

Unveiling the Influence of Transparency in Risk Communication: Shifting from Information Disclosure to Uncertainty Reduction

Abstract

While the importance of government transparency is extensively discussed in risk communication literature, its practical application in risk contexts presents intricate challenges. This study introduces a redefined concept of transparency in the context of risk, covering two dimensions: information disclosure and uncertainty reduction. To investigate the impact of transparency, ranging from mere information disclosure to significant uncertainty reduction, a hierarchical multiple regression model is employed. Specifically, trust in government serves as a benchmark for information disclosure, while indicators for information disclosure strategies and public vulnerability are incorporated into the model as proxies for uncertainty reduction. The proposed model undergoes validation in a city lockdown scenario in China using self-report data from 435 college students, with anxiety serving as a benchmark for transparency outcomes. The findings suggest that indicators of uncertainty reduction (information disclosure strategies, individual vulnerability) exert much larger effects on anxiety than mere information disclosure (indicated by government trust). This implies that government transparency should prioritize uncertainty reduction, involving diverse strategies and addressing public vulnerabilities.

Keywords: Government transparency; uncertainty reduction; risk; anxiety, risk communication

1 Introduction

Government transparency presents an intricate aspect of risk communication. Achieving transparency within the government is a multifaceted undertaking and may not consistently yield advantageous outcomes (Adeoye & Ran, 2023; Zhu, *et al.*, 2021). The simple act of disclosing information may expose societal vulnerabilities, signify government weakness (Grimmelikhuijsen, *et al.*, 2013; Thompson, *et al.*, 2020), potentially giving rise to misunderstandings among the public, evoking adverse emotions, and even prompting irrational behaviors. To illustrate, during the initial emergence of the COVID-19

pandemic, the dissemination of information on a global scale did not necessarily translate into public compliance with recommended safety measures (Michener, *et al.*, 2021). Instead, it heightened public apprehensions, sparking irrational feelings and behaviors like anxiety and panic buying. Under these conditions, it becomes imperative to grasp the functional intricacies of government transparency in the realm of risk communication.

Within the body of government transparency literature, the concept frequently aligns with the practice of governance marked by transparency and accountability, emphasizing the significance of rendering information accessible to the public (Grimmelikhuijsen, *et al.*, 2013). This interpretation places a strong emphasis on making information available to the public, while the clarity and comprehensibility of that information are considered an extra bonus. Interestingly, the idea of uncertainty reduction is often seen as a result of transparency, rather than a fundamental element intertwined within it (Meijer, 2009; Venkatesh, *et al.*, 2016). This raises concerns, particularly in the context of risk, as an excessive focus on the act of openness could prompt governments to disclose information that might not effectively translate into public understanding or compliance (Porumbescu, *et al.*, 2017). Indeed, information disclosure is necessary but not sufficient (Halachmi & Greiling, 2013; Zhu, *et al.*, 2021). This circumstance might result in a superficial display of transparency, lacking the substantial fulfillment of genuine public demand. Moreover, considering the aspect of communication, information holds little value unless it is comprehensible enough to address the public's needs (Venkatesh, *et al.*, 2016). Therefore, it becomes vital to integrate the reduction of uncertainty as an inherent facet of transparency, rather than viewing it solely as an eventual consequence. This leads to the first research question of this study:

RQ1: What role does uncertainty reduction play within the framework of government transparency?

In the realm of risk communication, while disclosing information may be a relatively straightforward process, reducing uncertainty is more intricate, requiring governments to be responsive and openly addressing public needs (Halachmi & Greiling, 2013; Kim & Lee, 2012; Porumbescu, 2015; Zhu, *et al.*, 2021). This suggests that information disclosure does not automatically lead to uncertainty reduction

but requires devising strategies that address the public's needs. Indeed, from a top-down perspective, governments must first gauge the level of trust during risk communication, as the trust-transparency relationship is consistently emphasized in transparency literature (Mansoor, 2021; Venkatesh, *et al.*, 2016). Subsequently, diverse strategies should be formulated for uncertainty reduction. The notion that transparency is predominantly informative is similarly incorrect, as highlighted by research (Hu, *et al.*, 2022a; Zhu & Hu, 2023), particularly during periods of risk when emotional factors come into play. Finally, comprehending the individual variations in personality traits also contributes to improving uncertainty reduction (Millroth & Frey, 2021). These lead to our second research question:

RQ2: How do these factors illustrate the effects of the uncertainty reduction dimension of transparency in risk communication?

In addressing the two research questions above, we first highlight the role of uncertainty reduction, and a theoretical framework for transparency is proposed. This underscores the significance of substantially reducing uncertainty in the realm of risk, transcending a mere focus on information disclosure. Following this, we introduce an uncertainty reduction model outlining how various dimensions of characteristics contribute to reducing uncertainty. The model is empirically validated within the context of a sudden lockdown during the COVID-19 pandemic in China. Lastly, pragmatic strategies are formulated based on the impact of the variables.

