizens of different attributes respond to the same performance information differently. The differences are often attributed to motivated reasoning, but they may also be due to different disconfirmations as citizens of different attributes tend to possess different prior perceptions.

Although numerous experimental studies in the EDM literature have confirmed the disconfirmation process, most of these studies were conducted in hypothetical contexts where respondents were asked to evaluate government performance of a fictional locality. In such hypothetical environment, respondents are more likely to evaluate government performance rationally following information cues. In real world, citizens often have strong emotional attachment to the places where they live and possess deeply engraved pre-existing conception of local public services developed over a long time (Andersen and Hjortskov 2015; Jilke 2018; Jilke and Baekgaard 2019), which may cloud how they evaluate government performance (e.g. Baekgaard and Serritzlew 2016, 2020). Thus, the validity of the EDM and its contingency conditions in real world still await to be studied.

This study addresses some of the limitations by examining how citizen satisfaction responds to performance information in the context of a major environmental information disclosure programme in the U.S., the Toxics Release Inventory (TRI). Specifically, with a nationally representative sample of 1,000 respondents of the U.S. population, I measure respondents' prior perceptions of local environmental quality at zip code level, then provide randomly selected half of the respondents with object performance information derived from the TRI and compare respondents' satisfaction between those who received the performance information and those who did not. I analyse how performance information provision affects citizen satisfaction conditional on the direction and degree

of disconfirmation. Moreover, I distinguish and contrast responses between the uninformed citizens, who possess incorrect, but weak perceptions of government performance, and the misinformed citizens, who confidently hold incorrect perceptions (Kuklinski et al. 2000).

The results show that the impact of performance information does depend on the direction and degree of disconfirmation. It increases citizen satisfaction when disconfirmation is positive (better than citizens' prior perceptions) and decreases satisfaction when disconfirmation is negative. The larger the disconfirmation, the larger the impact. However, the impact of disconfirmation extends only to the uninformed. Misinformed citizens resist it, and their evaluation of government is unmoved by performance information.

This study contributes to the understanding of performance information disclosure and the EDM. It provides more clarities on the impact of performance information on citizen satisfaction by explicitly modelling disconfirmation. It also extends the EDM by testing the disconfirmation process in a more realistic context with a nationally representative U.S. sample and identifying an important contingency condition (uninformed vs. misinformed; strength of prior perception) of its application. With the misinformed consisting a large portion of the population, the findings have important implications for the use of performance information in public policy and management.

## Literature review and theoretical expectation

### *Performance information and citizen satisfaction*

Research has long shown that citizens' subjective perceptions of government performance deviate from objective measures (e.g. Andersen and Hjortskov 2015; Brown and Coulter 1983; James 2011; Van Ryzin 2004). The discrepancy raises concern about citizens' ability to provide correct incentives for bureaucrats to improve public services (Baser and Tan 2023). The concern has prompted massive efforts in many countries to make performance information more accessible to citizens (e.g. Adeoye and Ran 2023; Cucciniello, Porumbescu, and Grimmelhuijsen 2017; Kroll 2015; Meijer 2013), with the expectation that performance information would make citizens more informed of the qualities of public services and, as a result, more rational in their evaluation of government performance.

While results from experimental studies do offer some support for the argument by showing that positive (negative) performance information often leads to higher (lower) levels of satisfaction (e.g. James 2011; James and Moseley 2014; Porumbescu, Neshkova, and Huntoon 2019), a far more common finding from this strand of literature is that citizens are inclined to engage in confirmation bias and motivated reasoning to defend their prior preferences, attitudes, beliefs, or identities, which results in biased interpretation of performance information (e.g. Andersen and Hjortskov 2015). Two of the most extensively examined biases are partisan bias and bias associated with anti-public sector sentiment.

Partisan bias has received strong support from the literature. When citizens are exposed to positive performance information, supporters of the incumbent experience a much larger increase in their satisfaction with government performance (James 2011). When citizens' partisan identities have been accentuated, the bias in their evaluation of government performance also intensifies (Baekgaard et al. 2020;

James and Van Ryzin 2016). Moreover, citizens change their evaluation of government performance after elections depending on whether the parties that they are affiliated with win the election and become in control (Jilke 2018; Jilke and Baekgaard 2019).

When it comes to anti-public sector bias, findings are less conclusive. Some studies show that citizens associate public sector organizations with inefficiency and inflexibility, which negatively bias their assessment of government performance (e.g. Marvel 2015), but others do not find such bias (e.g. Lee and Kim 2023; Meier et al. 2022; Meier, Johnson, and An 2019). While the whole citizenry's negative bias towards the public sector is in debate, Baekgaard and Serritzlew (2016) demonstrate that individual citizens who prefer public service provision, compared with those who prefer private service provision, are more acceptive of information that indicates public organizations have better performance and less acceptive of information that indicates the opposite, which accords with the argument of motivated reasoning.

The core argument for the impact of performance information is a disconfirmation process, in which the provision of new information updates citizens' inaccurate prior perceptions of government performance, which further leads their satisfaction levels to change. Thus, it is critical to model disconfirmation in analysing the impact as omission of it will create several ambiguities.

First, provision of information could mean disconfirmation of different direction and degree for different people. For people who perceive public services to be of very high quality, performance information likely will not live up to their high perceptions and information provision thus will likely create a negative disconfirmation, and we expect them to become less satisfied, and vice versa for people who perceive public services to be of very low quality. In a sample of respondents, there may be people who experience negative disconfirmation and people who experience positive disconfirmation, and the impact of information provision on the two types of people will cancel out. There may also be people whose prior perceptions are about right, and information provision does not provide anything new and thus is not expected to have a large impact. If we do not consider disconfirmation, analysis will not be able to provide clear answers about how citizens respond to performance information.

Moreover, the different disconfirmations generated by information provision may systematically associate with people of different characteristics. In the context of information provision, disconfirmation, which equals actual performance minus perceived performance, is equivalent to but in opposite direction of misperception, which equals perceived performance minus actual performance. Since people with certain attributes are predisposed to hold certain perceptions and/or sorted into communities with certain levels of actual performance, they may possess systematically different misperceptions. Because of the equivalency between disconfirmation and misperception, the disconfirmation from information provision may also differ systematically for people of different attributes. Comparing responses from people of different attributes to information provision without considering disconfirmation/misperception may create misleading results. Take the most examined attribute, partisan affiliation, as an example. If Republicans and Democrats hold different prior perceptions, the disconfirmation from information provision will be different for them. Without considering disconfirmation/misperception, we are uncertain if partisans' different

responses are due to different disconfirmations or their different interpretations of the same disconfirmation.

