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The reduction of effective feedback reception due to negative emotions in appeals

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Citizens' daily appeals are generally accompanied by negative sentiment, yet little is known about the impact of negative emotions on official response behaviors in a closed online environment. This study analyzed over 2.6 million environmental appeals and their handling records from China's closed complaint platform to explore how individual negative emotions affect department response behaviors. The results showed that negative emotions could cause departments to respond more rapidly and decrease the likelihood of the citizens receiving department assistance. Whether the appeal can be handled efficiently also depends on the oversight of the department and the respondent's implementation. Negative emotion towards the department is more likely to lead to a failed handling of the appeal. In addition, when citizens face serious hazards, such as health risks, negative emotions are understandable. Negative emotional appeals concerning health risks receive more time and effective intervention by departments. This paper sheds light on the role of negative emotions in shaping feedback and provides suggestions for improving individual appeal expression and departmental response behavior.

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Introduction

In their daily lives, people frequently encounter problems that necessitate assistance from a supervision or service department. For example, citizens might report pollution in a river to the Environmental Protection Department (Buntaine et al. 2021), or employees might raise concerns about workplace unfairness with the Human Resource Department (Feuille and Chachere 1995). The ability to initiate an appeal is vital to citizens and public relation administration. It helps citizens protect their rights and interests and allows organizations to understand public opinion. Most appeals are resolved through private and confidential interactions between residents and departments (Jiang et al. 2019). As personal or public interests have been compromised, appeals may be accompanied by negative emotional expression (Dwertmann and Kunze 2021). However, little is known about whether individual negative emotions in the private interactions affect the response behavior of the department. Therefore, our study explores the relationship between individual emotional expression and departmental reactions.

The manner in which appeals are expressed may affect whether the department receiving the appeal provides effective feedback (Shen et al. 2019; Wang et al. 2022a, 2022b). Typically, an appeal contains both objective and emotional information. Objective information mainly refers to the facts surrounding when and where an event occurred and the details of the event, which impact the clarity and authenticity of the event (Brady et al. 2017; Liu et al. 2017). Emotional information, on the other hand, primarily manifests as negative feelings following harassment, such as anger and concern for one's personal circumstances (Merry, 2010; Bolderdijk et al. 2013; Xin et al. 2022). When they are faced with these negative emotions, department personnel may respond inferentially or emotionally according to the "emotion as social information" theory (Van Kleef 2010). An inferential reaction is the result of inferring the cause of negative emotions, allowing responders to feel the urgency of the complainant's psychology and to provide timely and effective interventions (Van Kleef et al. 2010; López-López et al. 2021). This reaction aligns with the theory of social norms; that is, when people's personal interests are damaged, the expression of anger is understandable (Heffner and FeldmanHall 2022). In contrast, an emotional reaction is a kind of rebellious psychology against negative emotions, which may cause department to treat relevant appeals negatively (Van Kleef et al. 2011). Therefore, the question arises: does negative emotional information help complainants receive effective responses from departments?

Existing research indicates that negative appeals on an open network platform prompt departments to respond quickly. In such environment, negative content easily attracts citizens' attention and spreads rapidly (Robertson et al. 2023), prompting departments to provide feedback as soon as possible (Kelley and Davis 1994; Goes et al. 2014; Wang et al. 2019; Robertson et al. 2023). This is because any user can access these appeals, evaluations, or feedback material, which have a strong impact on an organization's reputation and image (Chen et al. 2019). Consequently, both government agencies and enterprises have sufficient motivation to respond to negative appeals on open platforms. However, this does not imply that negative appeals can receive effective responses in the private interactions. The appeal and feedback content on closed communication platforms can only be accessed by complainants and department staff. It is difficult to propagate and draw the attention of other users, regardless of the appeal or feedback information. As a result, the relevant departments have more discretion in their responses, raising doubts about their ability to effectively address negative emotional appeals.

In this study, 2.6 million records of personal environmental appeals and government responses from China's closed environmental complaint platform were used to examine how negative emotions in individual appeals affect department response behavior. We utilized the long short-term memory model (LSTM) to analyze the appeal contents. In addition, we sorted out the department feedback records for each appeal. Specifically, we calculated the response time to reflect the timeliness of the response and compiled the department interventions and final handling evaluation in the records to reflect the efficacy of the response behavior. The comprehensive database includes the complainant's emotional state, emotional object, and objective information characteristics, as well as the response time of the department, the measures taken, and the evaluation by a third-party department. The high-resolution data allow us to correlate the characteristics of appeal content with the department's response. Furthermore, the study of these data removes the effect of negative emotion contagion on the department response behavior. Our analysis revealed that negative emotional appeals are more likely to receive timely official reactions but less likely to obtain assistance or intervention from departments. When the individual negative emotions are directed at the department, a failure of appeal handling is more likely to occur. Negative emotional appeals with health risk information are more likely to receive department assistance, but these responses take more time. This research provides valuable insights for optimizing individual appeal expression and departmental feedback behavior.