1.1 Theoretical framework: Two dimensions of transparency

How to improve transparency for better risk management is not a new question. Previous studies have generally argued that transparency is the key to effective risk management, as it contributes to trust and enhances citizens' compliance with government measures (Barton, *et al.*, 2020). However, there are also skeptics who argue that transparency arrangements undermine governance (Etzioni, 2016; Heald, 2012; O'Neill, 2002). Particularly, while transparency is frequently implemented to promote governance, it may breed risk aversion and increase compliance and control costs (Heald, 2012). Further, Meijer, *et al.* (2018) argued that the key issue with the skeptics is that transparency is often implemented as "dialogues of the deaf" rather than "a productive deliberative engagement". In other words, transparency

might be implemented as a symbolic demonstration of sharing information with the public, instead of genuinely providing open insights into the workings of the governance process. The fundamental question that arises is whether transparency should be understood purely as a standalone process or as a comprehensive approach that aligns with specific intended results.

The existing literature on government transparency largely equates transparency with information disclosure from the government side (Porumbescu, 2015, 2017; Venkatesh, *et al.*, 2016), while the substantial outcome of information disclosure from the public side is considered a separate concept. In our transparency definition, we suggest a modification: government transparency should surpass mere information disclosure. Specifically, in risk management, we assert that information disclosure alone is ineffective unless it significantly diminishes public uncertainty. In this research, we therefore introduce uncertainty reduction as the second aspect of government transparency, emerging from the public-side information disclosure.

Information disclosure is broadly defined as the information provided to the public (Grimmelikhuijsen & Feeney, 2017). In the literature on public administration, information disclosure is identified as an important topic since it is a typical reflection of the new public management style that promotes proactive transparency to win the trust of the public (Mansoor, 2021; Song & Lee, 2016). Information disclosure or government openness is also viewed as a basic remedy for problems associated with democratic government, where transparency in decision-making and disclosing information to the public enhances citizens' trust in government (Grimmelikhuijsen, 2012; Porumbescu, 2017). As argued previously, the transparency literature has largely focused on the information disclosure from the government side (Porumbescu, 2015, 2017; Venkatesh, *et al.*, 2016). In this context, the term "information disclosure" is employed to denote the action of governments revealing information to the public.

Uncertainty reduction pertains to how the government's disclosure of information contributes to enhancing the public's comprehension of the risk. Within the literature on transparency, numerous scholars have emphasized that uncertainty reduction is a crucial aspect of transparency. For instance,

Venkatesh, *et al.* (2016) claimed that transparency and trust can help citizens resolve their uncertainty. Likewise, Meijer (2009) argued that transparency reduces uncertainty. However, there are also studies positing that transparency is negatively associated with uncertainty. For example, O'Neill (2002) argued that simply transparency may not directly lead to uncertainty reduction since misinformation, unsorted information, and flooding information may lead to an increase in uncertainty rather than a reduction in it. In this study, our perspective does not undermine the significance of the information disclosure aspect of transparency. Rather, we place greater emphasis on the overarching goal of reducing uncertainty. In the special context of risk communication, uncertainty reduction also forms an important dimension of transparency. Indeed, if we glean insights from Reynolds and Seeger (2005) that “the immediate communication needs are to reduce the uncertainty, allowing audiences to create a basic understanding of what happened so that they may act appropriately”, it becomes apparent that government transparency in risk communication should go beyond simply information disclosure but employ strategies and address public concerns. Thus, equating transparency solely with information disclosure may introduce bias; incorporating uncertainty reduction into the definition of transparency is essential. Nonetheless, empirical evidence on the separate impact of the uncertainty reduction dimension of transparency remains scant.

2 Methods

2.1 Hypothesis development

To substantiate the previously discussed two-dimensional transparency concept, we introduce the impact model of transparency on anxiety in risk communication (Figure 1). Specifically, we begin by incorporating government trust into the model. Since government trust does not substantially contribute to uncertainty reduction, its impact can be utilized to proxy the effect of simple information disclosure, excluding the effect of uncertainty reduction. Following that, we integrate variables reflecting uncertainty reduction into the model. Two information disclosure strategies are introduced, emphasizing that transparency goes beyond mere information disclosure and necessitates strategies for uncertainty reduction. Finally, two individual characteristics are included in the model, underscoring the importance

of addressing public requirements within the context of uncertainty reduction.