### ***Expectancy-Disconfirmation Model (EDM)***

The EDM was originally used by marketing scholars (Oliver 1980) to understand consumers' satisfaction with private products. Since its introduction into public administration by Van Ryzin (2004), it has also become the dominant model to explain citizen satisfaction with public services. The core component of the EDM is the process of disconfirmation. Specifically, the EDM argues that citizens possess some prior expectations about the quality of public services. If their experience of government performance exceeds their expectations (positive disconfirmation), their satisfaction level would increase, and vice versa for worse than expected performance.

The argument is strongly supported by empirical evidence (for a recent review, see Zhang et al. (2022)). Earlier research shows that disconfirmation is positively associated with citizen satisfaction across a wide variety of public services, such as road conditions, street cleanness, and general service, in the US and UK (e.g. James 2007; Morgeson 2012; Poister and Thomas 2011; Van Ryzin 2004, 2005). A major challenge the earlier observational research faces is to prove that the relationship from disconfirmation to satisfaction is causal as the correlation could be due to reverse causality or omitted variables. To overcome the challenge, recent studies increasingly use experimental approaches (e.g. Andersen and Hjortskov 2015; Favero and Kim 2020; Grimmelikhuijsen and Porumbescu 2017; James 2011; Van Ryzin 2013), and the contexts of these studies also expand into other developed countries, such as Denmark (Filtenborg, Gaardboe, and Sigsgaard-Rasmussen 2017; Hjortskov 2019), the Netherlands (Thomassen et al. 2017), and Japan (Noda 2021), and developing countries, such as Mexico (Petrovsky, Mok, and León-Cázares 2017) and China (Chen et al. 2022). All these studies unanimously confirm the disconfirmation process of the EDM.

One limitation of the existing experimental studies on EDM is that they are primarily conducted in hypothetical scenarios constructed by researchers. These studies often start by informing survey respondents that they are going to evaluate public services in a fictional locality. Then, respondents will be randomly given different information (usually on fiscal conditions) that implies different qualities of public services. This is to manipulate respondents' prior expectations. Respondents then are shown different performance of relevant public services (e.g. pictures that show different levels of street cleanness in (Van Ryzin 2013)). The procedures create four randomized groups, who experience different combinations of high/low expectation and high/low performance that lead to different types of disconfirmation. The impact of disconfirmation can be identified by comparing the satisfaction of different groups.

The 'vacuum' environment constructed by researchers is great for testing basic tenets of the EDM, but when we apply the theory to explain real-world phenomena, we need to consider the complexities of reality and identify boundary conditions of the theory (Bertelli and Riccucci 2022). Specifically, the 'vacuum' environment usually pertains to evaluation of public service in a fictional locality that respondents are not attached to and have no other information about other than the styled treatments provided by researchers. But citizens in real world have higher stakes at and are

strongly emotionally attached to public services of the localities where they live (Andersen and Hjortskov 2015). They have usually formed their beliefs about local public services over a long time (Jilke 2018; Jilke and Baekgaard 2019). Engraved beliefs often bias citizen's acceptance of new information and evaluation of public services (e.g. Baekgaard and Serritzlew 2016, 2020; James 2011; Marvel 2015; Teodoro and An 2018), thus casting doubt on the validity of the disconfirmation process in real world.

In addition, since experiments conducted in 'vacuum' environment often manipulate respondents' expectations with clear fiscal information, respondents usually develop strong corresponding expectations. But this may not be true in real world. Some citizens may know little about certain public services and do not have clear expectations (James 2011) because they may only have limited experience with these public services, or qualities of the services, such as environmental protection, are hard to observe or require significant resources to obtain relevant information. These citizens, who do not have strong beliefs in their expectations, are common (James 2011; Kuklinski et al. 2000), and they may have quite different responses to performance information compared with citizens that hold strong expectations.

This study addresses these limitations by applying the EDM in the context of a real-world information disclosure programme with a nationally representative sample of the U.S. population. It also investigates how the disconfirmation process works differently for uninformed vs. misinformed citizens, an important yet overlooked distinction in the performance information and EDM literature.

### ***Uninformed vs. Misinformed***

When a citizen is *informed*, she possesses correct perception of government performance. However, opposite to the informed, that is when one holds incorrect perception, there are two types of individuals (Alvarez and Franklin 1994; Kuklinski et al. 2000). If an individual has strong confidence in her incorrect perception, she is *misinformed*. If she is not confident about her incorrect perception, she is merely *uninformed*. The existing literature largely overlooks the distinction and conflates the two types of citizens. However, there are strong reasons to believe their responses to performance information may differ.

Classic public opinion theory argues that citizens' attitudes are highly malleable (J. R. Zaller 1992). Specifically, the discourses of policy elites – such as politicians, interest groups, and the media – have a large influence over how citizens evaluate public policy. The reason is that many citizens do not possess specific knowledge about policy or government performance (J. Zaller and Feldman 1992). That is, they are ambivalent when asked to answer relevant questions by pollsters (Alvarez and Franklin 1994). The ambivalence makes them subject to the influence of recent events, framing of elite messages, and information provided in surveys (Christensen and James 2022). Because of the ambivalence in their perceptions, this type of citizens conforms to the description of the uninformed who have no confidence in their perceptions.

However, lack of knowledge about public policy and government performance does not preclude all citizens from developing factual beliefs. Research finds that many people fall back on their existing preferences, and infer factual beliefs that are consistent with their preferences (these factual beliefs may be incorrect) (Kuklinski et al. 2000). Moreover, these inferred beliefs become more entrenched over time and grow



into hard data for many people (Srull and Wyer 1979). This type of citizens corresponds to those with confidence in their perceptions.

How will the two types of citizens respond to performance information? The key to understand their responses lies in individuals' tendency to avoid dissonance with their beliefs and preferences (Festinger 1962). In the EDM literature, the tendency is encapsulated in the assimilation effect, which describes a phenomenon that citizens assimilate their satisfaction evaluation towards their previous expectation to reduce cognitive dissonance (Van Ryzin 2004). In the information provision context, when people come across new information that conflicts with their prior perceptions, they may pursue either an accuracy goal by updating their perceptions and relevant attitudes, or a directional goal to maintain consistency with their existing beliefs and preferences (Taber and Lodge 2006). For those who firmly believe in their perceptions, contradicting information will cause them more intense dissonance, and they are more likely to pursue the directional goal by ignoring the new information or interpreting it in ways that are consistent with their existing beliefs and preferences (Kunda 1990).