Methods

Data. The citizen appeals and department responses utilized in this paper were collected from the appeal platform of the Ministry of Ecology and Environment. These appeals originate primarily from the WeChat platform, telephone reports, official websites, and social media accounts. Due to the introduction of WeChat and online reporting platforms in 2015 and 2017, respectively, the number of public appeals has grown considerably (as shown in Fig. 1).

Building on the noticeable increase in public appeals, we further examined the efficiency and effectiveness of government response. According to the philosophy of service-oriented governance, responsiveness involves prompt responses to the public's demands and the implementation of effective problem-solving methods (Schumaker 1975). Therefore, the government's response is evaluated from two key aspects: the ability to provide timely guidance (Nie and Wang 2023) and the effectiveness of addressing public concerns (Linde and Peters 2020). To assess timeliness, we measured the time taken by the government to respond (*Time*). For effectiveness, we evaluated whether the government provided clear handling opinions (*Suggestion*) and analyzed the final handling reviews of appeals (*Evaluation*). The changing trend of government response is shown in Fig. 2. Compared to 2016, most of the appeals in 2020 received clear responses. Responses were provided to most personal appeals within one week. After the handling is completed, the supervisory department would review the entire complaint handling process, and the review results will be divided into three levels: unsatisfactory, satisfactory, and good. We observed the distribution of unqualified results over the years and found that there has been minimal change in the distribution.

Text classification model. To investigate the impact of negative emotion on department response, we first analysed the content of the appeal using the LSTM model, which quantifies sentences through word embedding, fully considers context in sentences,
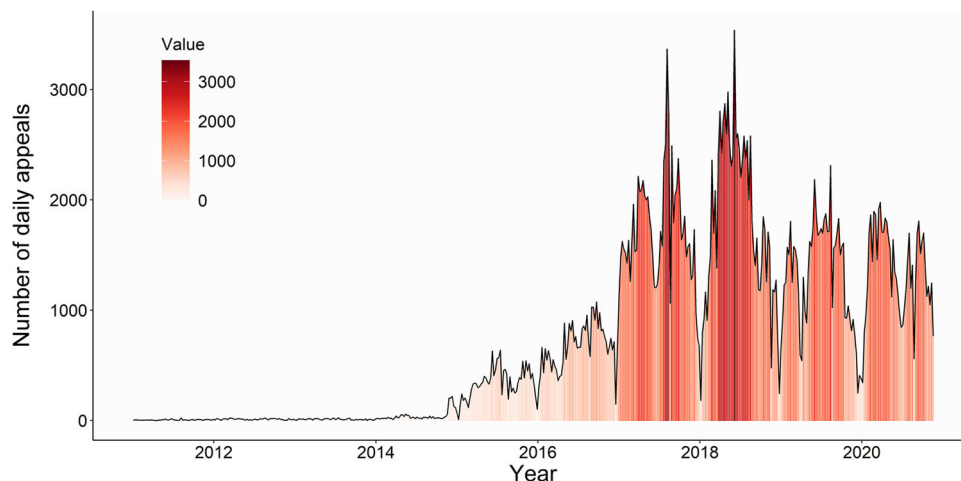
Fig. 1 Change in the number of appeals per calendar day. The graph displays the daily number of environmental appeals, with darker colors denoting a higher frequency of appeals. The Year axis marks the starting point of the year, and the imagery between two points illustrates the trend of appeals over that period. Value signifies the range of appeal numbers.
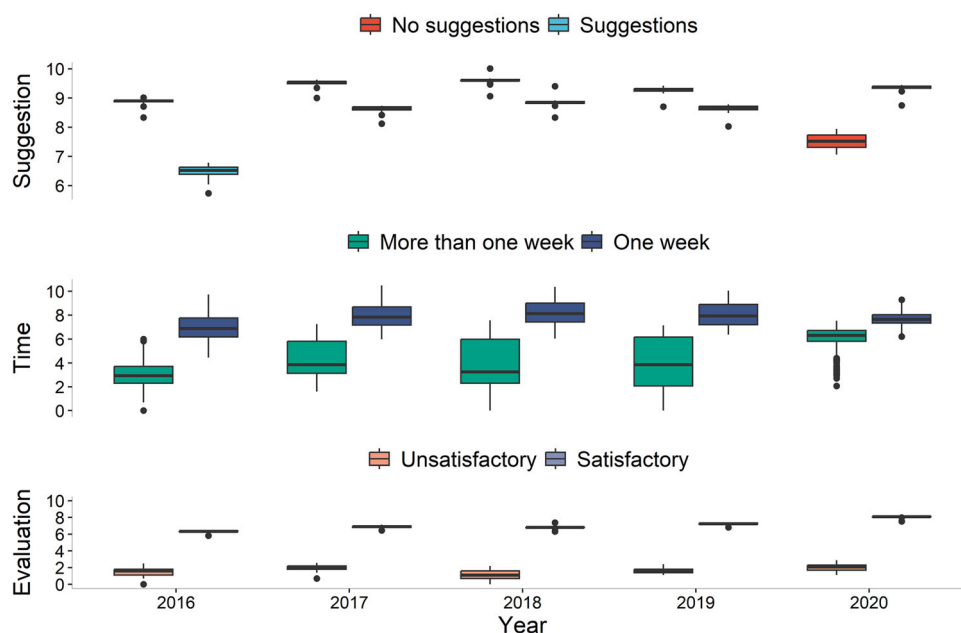
Fig. 2 Distribution changes in departmental responses per year. *Suggestion* pertains to the department's handling opinions regarding appeals. *No suggestions* implies the absence of explicit handling recommendations or actions (which may merely consist of verbal reassurance), whereas *Suggestions* denotes the provision of specific handling recommendations (such as Fines or Production suspension). *Time* refers to the appeal processing time, with *More than one week* indicating a processing time exceeding 1 week, and *one week* indicating a processing time of 1 week or less. *Evaluation* represents the evaluation of the final handling results, where *Unsatisfactory* signifies a case of inadequate handling, and *Satisfactory* indicates that the handling result is above satisfaction.