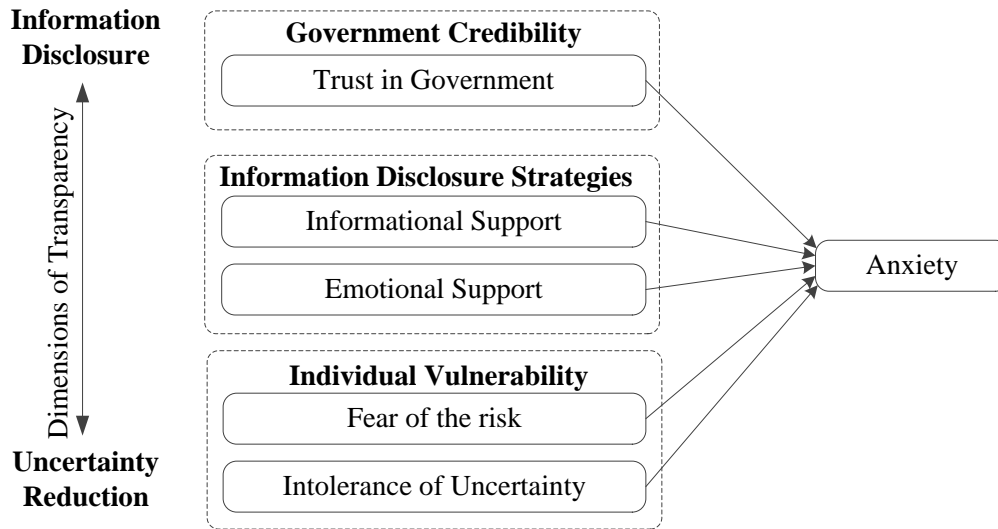


Figure 1 The impact model of transparency on anxiety in risk communication

Trust in government

Trust in government is the degree of confidence and belief individuals hold in the government's ability, intentions, and actions. It encompasses the faith people have in the government's capacity to shield them from risks and associated harms. Research conducted previously has established a link between trust and the reduction of uncertainty, which in turn plays a role in diminishing anxiety (Nitschke, *et al.*, 2021; Scandurra, *et al.*, 2021). Thus, we consider trust in government to be a significant contributor to alleviating anxiety. First, trust and vulnerability (or resilience) are intertwined. As defined by Rousseau, *et al.* (1998), trust embodies a psychological state characterized by the intention to embrace vulnerability arising from the actions of the government or other medical institutions. This implies that individuals with a heightened level of trust in government are more inclined and prepared to acknowledge the potential vulnerability inherent in both the pandemic itself and the potential consequences of governmental or institutional actions. Consequently, they experience reduced feelings of anxiety. Further, trust in the government also reflects the public's assurance in or contentment with the government's performance, as well as their perception of the government's credibility (Bouckaert & Van de Walle, 2003). This means that people with substantial trust in government levels might view the

situation as predictable and under the control of both the government and institutions, thereby alleviating their anxiety (Scandurra, *et al.*, 2021).

When confronted with risk situations like the COVID-19 pandemic, trust in government bolsters students' confidence in the government and medical institutions to effectively address the pandemic. This, in turn, diminishes their sense of uncertainty regarding the progression of the pandemic and the corresponding measures, ultimately leading to a reduction in their anxiety levels. Likewise, in the context of the SARS outbreak, Cheung and Tse (2008) contended that a lack of trust in the government and medical institutions exacerbates public anxiety. Thus, we formulate the hypotheses as follows:

H1: Trust in government exhibits a negative correlation with the level of anxiety observed in risk scenarios.

Social support provision as information disclosure strategies

Social support refers to the aid and protection extended to individuals, safeguarding them from precarious situations and adverse consequences (Wortman & Dunkel-Schetter, 1987). Throughout the risk literature, social support has consistently emerged as a factor with a positive influence on individuals' anxiety levels (Hu, *et al.*, 2022b; Szkody, *et al.*, 2021). For instance, Szkody, *et al.* (2021) delved into the stress-buffering role of social support during the pandemic, concluding that both perceived and received social support contribute positively to psychological well-being. In a separate line of inquiry, Hu, *et al.* (2022a) explored the impact of social support on mental health resilience within the realm of social media and determined that while social support has the potential to be beneficial for mental health, its application should be tailored to the evolving pandemic landscape.

In line with the abovementioned studies, our standpoint asserts that government information possesses the potential to yield a favorable impact in safeguarding students against the challenges posed by the risk through social support. Amid various social support constructs (Cohen & Syme, 1985), two principal forms—informational support and emotional support—come under consideration. Precisely, informational support encompasses the sharing of knowledge, information, and measures, while emotional support involves extending compassion, empathy, and affection. Specifically concerning

students navigating static management measures, we contend that the level of social support uncertainty from others can exert a positive influence in mitigating anxiety. Notably, the information uncertainty induced by peers can aid students in grappling with the situation uncertainties at hand, while the care and affection they experience can fortify their mental resilience, ultimately contributing to anxiety reduction. In light of this, we formulate the hypotheses as follows:

H2: The perceived informational support exhibits a negative correlation with the level of anxiety observed in risk scenarios.

H3: The perceived emotional support exhibits a negative correlation with the level of anxiety observed in risk scenarios.

Fear of the risk

Fear refers to the adaptive emotion that mobilizes one's energy to counter a current or identifiable threat (Karataş & Tagay, 2021). In line with Carleton (2012), we argue that the two constructs are different: fear refers to the protective response to a current and identified threat, and anxiety occurs in response to a pending threat that may or may not occur. Specifically, in the context of COVID-19, fear refers to the rational response to the pandemic, and a certain level of fear is good for the COVID-19 response since it encourages protective action against the risk (Millroth & Frey, 2021). On the other hand, anxiety refers to the emotional response to threats that remain uncertain and most likely not to occur, such as health anxiety and career anxiety, which might lead to overresponse or even obsessive use of medications (Banerjee, 2020).