Thus, I hypothesize the disconfirmation process to work for the uninformed, who do not have strong prior perceptions of government performance, and expect it to fail, or work to a lesser degree, for the misinformed, who have strong confidence in their prior perceptions.

## Policy context and performance information

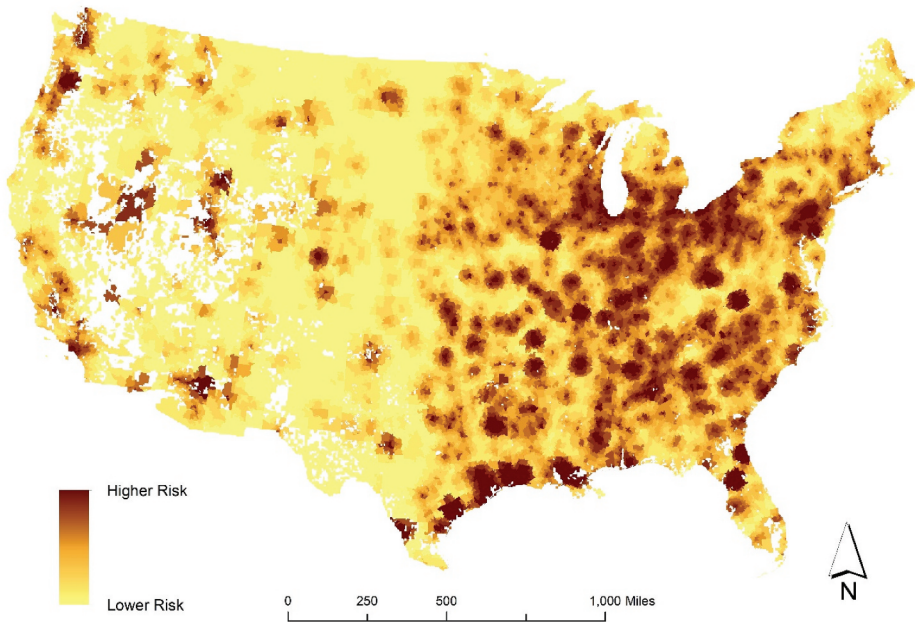
The policy context to test the hypothesis is the Toxics Release Inventory (TRI). Established by the Environmental Protection Agency (EPA) in 1986, the TRI is a major environmental information disclosure programme in the U.S. that aims to enhance local preparedness for chemical emergencies and motivate citizens and other stakeholders to press business and government to take actions to reduce emissions of toxic chemicals (U.S. EPA 2013).

The TRI collects and publishes information about the use of toxic chemicals that may threaten human health or harm the environment across the U.S. on an annual basis. It requires major industrial facilities to report how much each of the more than 700 covered chemicals is released into the environment and managed through recycling, energy recovery, and treatment. For the calendar year of 2021, more than 21,000 facilities submitted TRI data to the EPA, reporting 29.30 billion pounds of TRI-listed chemicals as production-related waste. Of this total, 89% was recycled, combusted for energy recovery, or treated. Only 11% (3.30 billion pounds) was disposed of or otherwise released into the environment. These releases have large impact on the environment and health. For example, Currie and Schmieder (2009) found that a two standard-deviation increase in releases of the TRI chemical toluene, a common volatile organic compound, is associated with a 2.7% points increase in the incidence of low birth weight at the county level. The effect is likely to be much larger in locations in proximity to the emitting facilities.

This study uses the Risk-Screening Environmental Indicator (RSEI), a risk measure derived from the TRI data, as the performance measure. Specifically, to better understand the risk from toxic emissions, the EPA has developed the RSEI model. The model incorporates information about the amounts and location of emitted toxic chemicals, chemicals' fate and transport through the environment, and each chemical's relative toxicity to calculate a risk measure for each 810-metre-by-810-metre grid cell that,



## Zip Code Toxicity Concentration Risk Score for 2018



**Figure 1.** Zip code Risk-Screening Environmental Indicator (RSEI) score for 2018. Source: Author's computation based on EPA's RSEI Model Microdata (Version 2.3.8)

when combined, covers the entire U.S. Following instructions of the RSEI model, I generate a RSEI score for each zip code in the contiguous U.S. by calculating a weighted average of the grid cell RESI (weighted by the sizes of the overlapping areas between a zip code and the grid cells). The score is based on toxic air releases in 2018, the latest year that the RSEI data were available for at the time of the survey. [Figure 1](#) shows the RSEI scores for zip codes in the contiguous U.S.

The zip code RSEI score measures relative risk from toxic air emissions for a zip code. The zip code system was created by the U.S. postal service to handle mails and delivery. It has become a common geographic concept for the public to conceptualize a neighbourhood. For example, information on housing price, household income, public safety, public school quality, insurance quotes among other aspects of living, is often organized by zip code. Based on the Census Bureau's tabulation, there are about 41,683 zip codes in the US. On average, each state has about 834 zip codes (50 states) and each county has about 13 zip codes (3,143 counties). But their sizes vary greatly. While there are 93 zip codes in Manhattan of New York City (33.58 square miles), the largest zip code, in a sparsely populated area of Nevada, covers 10,000 square miles.

This study measures performance at zip code level – instead of larger areas such as county or state because citizens may find performance information at a smaller geographic level more relevant to themselves and their family. Although the geographic coverage of a government is much larger than a zip code, the environmental quality of a zip code is nonetheless shaped by government actions. Moreover, environmental quality, the public service examined in this study, also varies within the jurisdiction of

a government. The zip code level performance is a closer match to one's experience of environmental quality. Previous studies show that individuals tend to be more responsive to direct experience of or proximity to environmental events or risk (e.g. Egan and Mullin 2017).

This study uses performance information in a comparative format. Specifically, the performance information is the percentile ranking of a zip code's environmental quality based on the RSEI score among all zip codes in the contiguous U.S. Since the RESI score cannot be directly translated into tangible health outcomes – such as mortality, life expectancy, or rates of various diseases – that citizens are more familiar with, the comparative format makes the performance metric more intuitive and concrete. Social comparison information has also been found to be most effective at affecting citizen evaluation of government (Charbonneau and Van Ryzin 2015; Olsen 2017) and widely used in previous studies (e.g. Baekgaard and Serritzlew 2016; James 2011).