and successfully increases classification accuracy. The LSTM model is a type of recurrent neural network (RNN) that is commonly used for sequence data processing, such as natural language processing and time series analysis. It considers the character sequence information of the appeal content by overcoming the vanishing gradient problem in traditional RNN, where it is difficult to capture long-term dependencies. The LSTM model achieves this by introducing a memory cell that can store information over character sequences, allowing it to retain important information and selectively forget irrelevant information. Based on extant studies (Glassner 2021; Wang et al. 2022a, 2022b; Yang et al. 2023), we used the LSTM model to classify large-scale demand texts (detailed LSTM architecture see Supplementary Information).

The majority of the analysis outputs from the LSTM model consist of two types of content. The first type is emotional indicators, including whether negative emotions (*Emotion*) are present and whether the negative emotional objects are government departments (*Target*). Negative feelings towards the official handling department may have a larger effect on the attitude and behavior of the handling staff than negative feelings about the appeal events (Huang and DiStaso 2020). The second type is the content aspects of objective knowledge, namely, whether to emphasize the health risks (*Health*) to oneself or one's family and whether to expressly seek official intervention (*Request*). The inclusion of life and health impacts in the appeal can successfully emphasize the gravity of the problem and the need for prompt treatment. Similarly, a clear request for intervention can signify a
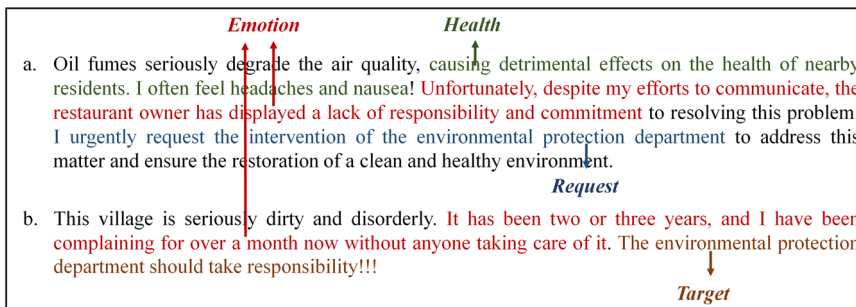
Fig. 3 Characteristics of appeal information from LSTM model. *a* and *b* are two entries randomly selected from the appeal database, with different colors indicating various types of tagged fields.

Table 1 LSTM Classification Indicators.		
Content type	**Variables**	**Measure**
Emotional characteristics	Emotion	which is 1 if negative emotions are present, otherwise it is 0
	Target	which is 1 if negative emotions towards the government department, otherwise it is 0
Other characteristics	Health	which is 1 if health problems are present, otherwise it is 0
	Request	which is 1 if requesting government intervention are present, otherwise it is 0

readiness and urgency to receive official assistance, potentially eliciting a more effective response from the officials.

We began by randomly selecting 20,000 texts from our corpus for manual labeling. Initially, we conducted a basic training session for the researchers to ensure they clearly understood our semantic objectives. Following this, the texts were equally divided into five parts. Each of the five individuals then sequentially labeled the same sample, enabling cross-validation to evaluate the consistency and quality of their labeling. In cases where there was a notable discrepancy in the labels assigned by different personnel, those particular results were set aside. And a new team member would be appointed to relabel these samples, and their work was cross-validated against the existing data to ensure uniformity. The difference in labeling for each part is less than 4%.

In this way, we categorize the characteristics of public appeals into the four distinct categories. Firstly, we analyze the presence of negative emotions and their direction towards government entities. Inspired by research including Izard (1992) and Xu et al. (2020) our analysis focuses on identifying expressions of dissatisfaction, such as complaints, accusations, and calls for change, particularly those aimed at government departments. Secondly, we evaluate health risk concerns within these demands, specifically looking for references to symptoms and conditions like nausea, headaches, sore throats, heart disease, hypertension, and impacts on vulnerable groups such as pregnant women and infants. Thirdly, we assess whether the demands explicitly call for intervention, scrutinizing for clear requests directed at authorities like environmental protection departments or higher-level leadership.