Numerous research endeavors have contended that risk not only triggers fear in individuals but also gives rise to feelings of anxiety, with these two constructs displaying a significant and positive correlation. For instance, when scrutinizing the vulnerability of individuals in the context of COVID-19, Millroth and Frey (2021) posited that fear and anxiety are distinct constructs; however, they are significantly correlated ($r = .59$). Likewise, Salehi, *et al.* (2020) explored the connection between fear and anxiety among pregnant women during the COVID-19 pandemic and arrived at analogous correlation findings ($r = .60$). Specifically concerning students subjected to temporary regulatory

measures, it is hypothesized that risk such as the COVID-19 infection would prompt emotional reactions in students in relation to the virus itself (fear) and simultaneously trigger persistent concerns about other potential threats (anxiety) regarding their health and academic pursuits. As such, we posit that heightened levels of fear correspond to elevated levels of anxiety. In light of this, we propose the following hypothesis:

H4: The fear of risks exhibits a positive correlation with the level of anxiety observed in risk scenarios.

Intolerance of uncertainty

Intolerance of uncertainty, according to Carleton, *et al.* (2007) is defined as the tendency to consider a negative event occurring unacceptable, regardless of how likely it is to happen. Risk scenarios like the COVID-19 pandemic are marked by substantial uncertainty surrounding the proliferation of the pandemic and its resulting implications. A key personal trait to cope with such uncertainty is an aversion to uncertainty (Millroth & Frey, 2021). Within the COVID-19 literature, it is generally posited that intolerance of uncertainty is a salient predictor of individuals' anxiety (Korkmaz & Güloğlu, 2021; Rettie & Daniels, 2021), however, their conclusions have yielded entirely disparate outcomes. For example, in Korkmaz and Güloğlu (2021) and Rettie and Daniels (2021), the intolerance of uncertainty is found positively related to anxiety.

Precisely, the risks linked to the commencement of the COVID-19 pandemic in August 2022 have intensified uncertainties regarding economic stability, physical health, and mental well-being. This circumstance poses an elevated challenge for students, fostering the perception that their educational journey and future employment opportunities are beyond their control. Thus, in line with Millroth and Frey (2021), we assert that students exhibiting a greater degree of intolerance for uncertainty would manifest heightened distress when confronted with the ambiguous circumstances stemming from risks associated with COVID-19 and the imposed static management measures. Consequently, they are likely to exhibit elevated levels of anxiety. This leads us to propose the subsequent hypothesis:

H5: The intolerance of uncertainty exhibits a positive correlation with the level of anxiety observed in risk scenarios.

2.2 Survey design

In response to the rapid spread of the pandemic, the city of Shapingba, Chongqing, China announced a temporary static management measure on August 16, 2022, advocating against unnecessary commuting and cross-area travel. We conscientiously gathered survey data from on-campus students regarding their experiences during the on-campus lockdown from August 25 to September 5. This timeframe corresponds to a week during which the temporary measure had been in effect, the pandemic outbreak was ongoing, and no official timetable had been disclosed for the conclusion of this temporary measure. Additionally, as the survey was conducted in Chinese, we employed the back-translation method (Bhalla & Lin, 1987) to ensure accuracy. Precisely, a faculty member skilled in both Chinese and English undertook the translation of the questionnaire into Chinese. Following that, another faculty member, equally proficient in both languages, conducted the back-translation by rendering the Chinese version of the questionnaire back into English. Discrepancies between the original and the backward-translated questionnaires were identified and rectified to ensure a satisfactory level of equivalence. Before the online distribution, the phrasing and appropriateness of the questionnaires were reviewed by three graduate students and two faculty members.

2.3 Data collection

Data for this study were gathered in August 2022, coinciding with the abrupt surge of the COVID-19 pandemic in the Shapingba area of Chongqing province, China, a significant part of which encompasses Chongqing University. Adhering to Cohen (2013), a prior sample size analysis was performed to establish an appropriate sample size. In the hierarchical regression model, we initially examined the impact of trust in government. Subsequently, information disclosure strategies as well as individual vulnerability variables were introduced into the regression model. With effect size, significance level, and power set at .15 (for medium effect), .05, and .80, respectively, the determined minimum sample size is 78. Additionally, due to the inherent randomness associated with the snowball sampling method and the aim to ensure diversity in student grades, we collected as much data as possible.

As the data collection took place during the summer break, a period when a majority of students were off-campus, and the certainty of on-campus student availability was low, we opted to utilize a snowball sampling technique to administer the survey. Initially, we enlisted the help of three on-campus students to recruit their fellow on-campus students to participate in an online survey concerning their mental health amid the ongoing lockdown measures. This invitation was circulated through WeChat, a widely-utilized instant messaging application. Participants were fully informed of the objective of this study, assured of confidentiality, and informed that the purpose of the questionnaires was solely for research. Those who provided consent to participate in the survey were directed to an online questionnaire. Submission of the survey was restricted to those who completed all the questions. Ultimately, the survey generated a total sample size of 435.

2.4 Variables

Whenever possible, we adopted the already tested and validated measurement scale for each variable from earlier studies and adapted to this context (Appendix), such as anxiety (Zigmond & Snaith, 1983), fear (Ahorsu, *et al.*, 2020), uncertainty tolerance (Carleton, *et al.*, 2007), informational support (Liang, *et al.*, 2011), emotional support (Liang, *et al.*, 2011), and trust in government (Porumbescu, 2016). These measurement scales were chosen due to their widespread usage for these variables, and their reliability has been thoroughly validated in the literature on anxiety or uncertainty. To maintain consistency in the measurement items, we assessed the internal consistency of each variable. A Cronbach's Alpha value of 0.7 is deemed indicative of good consistency (Nunnally, 1978). Additionally, we introduced two commonly used control variables to this study, including gender and grade. Furthermore, we introduced an additional variable, accompany, to assess whether peer support (presence of other roommates in the dormitory) can affect students' anxiety levels.