An important question arises from the comparative format is who/what to compare to. Although a zip code could be compared with other zip codes in the same county, in the same state, or with neighbouring zip codes, this study compares zip codes nationwide as the performance measure is constructed to be comparable across the nation. Moreover, recent studies (e.g. Kuziemko et al. 2015) on the relationship between citizens' preferences for redistributive policy and their knowledge of relative personal income also adopt a nationwide comparison. Although comparisons to other reference groups may also shape citizen's evaluation of government performance, I believe the nationwide comparison used in this study is a reasonable and meaningful choice.

The performance information used in this study (zip code level environmental quality) differs from that used in other studies in a few ways. While previous studies largely focus on information about public services that citizens regularly experience – such as cleanness of streets and waiting time at government agencies, government performance in environmental protection is more obscure. Although everyone experiences environmental quality and many rank protecting the environment as a top priority of government (Pew Research Center 2023), barring extreme pollution cases, citizens often do not have good knowledge of local environmental quality and, as a result, tend to develop perceptions that are highly influenced by their beliefs and preferences (Kuklinski et al. 2000). As discussed earlier, citizens also tend to have strongest resistance to information that is inconsistent with their beliefs and preferences. The situation highlights both the necessity and challenges of using information disclosure to inform citizens, providing an interesting case for studying the impact of performance information.

A second difference lies in the indirect link between the performance metric and government actions. Many of the existing studies have examined public services that are directly provided by government, such as street cleaning, trash collection, etc. However, environmental quality is largely directly determined by behaviours of business instead of government (e.g. Li et al. 2019). Nonetheless, government plays critical roles in shaping the performance. Government agencies assume central roles in the siting, permitting, regulating, and monitoring of polluting facilities, and studies have found that pressure from regulators is the top motivator for business to improve their environmental performance (Blackman, Li, and Liu 2018; Delmas and Toffel 2008). Citizens also attribute the responsibility of providing a healthy and clean environment,

at least partly, to government (Li 2021). Deep involvement of government in enhancing environmental quality makes the information relevant to citizens' evaluation of government. Similar arrangements, where public services are not solely and/or directly delivered by government agencies, are common in complex contemporary governance system (Cheng and Li 2022; Moynihan et al. 2011), ranging from drinking water supply, healthcare provision to public education and restaurant hygiene.

A third issue of performance information on environmental quality is the potential fluidity of pollutants, which makes it hard to decide if a government is actually responsible for the environmental risk in its jurisdiction as pollution could be from other jurisdictions that it has no authority over. This would be the case for global pollutants such as greenhouse gas. For the performance information that this study focuses on – environmental risk from toxic air emissions, while these emissions disperse, studies show that their impacts on air quality are still largely local and dissipated beyond 1 mile radius of an emitting facility (Currie et al. 2015).

## Survey experiment and data

### Survey experiment and measurements

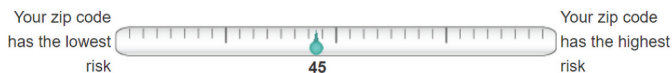
Data to test the hypothesis came from a survey that was administered on a representative sample of 1,000 adult respondents (age >18) in the contiguous U.S. by YouGov, an internet-based market research firm, in February 2020. YouGov created the sample by drawing respondents from their opt-in panel to match a target sample based on the 2018 American Community Survey.

In the survey experiment, I first collect the pre-treatment baseline information, such as demographic, socioeconomic, and political characteristics of the respondents. In this step, I also assess all respondents' perceptions of government performance on the specific issue through the question below.

*Toxic chemicals can cause significant adverse effects on human health and the environment. Every year, the Environmental Protection Agency (EPA) requires industrial facilities to report information on the releases of toxic chemicals to the environment. Incorporating the reported information on the amounts of toxic chemicals released and risk factors such as toxic chemicals' transport through the environment and their relative toxicity, the EPA generates indicators to compare the potential risk from toxic chemicals among geographic areas.*

*If we rank all zip codes in the contiguous U.S. from the lowest risk to the highest risk from toxic chemicals, how do you think your zip code compares to other zip codes? Please give your best estimate on the rule/thermometer below.*

Respondents answer the question on a thermometer, shown in Figure 2, and the answers are their prior perceptions. Specifically, we use the share of zip codes with worse environmental quality/higher risk than a focal zip code to measure the zip code's



Your estimate: The potential risk from toxic chemicals for your zip code is higher than **45%** and lower than **55%** of the zip codes.

**Figure 2.** Assessment of prior perception. Source: Snapshot from the survey

*performance*. It ranges from 0 to 100. In **Figure 2**, the perception of performance is 55, meaning that the respondent thinks the specific environmental quality in her zip code is better than 55% of other zip codes in the country.

Following this question, I ask respondents to answer ‘*how confident are you that your estimate would be approximately correct?*’ Respondents who are ‘not at all confident’ or ‘only a little confident’ are classified as the *uninformed* (if their perceptions are incorrect), while those who are ‘moderately confident’, ‘very confident’, and ‘extremely confident’ are classified as the *misinformed* (if their perceptions are incorrect).

In the second step, I apply the treatment by providing respondents in the treatment group information about the actual performance of their zip codes based on the computed RSEI scores, along with their own prior perceptions. For respondents in the control group, I show them only their own prior perceptions. The *disconfirmation* is the difference between the objective metric and a respondent's perception.

In the third step, I assess all respondents’ satisfaction with the local and federal governments by asking them to answer the questions ‘*how satisfied are you with the local/federal government’s performance to prevent pollution from toxic chemicals?*’ in a 5-point Likert scale. I evaluate citizens’ satisfaction with two levels of government because both levels of government play important roles in shaping the performance. In the U.S., environmental protection is often characterized by a federalism system, where authorities and responsibilities are shared between the federal and state/local governments. While the federal government sets standards and supervises enforcement, state/local governments conduct the day-to-day regulating activities. Local governments also influence the environmental quality of a certain locality through zoning and land use requirements. The complexity of environmental protection and interplays among different levels of governments make it hard to decide in advance how citizens may assign responsibility and blame/prize. Thus, I ask about their satisfaction with both the federal government and local government, respectively.<sup>1</sup>

### **Descriptive statistics**

**Table 1** reports the summary statistics by treatment/control. The randomization is successful. All the pre-treatment measures between the two groups are similar, and none of the differences is statistically significant. Looking at the overall sample, people tend to overestimate the performance in their neighbourhoods. While they, on average, estimate the performance of their zip codes to be 57, the average actual performance is lower, at 36.