For example, as shown in Fig. 3, two appeals which is randomly selected comprises multiple information features. The first appeal encompasses negative emotions, concerns about health issues, and a strong desire to seek government intervention. Conversely, the second demand corpus comprises unresolved negative emotions and places blame on the environmental protection agency for insufficient regulations.

Before inputting the corpus into the model, we performed preprocessing on a dataset of over two million appeal corpora. Initially, we removed punctuation, special symbols, numbers, and letters from the corpus. And then, we constructed a word segmentation dictionary and a stop list to divide and clean the content of the corpus. Finally, we vectorized the corpus by representing each sentence with a string of numbers.

For the training of the model, we split the labeled dataset, allocating 80% (16,000 texts) for training the model parameters. The remaining 20% (4000 texts) formed the test set, used to evaluate the model's performance. Both the training and testing phases achieved an accuracy rate of 95%, indicating a high level of precision in the model's predictions. With this trained model, we then proceeded to analyze the entire corpus. The specific indicators were as follows (see Table 1).

In addition, we investigated objective information factors that might influence reactions from officials. The objective information primarily consists of the following elements: authenticity, level of detail, whether it is a recurring appeal, and the level of the government handling department. Authenticity is the alignment between the content of the appeal and the real circumstances, and it is given by the handling department. When a complaint is made, the department compensates individuals, such as employees or local residents, for verifying the situation and uploading videos or photos as proof. For example: "The chemical plants are often emitting thick smoke and unpleasant gases." When such complaints are made, the department would post payment tasks on website or dispatch a staff to the location for verification. Upon investigation, if it's discovered that the chemical plant has been closed for over a year and the actual source of the odor and smoke is a nearby waste incineration plant that complies with emission standards, then the complaint against the chemical plant is deemed false.

The level of detail refers to the extent to which the specific details of the appealed event are described. A longer text usually contains more information (Johnson 1981), and we measure this element by the number of characters in the text. Citizens believe that repeated appeals regarding a specific issue may affect the level of the official response (Yang and Holzer 2006). Public revelation of an issue on multiple occasions may alter the level of the eventual official response and management. The hierarchy of processing departments also impacts the final response (Lewis-Beck et al. 2014). Only municipal and county-level departments

handle public appeals, and each local government is responsible for those within its jurisdiction. Therefore, we used whether the processing unit is a county or district department to reflect the level of the processing department. Other factors, such as the source of the appeal, the sort of environmental issues highlighted in the appeal, and the trend of time, also influence the government response to public appeals. These elements were also taken into consideration in our study.

Base regression model. Next, we examined the impact of negative emotions on department responses using the regression model. We first explored the direct effect of negative emotions in the appeal on the department's responsiveness. As shown in Model (1), the dependent variables include response time, whether clear treatment opinions are provided, and whether the handling results is unqualified. Since the processing time for the first dependent variable is represented as an integer variable, we employ negative binomial regression to analyze it. As for the last two dependent variables, which are binary (0–1), we use logistic regression. The primary independent variables consist of *Emotion*, *Target*, *Truth (Authenticity of appeals)*, *Health*, and *Request*. The control variables mainly include *length*, *reporting sources*, *pollution types*, *government treatment units*, etc.

$$Response_i = \gamma_0 + \gamma_1 Emotion_i + \sum_{2}^{k} \gamma_k X_{ki} + \varepsilon_i \qquad (1)$$

where i refers to the individual complainer; γ is the estimation coefficient; ε_i is the disturbance term; *Response* represents the official response; *Emotion* refers to emotional characteristics; and *X* refers to other explanatory variables.

Then, we investigated the moderating effect of negative emotions on the function of objective information. Due to the important role played by truth, health, request and other content, we mainly investigated the moderating effect of emotional characteristics on

these factors in public appeals and official responses.

$$Response_i = \gamma_0 + \gamma_1 Emotion_i + \gamma_2 Emotion_i \times Truth_i + \gamma_3 Emotion_i$$
$$\times Health_i + \gamma_4 Emotion_i \times Request_i + \sum_{5}^{k} \gamma_k X_{ki} + \varepsilon_i \qquad (2)$$

where *Truth* refers to the authenticity of the appeal; *Health* means whether the appeal contains content harmful to life and health; *Request* indicates whether the request for official intervention is explicitly made in the appeal.

Additionally, the study conducts various robustness checks, including the generalization of the LSTM model, the sensitivity of variable measurement and model selection, and causality test (see Supplementary Information).

Results

The impact of negative emotions on access to interventions. Negative emotional information reduces the chance of receiving departmental assistance (Table 2). The odds of department intervention in the appeal is diminished by 10% (1-exp (−0.105)) when negative emotions are incorporated. There are two potential reasons for this difference. First, departments often prioritize appeasing complainants over solving the actual problems in the appeal (Wang et al. 2021). Specifically, negative emotions may induce a worker to focus excessively on the emotional state of the complainants while neglecting the obstacles they experience and failing to provide adequate treatment in a timely manner. Second, when experiencing the negative emotion of the appeal, the department workers who handle appeals are more likely to react emotionally, resulting in a negative reaction to the negative emotional content (Peters et al. 2006; Evans et al. 2015). In this situation, negative emotions are less likely to evoke sympathy and understanding from the worker and are more likely to result in the problem being unaddressed. However, when the complainants' negative feelings are not directed at the actual problems but rather at the supervisory department, this department is more likely to provide intervention. Citizens' dissatisfaction with the department may clarify the inadequacy of its behavior,

Table 2 Effect of negative emotions on department intervention.