Dependent variable

The central motivation of this study is to identify the antecedents of students' anxiety levels during uncertain situations, and thus anxiety is selected as the dependent variable. This study adopted the Hospital Anxiety and Depression Scale from Zigmond and Snaith (1983) because the scale is well-

tested and easy to operate (Özdin & Bayrak Özdin, 2020). Among the original 14-item measure, 7 items for the anxiety measurement are selected in this study (see Appendix). To maintain consistency in measurement scales and allow participants to articulate their agreement or disagreement more precisely, this study substituted the original scale (0: not at all; 1: from time to time, occasionally; 2: a lot of time; 3: most of the time) with a five-point Likert scale, ranging from strongly agree (1) to strongly disagree (5). The 7 items yielded a Cronbach's Alpha of .91.

Independent variables

Fear refers to the intensely unpleasant emotion in response to the threat or danger from the pandemic. We adopted the Fear of COVID-19 Scale from Ahorsu, *et al.* (2020). The 7-item scale has been validated for robust psychometric properties in the context of the COVID-19 pandemic and is deemed appropriate for this study. All the items are measured using a 5-point Likert scale anchored from strongly agree (1) to strongly disagree (5). The 7 items yielded a Cronbach's Alpha of .87.

Intolerance of uncertainty is the tendency of an individual to consider the possibility of a negative event occurring unacceptable, irrespective of the probability of occurrence. We adopted the 12-item short version scale from Carleton, *et al.* (2007). All the items are measured using a 5-point Likert scale anchored from strongly agree (1) to strongly disagree (5). The 12 items yielded a Cronbach's Alpha of .85.

Social support uncertainty reflects one's perception of the certainty of the availability of information, assistance, care, love, and protection from others (Wortman & Dunkel-Schetter, 1987). Specifically in the context of the COVID-19 pandemic, two facets of social support are considered. Perceived informational support refers to the perception of the availability of information, advice, and guidance from others to cope with an uncertain situation. The 3-item measurement scale is adopted from Liang, *et al.* (2011). All the items are measured using a 5-point Likert scale anchored from strongly agree (1) to strongly disagree (5). The 3 items yielded a Cronbach's Alpha of .75.

Perceived emotional support refers to the perception of the availability of care and love from others to cope with an uncertain situation. The 3-item measurement scale is adopted from Liang, *et al.* (2011).

All the items are measured using a 5-point Likert scale anchored from strongly agree (1) to strongly disagree (5). The 3 items yielded a Cronbach's Alpha of .86.

Trust in government measures individuals' trust in a specific institution, the city government. The scale is adopted from Porumbescu (2016) which is a reflective measure, including students' perception of the city government's competence, benevolence, and honesty. Among the 13 items, 11 of them are adopted for this context. All the items are measured using a 5-point Likert scale anchored from strongly agree (1) to strongly disagree (5). The 11 items yielded a Cronbach's Alpha of .98.

Control variable

In this study, we controlled for demographic variables including gender (Female = 0 and Male = 1), grade (Undergraduate = 0 and Graduate = 1), and whether the student is physically accompanied in their dormitory (No = 0 and Yes = 1). This is because, within the mental health literature, it is commonly asserted that the vulnerability of individuals is often influenced by factors such as age, gender, and differences in companionship (Rudolph & Hammen, 1999).

2.5 Analysis procedure

A hierarchical multiple regression model is employed to investigate the impact of transparency, ranging from solely disclosing information to substantial uncertainty reduction. In Step 1, three control variables are introduced into the model. Subsequently, in Step 2, government trust is introduced to assess the impact of solely disclosing information, given that government trust does not substantially contribute to uncertainty reduction. Moving to Step 3, two social supports that characterize government uncertainty reduction strategies are added to the model. Lastly, fear of risk is included in Step 4, and intolerance of uncertainty is included in Step 5. Assuming a linear relationship between variables and independence of observations, ordinary least square estimation is applied for the regression analysis.

3 Results

3.1 Preliminary Results

Table 1 displays the univariate statistics. The average values for both fear (19.07) and anxiety (18.06) are below the midpoint of the scale, indicating that respondents generally acknowledge experiencing a

certain degree of fear and anxiety during the lockdown. Additionally, the intolerance of uncertainty exceeds the midpoint, implying that respondents are more inclined to admit having a low tolerance for uncertainty. Notably, respondents tend to agree (below the midpoint) on the perception of a high level of government trust, while simultaneously tending to disagree (above the midpoint) with the perception of support, both informational and emotional. Regarding the control variables, the mean values for gender (Female = 0), Grade (Undergraduate = 0), and Accompany (No = 0) are .46, .51, and .61, respectively. This implies that 46%, 51%, and 61% of the respondents are female, undergraduate, and unaccompanied, respectively.