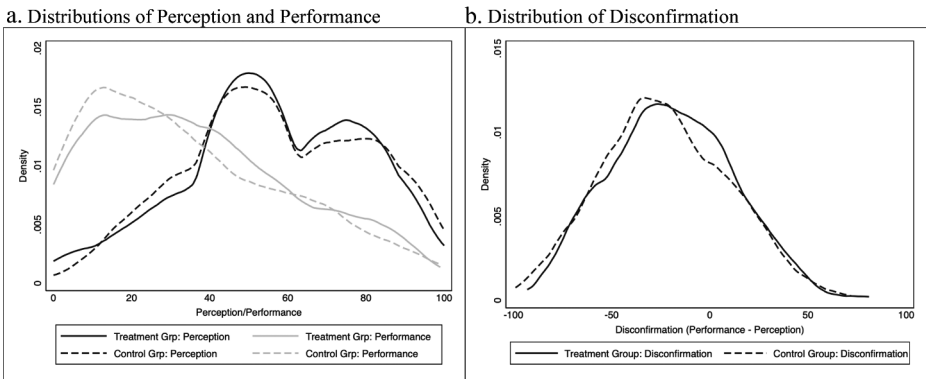
**Figure 3** further illustrates the distributions of perception, actual performance, and disconfirmation by control/treatment group. The distribution of perception (Panel A of **Figure 3**) shows a large cluster around 50, indicating a tendency of many people to assess their neighbourhoods to be average.

The rest of this section compares respondents with confidence and those without. **Figure 4** illustrates the distributions of perception, actual performance, and disconfirmation for the two groups. Panel A shows that for people without confidence, the cluster of respondents whose perception is at the middle (around 50) is even larger, probably a result of a higher tendency for people to pick the middle point when they have no idea of the asked performance. Other than this difference, the distributions of

**Table 1.** Summary statistics.

	Overall	Control group	Treatment group	T-test (p-value) of the difference
<b>Demographics</b>				
Male	0.47	0.47	0.46	0.66
Age (in years)	48.76	48.73	48.80	0.95
White	0.65	0.64	0.67	0.26
Black	0.12	0.12	0.11	0.92
Hispanic	0.15	0.15	0.15	0.79
Married	0.46	0.47	0.46	0.80
Has college degree	0.29	0.30	0.29	0.78
Democrat	0.40	0.39	0.41	0.65
Republican	0.39	0.41	0.37	0.24
Liberal	0.27	0.27	0.27	0.94
Conservative	0.35	0.36	0.34	0.43
<b>Before treatment</b>				
Perception (0–100)	56.87	57.31	56.42	0.54
Actual Performance (0–100)	35.76	34.54	36.98	0.13
Disconfirmation (Performance - Perception)	-21.11	-22.77	-19.45	0.10
(Performance - Perception)				
Not Confident in Perception	0.36	0.37	0.35	0.47
<b>Post treatment</b>				
Satisfaction with local gov.	2.57	2.60	2.53	
Satisfaction with federal gov.	2.34	2.40	2.29	
<i>N</i>	1,000	500	500	

Satisfaction measures are in 5-point Likert scales. All other measures are proportions unless specified.

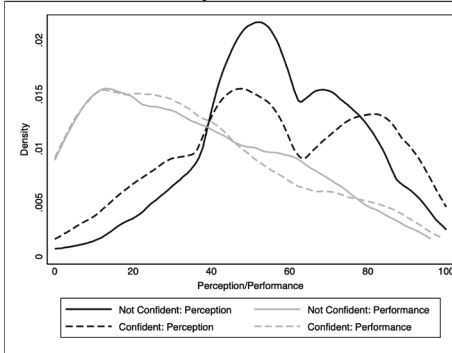


**Figure 3.** Distributions of perception, performance, and disconfirmation by treatment/control.

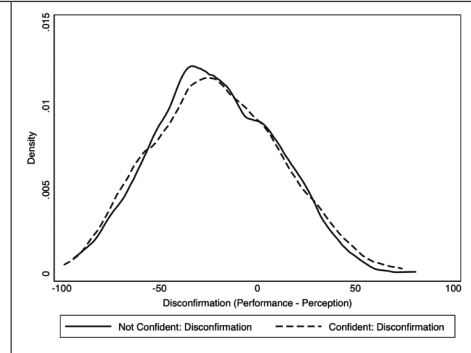
actual performance (Panel A) and disconfirmation (Panel B) are quite similar between the two groups.

Table 2 reports the correlation coefficients between perception and actual performance for the two groups, respectively, to assess whether people who live in places with better performance also tend to have better perception of it. It shows that for people who are confident, there indeed is a decently strong correlation (coefficient = 0.158, p-value = 0.000). But for people without confidence in their perceptions, the correlation is weak and insignificant.

a. Distributions of Perception and Performance



b. Distribution of Disconfirmation

**Figure 4.** Distributions of perception, performance, and disconfirmation by confidence level.**Table 2.** Correlation between perception and actual performance.

	Overall Sample	Not Confident	Confident
Correlation Coefficient	0.125	0.050	0.158
P-value of Correlation Coefficient	0.000	0.343	0.000

**Table 3.** Share of respondents with correct perceptions.

	Overall Sample	Not Confident	Confident
Correct Perception ( $-11 < \text{Disconfirmation} < 11$ )	0.202	0.185	0.212
Correct Perception ( $-16 < \text{Disconfirmation} < 16$ )	0.277	0.283	0.274
Correct Perception ( $-21 < \text{Disconfirmation} < 21$ )	0.358	0.361	0.356

Then, do respondents with confidence and those without differ in the accuracy of perception? Some previous studies (e.g. Kuklinski et al. 2000) show that people who have more confidence in the correctness of their political knowledge tend to be less correct. Here, we examine if it is the case in this research context. Of course, we do not expect respondents to come up with the exact rankings of their zip codes. Instead, we define a perception as ‘correct’ if it is within a certain distance from the actual performance. Table 3 reports the shares of respondents who possess correct perceptions with a buffer distance of  $-/+$  10, 15, 20, respectively. It shows that across the three definitions, the shares of respondents with ‘correct’ perceptions are similar between those with vs. without confidence, suggesting there is no systematic difference in the correctness of their perceptions.