	(1)	(2)	(3)
Emotion	−0.344*** (0.003)	−0.105*** (0.004)	−0.057*** (0.006)
Health		0.279*** (0.007)	0.126*** (0.012)
Request		0.005 (0.004)	0.012* (0.006)
Truth		0.010 (0.006)	0.063*** (0.008)
Emotion×Request			−0.010 (0.007)
Emotion×Health			0.217*** (0.014)
Emotion×Truth			−0.096*** (0.007)
Target		0.101*** (0.005)	0.095*** (0.005)
Repeat		0.088*** (0.005)	0.086*** (0.005)
Length		−0.001*** (0.000)	−0.001*** (0.000)
Department		0.079*** (0.004)	0.080*** (0.004)
Type dummy		Yes	Yes
Source dummy		Yes	Yes
Year dummy		Yes	Yes
Province dummy		Yes	Yes
Cons	−0.699*** (0.002)	−2.301*** (0.024)	−2.328*** (0.024)
N	2497501	2493326	2493326
Pseudo R2	0.005	0.213	0.214

The dependent variable, *Response Suggestion*, equals 1 if the department proposes clear intervention measures (such as shutdown, fines, etc.) and 0 otherwise; *Emotion* equals 1 if negative emotions are included and 0 otherwise; *Health* equals 1 if health risk information is included and 0 otherwise; *Request* is a dummy variable equal to 1 if the complainant requests an intervention and 0 otherwise; *Truth* equals 1 if appeal content is true and 0 otherwise; *Repeat* equals 1 if the appeal is made more than once and 0 otherwise; *Target* equals 1 if the negative emotion is aimed at the appeal processing department and 0 otherwise; *Length* indicates the character length of the appeal content; *Department* equals 1 if the appeal handling department is at the city level and 0 otherwise; *Type* represents the dummy variable of different types of appeals, *Source* represents the dummy variable of appeal source; *Year* represents the year dummy variable; *Province* represents the province dummy variable; *N* is the number of observations; and *Pseudo R²* measures the fitness of the regression model. The estimated value of the coefficient indicates the marginal change in the log-odds ratio caused by the increase of one unit of the independent variable. We used the exponential function for calculation and analysis. Robust standard errors are in parentheses.
* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001.
In the estimation, we first examined the effect of negative emotions without control variables, as shown in Column (1), because the impact of negative emotions may be influenced by other factors. Then, we added control variables to estimate the individual effects (Column (2)) and interaction effects of negative emotions (Column (3)).

Table 3 The marginal interaction effect of negative emotions on department intervention.

	Predicted odds		Marginal effects	
	Health = 0	Health = 1	Odds difference	Interaction effect
Em = 0	0.713*** (0.002)	1.067*** (0.013)	1.067-0.713 = 0.354*** (0.013)	0.644-0.354 = 0.291*** (0.015)
Em = 1	0.494*** (0.001)	1.138*** (0.008)	1.138-0.494 = 0.644*** (0.008)	

Parameter calculations on the odds scale; standard error in parentheses.

prompting the department to enhance its supervision and intervention behavior and provide relevant assistance.

Including objective information in an appeal also affects the department response. Appeals related to health or interventions are more likely to receive clear action from departments. Health risk information reflects the severity of the concerns raised in the appeal. Departments are more willing to intervene or offer assistance upon recognizing severe consequences (Chow et al. 2022). For example, "The construction nearby is too noisy" differs from "The construction nearby is too noisy, and the pregnant woman has neurasthenia and cannot rest normally". The latter is more likely to concern department personnel and receive immediate attention. Requests for intervention reflect the complainant's feeling of urgency and desire that the appeal can be effectively resolved by the supervisory department. The complainant's expectation prompts the department to provide assistance. For example, between "A thermal power plant generates black smoke" and "A thermal power plant generates black smoke, please shut it down as soon as possible", the latter is more likely to prompt department action to handle the issue.

Other content characteristics also play a role. Municipal government units tend to intervene more than county or district governments. Appeals with excessive length may cause the handling personnel to miss important information, which is not conducive to encouraging the department to assist. Repeated appeals by complainants can draw official attention and help to obtain clear interventions. In addition, whether it can be addressed by the supervisory department depends on the comprehensive role of emotional and objective information (Hale et al. 2021). We examined the interaction effects of negative emotions and primary objective information characteristics on department responses.