Table 1 Univariate Statistics

	Items in Scale	Potential Scale Range	Scale Midpoint	Mean	Standard Deviation
Anxiety	7	7 – 35	21	18.06	6.35
Gender (Female=0)	1	0 – 1	-	0.46	0.50
Grade (Undergraduate = 0)	1	0 – 1	-	0.51	0.50
Accompany (No=0)	1	0 – 1	-	0.61	0.49
Trust in government	11	5 – 55	33	30.39	10.79
Informational Support	3	3 – 15	9	11.40	2.37
Emotional Support	3	3 – 15	9	11.88	2.52
Fear of the risk	7	7 – 35	21	19.07	5.60
Intolerance of uncertainty	12	12 – 60	36	41.63	7.40

Table 2 provides an overview of bivariate correlations and internal reliability. The correlation coefficients unveil the following associations: (1) a significant negative relationship between trust and anxiety; (2) a moderate correlation between individual vulnerability (intolerance of uncertainty and fear of risk) and anxiety; (3) a negative partial correlation between government support strategies (emotional support) and anxiety. Among the control variables, only the variable "grade" demonstrates a correlation with the dependent variable. Regarding internal reliability, all measures with multiple items exceed .70, indicating a satisfactory level of reliability according to Nunnally (1978).

Table 2 Correlation Matrix

	1	2	3	4	5	6	7	8	9
1 Anxiety	(.91)								
2 Gender	.07	-							
3 Grade	.21*	-.14	-						
4 Accompany	.04	-.19*	.14	-					
5 Trust in government	-.23**	-.13	.03	.24**	(.98)				
6 Informational Support	-.08	-.03	.01	.00	.55**	(.75)			
7 Emotional Support	-.42**	-.12	-.19*	.16	.56**	.40**	(.86)		
8 Fear of the risk	.62**	.11	.17*	.07	.03	.11	-.10	(.87)	
9 Intolerance of uncertainty	.61**	.00	.10	.20*	-.07	.30**	-.06	.52**	(.85)

Note: Inside the parentheses are standardized Cronbach alpha values. *** $p < .001$; ** $p < .01$; * $p < .05$.

3.2 Hierarchical Regression Analysis Results

Table 3 presents hierarchical regression analysis results. Overall, most of the hypotheses are validated except for H1 and H2. Trust in government demonstrates a significant and negative correlation with anxiety in Step 2 ($\beta = -.245$, $p < .001$). However, upon introducing other variables into the model, the effect diminishes (to $\beta = -.112$, $\beta = -.114$, and $\beta = -.055$ for Step 3, Step 4, and Step 5 models, respectively), and the correlation even becomes insignificant in Step 4. Similarly, the correlation between information support and anxiety varies inconsistently across the Step 3 to Step 5 models ($\beta = .145$, $\beta = .046$, $\beta = -.117$). Surprisingly, contrary to our hypothesis, perceived informational support is initially found to be positively and significantly correlated with anxiety in Step 3 ($\beta = .145$, $p = .006$), becomes insignificant in Step 4 ($\beta = .046$, $p = .262$), and turns negative in Step 5 ($\beta = -.117$, $p = .002$). Notably, across all three models, the influence of perceived informational support is much smaller compared to perceived emotional support, which consistently exhibits a negative and significant effect on anxiety ($\beta = -.403$, $\beta = -.321$, $\beta = -.262$, respectively, and $p < .001$). Finally, hypotheses concerning individual vulnerabilities (H4, H5) are supported ($p < .001$). Notably, these variables exert the greatest influence among all factors. For example, in Step 5, the effects of intolerance of uncertainty and fear of risk on anxiety are .439 and .378, respectively. Furthermore, the effects of all demographic variables vary across the five models. Interestingly, in the Step 5 model, there is no significant correlation found between demographic variables (e.g., gender, grade, accompany).

Table 3 Hierarchical Regression Analysis Results for the effect of transparency on anxiety

	Step 1		Step 2		Step 3		Step 4		Step 5	
	Beta	p	Beta	p	Beta	p	Beta	p	p	
Gender (Female=0)	.105	.030	.083	.076	.053	.236	-.026	.456	-.009	.753
Grade (Undergraduate = 0)	.219	<.001	.215	<.001	.123	.007	.041	.254	.060	.052
Accompany (No=0)	.030	.538	.084	.080	.124	.007	.070	.049	-.028	.382
Trust in government			-.245	<.001	-.112	.060	-.114	.014	-.055	.172
Informational Support					.145	.006	.046	.262	-.117	.002
Emotional Support					-.403	<.001	-.321	<.001	-.262	<.001
Fear of the risk							.581	<.001	.378	<.001
Intolerance of uncertainty									.439	<.001
N	435		435		435		435		435	
Adjusted R ²	.047		.102		.206		.521		.640	
ΔR ²	.054		.056		.107		.312		.118	
ΔF	8.178 (p<.001)		27.204 (p<.001)		29.099 (p<.001)		282.717 (p<.001)		141.952 (p<.001)	
df1	3		1		2		1		1	
df2	431		430		428		427		426	

4 Discussion

4.1 Beyond information disclosure, transparency in risk communication requires uncertainty reduction

The primary assertion of this study centers on the idea that transparency is a two-dimensional construct. Neglecting the perspective of uncertainty reduction within transparency can result in a symbolic display of transparency without yielding substantial outcomes. The study employs anxiety reduction as an indicator of the outcome, and the results substantiate this overarching argument. This is first supported by the substantial increase in the R^2 (variance explained) from step 1 to step 5. When only trust in government is introduced into the model (Step 2), only a small portion of variance is explained (10.2%). As uncertainty reduction strategies are included, the R^2 significant increased. Further, when the government attends to public needs as explained by fear of the risk and intolerance of uncertainty, the R^2 raised to .521 and .640, respectively. The increasing R^2 underscores the robustness of the proposed model in explaining the level of anxiety.