Now that we have some definitions of the correctness of perception, although arbitrary ones, we can calculate the shares of uninformed citizens (i.e. those who hold incorrect, but weak perceptions) and misinformed citizens (i.e. those who confidently hold incorrect perceptions). The statistics suggests that both groups are common. If we use the  $-/+15$  cut-off, Table 3 shows that about 28% of the overall sample (and within each group) are informed citizens (those who hold correct perceptions). In Table 1, we see that 36% of respondents are unconfident and 64% are confident. If we exclude the roughly 28% within each group who hold correct perceptions, there will be about 26% ( $36\% \times (1-28\%)$ ) uninformed respondents and 46% ( $64\% \times (1-28\%)$ ) misinformed respondents in the sample.

## Methods

The main goal of the analysis is to estimate and compare the impact of performance information conditional on disconfirmation for the uninformed and misinformed. To achieve this, I estimate the below model separately for respondents with confidence and those without.

$$Y = \beta_0 + \beta_1 * Treatment + \beta_2 * Disconfirmation + \beta_3 * Treatment * Disconfirmation + \varepsilon \quad (1)$$

$Y$  is citizens' satisfaction.  $Treatment$  is a dummy variable and equals 1 for respondents in the treatment group, who received correct performance information.  $Disconfirmation$  is the difference between actual performance and perception. At a certain level of disconfirmation, the impact of information provision is  $\beta_1 + \beta_3 * Disconfirmation$ .

Technically speaking, we are not estimating the effect of performance information conditional on disconfirmation since only respondents in the treatment group received performance information and experienced disconfirmation and the concept does not apply to respondents in the control group. A more accurate way to characterize the conditional factor is misperception. Misperception is the difference between perception and actual performance (perceived performance – actual performance). It is opposite, but equivalent of disconfirmation (actual performance from information provision – perceived performance). In this study, all respondents' perceived performance is measured before the treatment, and the actual performance (risk) of their community is also long determined before the treatment. Since both inputs to calculate misperception are pre-treatment characteristics, so is misperception. We want to compare the satisfaction of respondents in the treatment group with respondents in the control group with the same level of misperception. Since misperception is a pre-treatment characteristic, estimating the treatment effect conditional on it is like estimating the treatment effect conditional on any other pre-treatment characteristics such as gender or education. Because of the equivalence between misperception and disconfirmation, the difference in the variables to condition on is only semantic. In this article, I use disconfirmation as the conditional factor to be consistent with the terminology of the EDM.

Equation (1) specifies a linear interaction between treatment and disconfirmation, which assumes that the effect of treatment changes at a constant rate along disconfirmation and that positive and negative disconfirmations have symmetric impact on satisfaction. Previous studies yield conflicting results on this matter. While some have shown that citizens may exhibit negative bias and are more affected by negative performance information than by positive information (e.g. James and Moseley 2014), others did not find evidence for it (e.g. James 2011). To test if we should consider negative bias in this study, I first conduct a semiparametric kernel estimation, which flexibly traces the marginal effect of the treatment across the full range of the moderator (disconfirmation) (Hainmueller, Mummolo, and Xu 2019). Results from the semiparametric approach are reported in Figure A1 in the Appendix. The results suggest that a linear relationship can reasonably approximate the interaction effect in this study.

A second issue arises from the interpretation of the estimated impact  $\beta_1 + \beta_3 * Disconfirmation$ . At a given level of disconfirmation, the impact is causally identified by comparing the satisfaction level between respondents in the treatment



and control groups with the same level of disconfirmation. However, when comparing the magnitude of the impact across the range of disconfirmation, the interpretation of the comparison is not causal. In the experiment, the level of disconfirmation is not manipulated but instead simply measured. Respondents with different levels of disconfirmation may differ in other attributes as well. As a result, if the impact of information provision varies across disconfirmation levels, it is not clear if the differences are due to different disconfirmation levels or the differences in other attributes.

The same issue applies to the comparison of the impact of information provision between the uninformed and misinformed. Even if we find that the uninformed and misinformed respondents that have the same level of disconfirmation respond to performance information differently, we are unclear if the difference in their responses is due to their uninformed/misinformed status or differences in other characteristics that are correlated with the uninformed/misinformed status.

To address this problem, I first investigate the correlations between uninformed/misinformed status, disconfirmation, and a set of factors that have been identified in previous studies as important factors that explain citizens' interpretation of performance information, including partisanship, ideology, gender, education, and rural/urban status (e.g. Baekgaard and Serritzlew 2016, 2020; James 2011; Porumbescu, Neshkova, and Huntoon 2019). The results (see the correlation matrix in Table A1 in the Appendix) show that neither uninformed/misinformed status nor disconfirmation have strong correlations with these factors, alleviating the concern that respondents' different responses to performance information across disconfirmation levels and between the uninformed and misinformed are due to other confounding factors. Furthermore, I add these important potential confounders and their interactions with the treatment status as covariates to Equation (1). This will rule out the potential roles of these factors in explaining citizens' different responses to performance information. Results with and without potential confounders in the model are similar (see the results section).

Another consideration about the model pertains to how to measure disconfirmation for the uninformed given that, by definition, they do not have any strong prior perception. Since all respondents did provide their prior perceptions, in the main model, disconfirmation is operationalized as 'performance – perception', which is the same as for the misinformed, for easier comparison. Alternatively, if we treat the uninformed as with no prior perception, we can also operationalize disconfirmation simply as the 'performance'. From a technical perspective, the two approaches do not differ substantively. Since the uninformed do not have strong prior perceptions, when they answer the question about their perceptions, they are likely to just pick random numbers. And the estimated coefficient on a variable ('performance') would be similar with that for a new variable that is measured as the difference between the same variable and a random variable ('performance – perception/random variable'). Results from the alternative approach are reported in Table A3 and Figure A3 in the Appendix, and they are similar with the approach used in the main analysis.