Negative emotional appeals, including health risks, are more likely to receive intervention from the supervision department. The marginal effect analysis of the interaction indicates that the health risks have a greater influence on the negative emotions compared to non-negative emotions (as shown in Table 3). The baseline odds of negative emotional appeals to obtain the intervention is 0.494, and the inclusion of health risk information raises this odds to 1.138. By comparison, the baseline odds of non-negative emotional appeals to obtain departmental intervention is 0.713, but the introduction of health risk information only raises this odds to 1.067. As a result, health risk characteristics increase the odds of the negative emotional reaction by 0.291. As mentioned above, emphasizing a health risk in an appeal highlights the harmfulness of the event to the complainant. Moreover, personnel handling the appeal may prioritize health-related information overemotional information. As a result, when negative emotions and health risk information coexist, the impact of the health risk content takes precedence. Nonetheless, it is reasonable to express negative emotions in an appeal when the appeal event will or has caused severe harm to the complainant (Heffner and FeldmanHall 2022).

However, negative emotional appeals that are authentic and include intervention-requested information are not guaranteed better chances of department intervention. Fully authentic negative appeals actually have a lower possibility of being granted

government support. Some appeals are only partially true and may contain exaggeration, untruthfulness, etc. Full and partial authenticity are not the primary concern of the departments that receive these appeals. Personnel handling the appeal may be drawn to other types of information in the appeal, such as intuitively negative emotions (Oh et al. 2023), rather than giving priority to examining the authenticity of the content. Therefore, the role of negative emotions is the primary driver of the combined effect of negative emotions and content authenticity. Negative appeals with requests for intervention have no significant impact on the intervention. This may be the result of the negative impact of the negative emotion counteracting the positive impact of the intervention request.

The impacts of negative emotions on timeliness. Negative emotions can prompt a department to respond more quickly. The average response time for negative emotional appeals is 0.8 times (exp (−0.229)) that of non-negative emotional appeals (see Table 4). As a result of the evolution of network information technology, responding promptly to prevent the escalation of incidents is essential in both government and enterprise appeal management. To ease the negative feelings of the complainants, the department staff respond promptly. However, when negative feelings are directed at the department, complainants may experience longer wait times for feedback. The department may need more time for internal investigation. Furthermore, the response time is extended when the appeal involves health risks. When severe implications (such as health problems) are possible, the department becomes more cautious (Li et al. 2020; Chow et al. 2022). The department may take more time to confirm the health consequences and make a final judgment.

However, faster responses do not necessarily lead to better outcomes. When handling negative emotional appeals, departments generally respond quickly without a well-formulated plan. Workers prioritize calming the complainants' unpleasant feelings over resolving the actual issues at hand. The handling time for negative emotional appeals concerning authenticity, health risks, and intervention requests is significantly longer. When these elements are part of a negative emotional appeal, departments are more careful and take longer to respond. We further analyzed the marginal effects of interactions and examined the comparative impact of intervention requests, health risks, and authenticity on the average processing time of negative and non-negative emotional appeals (as shown in Table 5). It indicates that the marginal effect of intervention requests and health risks on negative emotions is greater than no-negative emotions. The information of intervention requests and health risk raises negative emotional IRR by 0.314 and 1.46, respectively, surpassing non-negative emotional IRR. The significant marginal improvement effect of health risks suggests that the handling department is more sensitive to environmental pollution's health effects and more cautious in processing than reacting to appease the complainant. However, authenticity increases the IRR of negative emotional appeals by 3.952, which is lower than the improvement level of 4.285 for non-negative emotional appeals. Authenticity serves as a subsequent validation of the appeals made by the handling

Table 4 Effect of negative emotions on timeliness.

	(1)	(2)	(3)
Emotion	−0.184*** (0.004)	−0.229*** (0.005)	−0.286*** (0.009)
Health		0.138*** (0.008)	0.009 (0.010)
Request		−0.006 (0.005)	−0.036*** (0.009)
Truth		−0.224*** (0.009)	−0.254*** (0.011)
Emotion×Request			0.052*** (0.010)
Emotion×Health			0.180*** (0.015)
Emotion×Truth			0.055*** (0.009)
Target		0.034*** (0.006)	0.033*** (0.006)
Repeat		−0.191*** (0.005)	−0.190*** (0.005)
Length		0.000*** (0.000)	0.000*** (0.000)
Department		0.167*** (0.005)	0.167*** (0.005)
Type dummy		Yes	Yes
Source dummy		Yes	Yes
Year dummy		Yes	Yes
Province dummy		Yes	Yes
Cons	1.712*** (0.003)	0.452*** (0.018)	0.483*** (0.019)
lnalpha	1.175*** (0.001)	0.816*** (0.002)	0.815*** (0.002)
N	2333229	2333227	2333227
Pseudo R²	0.000	0.056	0.056