Moreover, the importance of integrating uncertainty reduction as an additional dimension of transparency is emphasized by comparing the effects of indicators for information disclosure and uncertainty reduction. In Step 5, indicators of uncertainty reduction (such as informational support, emotional support, fear of risk, and intolerance of uncertainty) show notably higher correlation coefficients (-.117, -.262, .378, .439 respectively) with anxiety compared to the indicator of information disclosure (0.06 for trust in government). This suggests that uncertainty reduction may play a more crucial role in alleviating anxiety than mere information disclosure. Further, when comparing the models of Step 2 and Step 5, the association between trust in government and anxiety is significant when uncertainty reduction is not taken into account (Step 2). However, in Step 5, where uncertainty reduction is included, this correlation weakens substantially and becomes statistically insignificant. This suggests that the relationship between information disclosure (as reflected by trust in government) and anxiety is more complex than a straightforward linear connection, possibly influenced by factors of uncertainty reduction acting as mediators or moderators. Hence, it is plausible to contend that

information disclosure might offer a partial perspective on transparency, underscoring the vital role of uncertainty reduction within transparency.

Indeed, the pairwise trust-transparency relationship is repeatedly raised and examined in transparency literature, establishing the argument that purely information disclosure builds government credibility (Grimmelikhuijsen, 2012; Porumbescu, 2017). This could be true in terms of regular government communication; however, in terms of risk communication, information disclosure is necessary but not sufficient (Halachmi & Greiling, 2013; Zhu, *et al.*, 2021). Government transparency, particularly in risk communication, should not excessively focus on the act of openness, which could prompt governments to disclose information that might not effectively translate into public understanding or compliance (Porumbescu, *et al.*, 2017), but it should be comprehensible enough to address the public's uncertainty (Venkatesh, *et al.*, 2016).

4.2 Emotional support cannot be ignored when implementing strategies to reduce uncertainty

Additional support for our argument, emphasizing the necessity of uncertainty reduction in transparency, stems from the notable correlation between emotional support and anxiety. If transparency were solely about information disclosure and dominated by informative aspects, the impact of emotional support might be weaker and insignificant. However, the regression results indicate the contrary. In reality, emotional support has a much more substantial influence than informational support on anxiety. As observed in the Step 5 model, the coefficient for emotional support is -.26, while the coefficient for informational support is -.12.

While it is true that information disclosure forms the core of transparency, it is worth noting that transparency also means the government being responsive and openly acknowledging problems (Halachmi & Greiling, 2013; Kim & Lee, 2012; Porumbescu, 2015), especially during times of risk when emotional aspects come into play. These emotions can evoke perceptions of resilience and reassurance, or conversely, lead to frustration, anger, and even escalate into panic and anxiety among the public (Zhu & Hu, 2023). The uncertainty surrounding these emotional dimensions not only has the potential to overshadow crucial risk-related information but can also contribute to biased interpretations

and undermine public trust in the government.

This discovery holds significant implications, especially if we interpret informational support and emotional support as two distinct mechanisms for reducing uncertainty. The larger impact observed for emotional support underscores its potential effectiveness. Indeed, considering the equivalency of informational support to information disclosure, this finding is noteworthy not just because it underscores the significance of providing information with emotional support (emotional certainty) in addressing anxiety (Zhu & Hu, 2023), but also because it emphasizes that government transparency encompasses more than mere informational provision. This outcome further bolsters our conceptualization of transparency as a two-dimensional construct: while divulging information to the public serves as the initial step toward government transparency during times of risk, the substantial reduction of uncertainty should take precedence.

4.3 Reducing uncertainty necessitates a focused consideration of public vulnerability.

The third piece of evidence supporting the pivotal role of uncertainty reduction as a dimension of transparency is found in the significant correlation between individual vulnerability indicators and anxiety. More precisely, these two indicators show the most substantial coefficients across all variables. The correlation coefficients for fear of the risk and intolerance of uncertainty, when correlated with anxiety (model 5), are .38 and .44, respectively.

Fear of risk encompasses a facet of individuals' vulnerability to dangers or threats, emerging as an emotional response to potential threats (Harper, *et al.*, 2021; Rosen & Schulkin, 1998). While fear can drive actions aimed at avoiding external threats, this motivation is temporary and tends to diminish rapidly once the threat is mitigated. Government transparency plays a pivotal role in acknowledging and alleviating this fear. In other words, if government transparency appropriately addresses such vulnerability, the short-term fear response would not escalate into a more detrimental and enduring reaction, namely anxiety. Conversely, if risk communication solely functions as information disclosure without effectively addressing uncertainty issues, the temporary motivation can transform into prolonged states of hypervigilance and heightened arousal, persisting even after the triggering stimuli

are no longer present (Barlow, 2004).