## Results

I estimate Equation (1) with respondents whose disconfirmation is within the (–80, 40) range because observations beyond this range are sparse (about 5% of the observations are beyond this range), which makes estimation beyond this range unreliable

**Table 4.** Impact of performance information on satisfaction with local government.

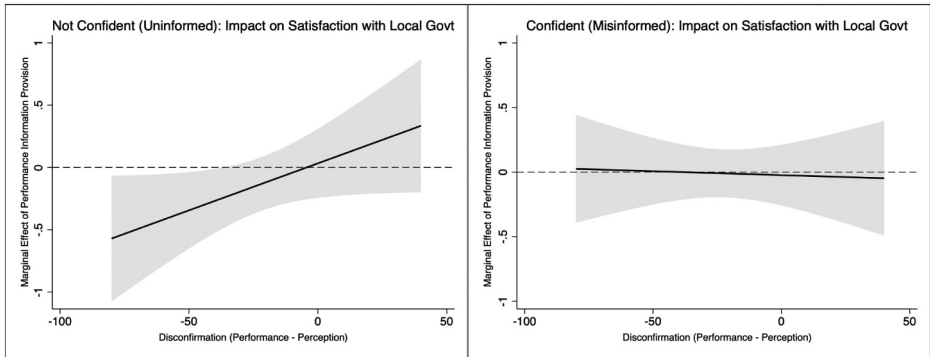
	(1)		(2)		(3)		(4)	
	Not Confident (Uninformed)				Confident (Misinformed)			
	Satisfaction (Local Gov.)		Satisfaction (Local Gov.)		Satisfaction (Local Gov.)		Satisfaction (Local Gov.)	
Treatment	0.033 (0.140)	0.028 (0.205)	−0.023 (0.120)	−0.143 (0.175)				
Disconfirmation	−0.003 (0.003)	−0.003 (0.003)	−0.001 (0.002)	−0.001 (0.002)				
Treat. * Disconf.	0.008* (0.004)	0.008** (0.004)	−0.001 (0.003)	0.000 (0.003)				
Male		0.187 (0.154)		0.034 (0.132)				
Treat. * Male		−0.024 (0.220)		0.019 (0.186)				
College		0.023 (0.158)		0.059 (0.143)				
Treat.*College		0.107 (0.233)		0.184 (0.201)				
Conservative		0.298* (0.163)		0.481*** (0.135)				
Treat.*Conser.		0.159 (0.229)		0.232 (0.192)				
Rural		−0.022 (0.217)		0.047 (0.200)				
Treat.*Rural		−0.271 (0.306)		−0.066 (0.274)				
Constant	2.269*** (0.104)	2.085*** (0.149)	2.681*** (0.087)	2.451*** (0.127)				
N	306	306	553	553				
R <sup>2</sup>	0.017	0.067	0.002	0.078				

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

(Hainmueller, Mummolo, and Xu 2019).<sup>2</sup> Table 4 shows the regression results for the impact of performance information provision on citizen satisfaction with local government, respectively, for the uninformed and misinformed, and Figure 5 further visualizes the impact.

For the uninformed, in column (1) of Table 4, the coefficient on ‘treatment’ is not substantially and statistically different from zero, indicating that when there is no disconfirmation, provision of performance information does not have any impact. The coefficient on the interaction term ‘treatment \* disconfirmation’ is statistically significant at 0.1 level, suggesting that the impact of information provision does depend on disconfirmation, which supports the disconfirmation process of performance information provision. For a respondent who experiences a disconfirmation of  $-40$  (the middle point of the range of negative disconfirmation), information provision decreases satisfaction with local government by  $-0.287$  ( $0.033 - 0.008 \times 40$ ), which represents a 11% decrease from the baseline satisfaction level of 2.6.

Panel A of Figure 5 (based on column (1) of Table 4) visualizes the impact of performance information across the range the disconfirmation for the uninformed. It shows that performance information decreases citizen satisfaction with local government if new information shows worse than perceived performance, and vice versa for information that indicates better than perceived



**Figure 5.** Impact of performance information on satisfaction with local government. Notes: This figure shows the impact of performance information on satisfaction with local government at different levels of disconfirmation, separately for unconfident respondents (uninformed) and confident respondents (misinformed). Solid lines are point estimates; shades are 95% confidence intervals. The figure is based on results from column (1) and column (3) of Table 4. At each level of disconfirmation, the impact is calculated as  $\beta_1 + \beta_3 * Disconfirmation$  based on estimates of Equation (1).

performance. In addition, as the magnitude of disconfirmation becomes larger, so do the effects.

In contrast to the uninformed, column (3) of Table 4 and Panel B of Figure 5 show that the misinformed are not affected by performance information. In column (3) of Table 4, the coefficient on the interaction term ‘treatment \* disconfirmation’ is very small and statistically insignificant, and in Panel B of Figure 5, information provision has no impact on satisfaction with local government, regardless of the direction and magnitude of disconfirmation.

As noted in the methods section, the comparisons of the impact of performance information across the range of disconfirmation and between the uninformed and misinformed may be confounded by differences in other attributes of respondents. One approach to address the problem is to include into the model potentially important confounders – especially factors that have been identified in previous studies as important in explaining citizens’ interpretation of performance information – and their interactions with the treatment status. Columns (2) and (4) of Table 4 report estimates from such an approach, and they are almost identical to the results from the main analysis (Columns (1) and (3)), highlighting the robustness of the findings to this concern.

Both local and federal governments influence local environmental quality, as has been explained in the data section. This study does not aim to disentangle the responsibility of each level of government in shaping the performance or investigate which level of government citizens attribute blame/prize to. Instead, it assesses and reports citizens’ satisfaction with different levels of government. Results reported above pertain to citizen satisfaction with local government. Results relating to satisfaction with federal government are reported in Table A2 and Figure A2 in the Appendix. They show that when it comes to satisfaction with the federal government, for the uninformed, coefficient on ‘treatment \* disconfirmation’ becomes slightly smaller and less significant, compared with that on satisfaction with local government. For the

misinformed, the coefficient on ‘treatment \* disconfirmation’ remains insignificant, suggesting that the misinformed continue to resist performance information.

Lastly, I report results in Figure A3 and Table A3 in the Appendix for the uninformed when disconfirmation is operationalized as the performance instead of the difference between performance and perception since, by definition, the uninformed do not have strong prior perceptions. Comparing with results from the main model, the coefficient on ‘treatment \* disconfirmation’ becomes slightly smaller and less significant. However, the patterns of the disconfirmation process still exist. Satisfaction increases when respondents receive good performance information and decreases when they receive poor performance information. The marginal effect of performance is also similar to the marginal effect of disconfirmation in the main model.