The independent variable, *Response Time*, is the days taken by a department to resolve a complaint from its receipt; *Emotion* equals 1 if negative emotions are included and 0 otherwise; *Health* equals 1 if health risk information is included and 0 otherwise; *Request* is a dummy variable equal to 1 if the complainant requests an intervention and 0 otherwise; *Truth* equals 1 if appeal content is true and 0 otherwise; *Repeat* equals 1 if the appeal is made more than once and 0 otherwise; *Target* equals 1 if the negative emotion is aimed at the appeal processing department and 0 otherwise; *Length* indicates the character length of the appeal content; *Department* equals 1 if the appeal handling department is at the city level and 0 otherwise; *i.Type* represents the dummy variable of different types of appeals, *i.Source* represents the dummy variable of appeal source; *i.Year* represents the year dummy variable; *i.Province* represents the province dummy variable; *N* is the number of observations; *Pseudo R²* measures the fitness of the regression model. Robust standard errors are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
lnalpha is the logarithm of the overdispersion parameter, and H_0: *lnalpha* = 0 indicates that the Poisson regression model should be used. The likelihood ratio test shows significant rejection of H_0, therefore, negative binomial regression should be used. In the estimation, we first examined the effect of negative emotions without control variables, as shown in Column (1), because the impact of negative emotions may be influenced by other factors. Then, we added control variables to estimate the individual effects (Column (2)) and interaction effects of negative emotions (Column (3)).

Table 5 The marginal interaction effect of negative emotions on timeliness.

Panel A: Emotion×Request

	Predicted IRR		Marginal effects	
	Request = 0	Request = 1	IRR difference	Interaction effect
Em = 0	6.329*** (0.026)	6.363*** (0.047)	6.363-6.329 = 0.034*** (0.052)	0.348-0.034 = 0.314*** (0.059)
Em = 1	4.876*** (0.017)	5.223*** (0.025)	5.223-4.876 = 0.348*** (0.028)	

Panel B: Emotion×Health

	Predicted IRR		Marginal effects	
	Health = 0	Health = 1	IRR difference	Interaction effect
Em = 0	6.307*** (0.024)	7.038*** (0.069)	7.038-6.307 = 0.731*** (0.071)	2.191-0.731 = 1.46*** (0.010)
Em = 1	4.837*** (0.015)	7.028*** (0.070)	7.028-4.837 = 2.191*** (0.070)	

Panel C: Emotion×Truth

	Predicted IRR		Marginal effects	
	Truth = 0	Truth = 1	IRR difference	Interaction effect
Em = 0	3.857*** (0.020)	8.141*** (0.037)	8.141-3.856 = 4.285*** (0.042)	3.952-4.285 = −0.333*** (0.049)
Em = 1	3.085*** (0.014)	7.037*** (0.025)	7.037-3.085 = 3.952*** (0.025)	

IRR is Incidence-rate ratio, which is the multiple of the average handling days change; standard error in parentheses.

department. In contrast to authenticity, the handling department places a heightened emphasis on the complainant's attitude and emotional tendencies. In addition, the success of the reaction is also dependent on the outcome of the intervention. We investigated the effect of negative emotions on the intervention outcome.

The impacts of negative emotions on handling results. Negative emotions directed against the department receiving the appeal are more likely to lead to final handling failure than appeals with no negative emotions. Although negative emotions have no significant impact on handling results, when they are aimed at the department receiving the appeal, the handling outcomes are more likely to fail (see Table 6). The department acting does not guarantee that the issues raised by the complainants can be resolved. The outcome depends on whether the department has enforced adequate punitive measures and whether the penalized party is under additional supervision and control. If an appeal contains a negative sentiment

Table 6 Effect of negative emotions on handling results.

	(1)	(2)	(3)
Emotion	−0.014 (0.067)	0.017 (0.081)	0.014 (0.081)
Health		0.095 (0.121)	0.292* (0.133)
Request		−0.139 (0.082)	−0.197* (0.093)
Truth		−0.662*** (0.142)	−0.584*** (0.149)
Target		0.259** (0.096)	0.372** (0.143)
Target×Health			−0.836** (0.301)
Target×Request			0.247 (0.179)
Target×Truth			−0.390 (0.202)
Repeat		0.103 (0.091)	0.105 (0.092)
Length		0.000 (0.000)	0.000 (0.000)
Department		0.015 (0.077)	0.019 (0.077)
Type dummy		Yes	Yes
Source dummy		Yes	Yes
Year dummy		Yes	Yes
Province dummy		Yes	Yes
Cons	−5.416*** (0.048)	−5.497*** (0.583)	−5.541*** (0.585)
N	200864	193253	193253
Pseudo R^2	0.000	0.154	0.156

The dependent variable, *Response evaluation*, equals 1 if the department response is evaluated as unsatisfactory and 0 otherwise; *Emotion* equals 1 if negative emotions are included and 0 otherwise; *Health* equals 1 if health risk information is included and 0 otherwise; *Request* is a dummy variable equal to 1 if the complainant requests an intervention and 0 otherwise; *Truth* equals 1 if appeal content is true and 0 otherwise; *Repeat* equals 1 if the appeal is made more than once and 0 otherwise; *Target* equals 1 if the negative emotion is aimed at the appeal processing department and 0 otherwise; *Length* indicates the character length of the appeal content; *Department* equals 1 if the appeal handling department is at the city level and 0 otherwise; *Type* represents the dummy variable of different types of appeals, *Source* represents the dummy variable of appeal source; *Year* represents the year dummy variable; *Province* represents the province dummy variable; *N* is the number of observations; and *Pseudo R^2* measures the fitness of the regression model. The estimated value of the coefficient indicates the marginal change in the log-odds ratio caused by the increase of one unit of the independent variable. We used the exponential function for calculation and analysis. Robust standard errors are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
In the estimation, we first examined the effect of negative emotions without control variables, as shown in Column (1), because the impact of negative emotions may be influenced by other factors. Then, we added control variables to estimate the individual effects (Column (2)) and interaction effects of negative emotions (Column (3)).