Intolerance of uncertainty represents a type of resilience in the presence of threats. This psychological concept indicates an individual's predisposition to respond negatively to situations characterized by uncertainty or ambiguous information (Carleton, 2012). It is chosen as an indicator for uncertainty reduction because a heightened level of intolerance of uncertainty tends to generate discomfort when faced with uncertain situations. This discomfort motivates individuals to actively seek information or reassurance to diminish ambiguity and establish a sense of certainty. In the context of government risk communication, it becomes crucial to pay attention to the intolerance of uncertainty among the public. This is because it can evoke heightened emotional responses, leading to increased stress and difficulties in adapting to challenging circumstances. Individuals with elevated intolerance of uncertainty may engage in excessive reassurance-seeking behaviors to acquire information and maintain a sense of control and security, thereby preventing anxiety (Millroth & Frey, 2021). Government agencies need to recognize and address this aspect of human psychology in their communication strategies to effectively support individuals with high levels of intolerance of uncertainty during times of uncertainty or crisis. Concerning the control variables, the lack of significance implies that unlike anxiety in typical circumstances where age and gender differences play a role (Sylvers, *et al.*, 2011), in uncertain situations like those arising from COVID-19, intolerance of uncertainty may serve as the primary predictor of anxiety. Nevertheless, when addressing public needs, distinctions related to grade, accompanying individuals, gender, and other individual differences should still be taken into account.

4.4 Managerial Implications

From a practical standpoint, this study provides some nuanced insights into managerial implications in risk communication practices. Firstly, risk communication should not be implemented as a mere gesture; instead, it should actively address the substantial need for reducing uncertainty among the public. Thus, the government needs to engage with the public's needs and address their concerns.

Additionally, although risk communication is typically viewed as informative, it is crucial not to underestimate its emotional impact. Emotional support conveyed through risk communication can foster

feelings of security and stability, validating individuals' experiences and emotions, which are essential for effectively managing risks, particularly concerning mental health issues. Therefore, it is essential for government agencies to integrate emotional support tactics into their risk communication efforts.

Finally, in the implementation of strategies, the government should avoid adopting a one-size-fits-all approach but rather should implement diversified strategies that account for public vulnerabilities. By comprehending and addressing these vulnerabilities, governments must customize their risk communication strategies to efficiently engage and connect with specific requirements.

5 Conclusion

This study makes a significant contribution by enhancing our understanding of government transparency, particularly in the context of risk communication. It emphasizes that transparency is a multi-dimensional concept, encompassing not only information disclosure but also, more pragmatically, the reduction of uncertainty. We argue that exclusively equating government transparency with information disclosure is biased, as it neglects the crucial need to alleviate uncertainty among individuals. Moreover, a framework is then proposed to illustrate how different dimensions of transparency lead to outcomes. Specifically, information disclosure, predominantly grounded in government credibility, can only result in limited transparency outcomes. Instead, true transparency, leading to significant outcomes, requires government information disclosure strategies aimed at reducing uncertainty, along with consideration for public vulnerabilities. The validity of the framework is subsequently confirmed through the utilization of self-reported data collected from 435 college student respondents during a city lockdown situation in China. Through hierarchical regression analysis, indicators for government credibility, information disclosure strategies, and individual vulnerability are sequentially integrated to evaluate the impact of government transparency on anxiety. By comparing outcomes between mere information disclosure and uncertainty reduction, the framework not only provides a benchmark for assessing transparency's effects on anxiety but also offers insights into alternative mechanisms through which

transparency can positively influence individuals.

5.1 Limitations and future directions

Nonetheless, this study has limitations. While we introduced a dual-dimensional transparency concept – comprising information disclosure and uncertainty reduction – our analysis predominantly focused on the associations between factors and anxiety, serving as a surrogate for uncertainty reduction outcomes. Nevertheless, the outcomes for government transparency in risk communication can extend beyond anxiety reduction to encouraging the public to be aware of the risk and take protective measures. The effect of uncertainty reduction may exert different effects on these outcomes, which requires further explanation.

Furthermore, in this study, the measurement and comparison of information disclosure and uncertainty reduction are indirect and derived from other indicators (such as trust in government, information disclosure strategies, and public vulnerabilities). Clarifying the distinction between these two dimensions proves captivating as their origins and influence mechanisms likely diverge. Future investigations should incorporate this direct comparison to enhance our understanding.

Finally, this study also has typical limitations associated with the datasets and the cross-sectional design. First, we centered our study on a single-city lockdown scenario. However, it is important to exercise caution when extending our findings, as the applicability of our conclusions to other contexts may not be automatic. Consequently, further investigations are warranted to validate our model among the broader population and across diverse risk scenarios, thereby enhancing the depth of discourse. Second, our research hinged on college students' perceptions to gauge the predictors of anxiety. Unexpectedly, the surveyed students exhibited a relatively low level of intolerance of uncertainty, as indicated in Table 1. This discrepancy might not mirror the sentiments of the general community. Thus, to present a comprehensive understanding of the entire populace, it is imperative to corroborate these outcomes using a dataset encompassing a broader demographic. Lastly, we concede that our study falls short of establishing causality. While our findings find solid theoretical underpinning in suggesting the critical role of diverse methods in reducing uncertainty to alleviate anxiety, further confirmation is necessary.

This could entail alternative experimental designs or longitudinal datasets to validate our assertions.

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