## Conclusion and discussion

This study applies the Expectancy-Disconfirmation Model (EDM) to examine how performance information affects citizen satisfaction in the context of a real-world information disclosure policy. It finds that the impact depends on how the performance information compares to citizens’ prior perceptions. It decreases citizen satisfaction if the information shows actual performance is worse than perceived, and vice versa if information is better than perceived. This provides evidence for the disconfirmation process, a core component of the EDM. The results, however, also show that the disconfirmation process only applies to the uninformed – citizens who hold incorrect, but weak perceptions. The misinformed – citizens who confidently hold incorrect perceptions – resist performance information.

Findings of this study are largely consistent with recent studies on this topic that citizens do respond to performance information, but their acceptance of new information is not uniform (e.g. Baekgaard and Serritzlew 2020; Porumbescu, Neshkova, and Huntoon 2019). They tend to accept information that conforms to and resist information that contradicts their existing beliefs and preferences (e.g. partisanship and anti-public sector sentiment) (e.g. Baekgaard et al. 2020; Jilke 2018). These findings make several contributions in our understanding of the impact of performance information and the EDM.

First, they have enriched the EDM by testing it in a more realistic context with a nationally representative U.S. sample and considering contingency conditions for its validity. While research on the EDM abounds in different countries and service domains, most of the existing studies were conducted in hypothetical contexts where respondents were manipulated to develop their expectations and evaluate government performance of fictional localities. Citizens are more likely to act ‘rationally’ and accept performance information neutrally in such ‘vacuum’ environment. It is unclear how the EDM will hold up in real-world situation when citizens are more emotionally attached to, have higher stakes in, and possess deeply engraved beliefs and preferences over, the performance of their governments. This study is conducted in the context of a real information disclosure policy in the U.S. Consistent with previous studies, the findings support the disconfirmation process – the core component of the EDM. But they also underscore the contingency conditions for the validity of EDM. While the disconfirmation process worked as expected for the uninformed, it failed to change the satisfaction of the misinformed, who have strong confidence in their prior expectations.

Second, the distinction between the uninformed and misinformed has import implications for performance information disclosure. Citizens' poor knowledge of government performance is a well-documented phenomenon (e.g. Andersen and Hjortskov 2015; Brown and Coulter 1983). But the degree of confidence that citizens have in their knowledge is often overlooked. In political science research, scholars have found that the distinction plays an important role in citizens' evaluation of public policy (e.g. Kuklinski et al. 2000). This article applies this distinction in the study of citizen satisfaction, and it reaches a similar conclusion: while the uninformed heed performance information, the misinformed resist it.

The difference between the uninformed vs. misinformed underscores important obstacles to achieve the goals of informing civic and political behaviours and enhancing democratic accountability through performance information disclosure. First, misinformed citizens, who tend to resist performance information, consist of a large portion of the population. In the representative sample of this study, the misinformed account for 46% of the sample (26% are uninformed and 28% are informed). And the performance that this study measured (local environmental quality) is a relatively obscure performance domain. In other domains, such as education, healthcare, economy, and law enforcement, even larger shares of the population may hold strong prior perceptions, and performance information disclosure will face an even larger obstacle to achieve the goal of informing citizens.

In addition, people who feel strongly about a certain issue or general government performance will tend to hold stronger perceptions (Kuklinski et al. 2000). They are also those who are most likely to exert their power through civic and political actions (Melissa 2004). Performance information provision will have the largest impact if it can affect the attitudes and behaviours of this group of citizens. Yet it fails to do so in this study. The obstacle echoes with the paradox identified by Baekgaard and Serritzlew (2020) that citizens who have the numerical skills to correctly interpret performance information do not respond to the information.

Understanding how to design performance information disclosure to overcome these obstacles is critical and should be a priority of future research. For example, some research has explored how citizens respond to performance information from different sources, such as government, non-profits, or other independent sources (e.g. James and Van Ryzin 2017). A related issue is the channels that citizens receive performance information from. This study provides performance information in a clinical approach. In real world, citizens may receive information from newspapers, social media, websites, or TV programs among other channels. It is unclear how citizens may respond differently in these situations. In addition, this study only involves a one-shot provision of performance information. Future research could explore how repeated exposure to performance information may change citizen satisfaction and the endurance of the impact of performance information.

The format of information may also matter. Researchers have already shown that citizens respond differently to information that is based on social comparison vs. historical comparison (Olsen 2017). This study employed social comparison information, and it has its idiosyncrasies. For instance, it is measured at a relatively granular level (zip code); the comparison is made nationwide; the information is presented numerically. Citizens may find the information not very easy to understand or not compelling and may respond differently to information that is constructed differently. For example, the literature suggests that vivid information is more likely to affect

changes compared with dry, statistical information (Loewenstein, Sunstein, and Golman 2014). Future research could test how different formats of performance information works in informing and motivating citizens.

Another caveat in interpreting the results lies in that the comparisons of the impact across disconfirmation level and between the misinformed and uninformed are correlational instead of causal. To mimic how an information disclosure policy would work in real world, this study merely measures (instead of manipulates) citizens' disconfirmation level and their confidence in their perceptions. However, the disconfirmation level and the uninformed/misinformed status could be correlated with other attributes of respondents. Measures have been taken in this study to alleviate the concern but nonetheless cannot eliminate it. To make the comparisons causal in experimental settings, we need to manipulate citizens' disconfirmation levels (as many studies in the EDM literature managed to do in hypothetical settings) and their uninformed/misinformed status. Despite the limitation, the findings are important for performance information disclosure. The goal of performance information disclosure is often to better align citizens' evaluation of government with objective performance. The comparison of the impact across disconfirmation level in this study, despite being correlational, demonstrates that performance information provision can achieve this goal, at least for the uninformed.

Finally, the results of this study face potential threats from a relatively small sample size. Estimates of the responses of the uninformed are only statistically significant at 0.1 level, and the study may potentially be underpowered with only 1,000 respondents, given the interaction effects conditional on disconfirmation on top of a split-sample analysis. Additional replication studies – with larger sample sizes and in other service domains – are needed to further investigate the validity of the findings.

## Notes

1. I did not ask about citizens' satisfaction with state government, which is an omission in hindsight.
2. Results with the full sample, reported Figure A4 and Table A4 in the Appendix, are almost identical to these reported in the main analysis.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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