against the department, the handler may respond with a negative attitude or behavior. As a result, appropriate punishment or follow-up supervision may not be implemented, and the actual problems cannot be resolved effectively. This indicates that a monitoring department is not affected by the initial negative emotions of the complainants when providing interventions or assistance. However, when the negative sentiment is aimed at the department receiving the appeal, this affects the department's treatment outcome. Nevertheless, appeals include health risk information are more likely to result in successful resolution. Appeals with a clear description of the severity of the situation may receive more consideration from the handling personnel.

Discussion

In this study, we utilized text data from Chinese environmental appeals and official response to provide empirical evidence on how negative sentiment in individual appeals impedes effective responses. We discovered that negative emotions in appeals can increase the speed of response but do not encourage departments to take effective action. Negative emotions directed towards the department receiving the appeal are likely to lead to incompetent handling. We thoroughly examined social norm theory and emotion as social information theory in this research, analyzing the social function of negative emotion in the context of private interactions between individual citizens and organizational departments. According to social norms, it is natural for individuals to exhibit anger when their own interests are threatened; nevertheless, this anger may not effectively prompt assistance from supervisory or service departments. Negative emotions cannot improve the likelihood of gaining successful responses in the closed platform, with large disparities between individuals and organizations. Therefore, social norm theory is inapplicable to people's daily appeals, and the responses of departments are more consistent with the emotional response path of social information function theory.

The effective handling of negative emotions in appeals is crucial for improving an organization's reputation or credibility. Whether the government or a company must address various appeals from citizens, the organization's reputation is affected by congruence between citizen expectations and organizational actions (Nakayachi and Cvetkovich 2010). Both the effectiveness of the response (Poelzer and Yu 2021) and the complainant's emotional state (Costa et al. 2022) can influence their perception of the organization. However, negative emotions expressed in an appeal decrease the chance of obtaining an effective response. According to the prediction results of the LSTM model, negative emotions were included in more than 60% of all appeals. Appeals that are not effectively addressed may damage the reputation of the organization. Therefore, the department of appeal management at that organization should optimize the processing of negative emotional appeals and enhance the efficacy of its response. Instead of overly focusing on response timeliness, they should give priority to the efficacy of their response. Although timeliness can enhance the feeling of involvement, failing to meet the needs included in appeals in a timely manner might have negative consequences. With the development of digitalization, emotional expression has become increasingly common. Departments should initially focus on the procedural screening of negative emotional appeals and anticipate higher communication costs to address such appeals effectively. Moreover, in response to a high volume of negative emotional appeals, processing departments may establish specialized agencies dedicated to handling these types of appeals.

These results are also instructive for individual citizens when communicating with service or regulatory departments. People often exaggerate the importance of negative emotions in their appeals (Heffner and FeldmanHall 2022). In situations of distress or urgent need for assistance, it is common to express negative emotions such as anger or worry (Russell 2017). However, we found that appeal handlers appear to be unaffected by complainants' negative emotions and provide timely and effective assistance. Consequently, complainants can subjectively modify the content of their appeals to

increase the likelihood of receiving a response that satisfies their needs. For minor issues, such as temporary noise disturbances or the need to replace purchased items, expressing displeasure appropriately may encourage a swift response from customer care. Conversely, for significant problems, such as long-term pollution impacts from nearby manufacturers or workplace inequity, they have high expectations and demands for intervention or assistance from departments. In such case, citizens should minimize the negative emotional content in their appeals and increase the quantity of objective information. For example, including details about health hazards and other evidence demonstrating the severity of the issue can draw more attention from departments.

Data availability

The appeal and response texts, sourced from the online platform of the Ministry of Ecology and Environment in China, is confidential and not permitted for public release. The appeal indicators processed by the LSTM model, response variables and other control variables are publicly available via the following link: https://github.com/we0909/Negative_appeals_and_Response.

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PZ: Conceptualization, Methodology, Writing—original draft preparation, Data curation. BP: Conceptualization, Supervision, Writing reviewing and editing, Funding acquisition. ZM: Conceptualization, Supervision, Writing reviewing and editing. ZL: Supervision, Writing—reviewing and editing. HD: Supervision, Funding acquisition, Writing—reviewing and editing. LC: Writing—review & editing. XZ: Data curation, Writing—reviewing and editing. GC: Data curation, Writing—reviewing and editing.

Competing interests

The authors declare no competing interests.

Additional information

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