Impacts of Information Dissemination Framework on Public Compliance Behaviour: Evidence from Sudden Power Outages

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Abstract. This study investigated the causal relationship between information dissemination framework and public compliance behaviour during sudden power outages. We conducted a (content dimension: interpretive framing vs. action framing) × 2 (time dimension: in-action response vs. post-action response) online experiment (N = 692) and surveyed participants' personal information and black-out experiences. The study found that the use of the action framework was more effective in improving public compliance behaviour on the content dimension. The main effect of the time dimension was not significant, but played a key moderating role. The effect of using the action framework for response during sudden power outage events was more pronounced.

Keywords: sudden power outage events, information dissemination framework, public compliance behaviour

1 Introduction

In the face of emergency crisis scenarios such as sudden power outages, ensuring the accurate and efficient transmission of relevant information is crucial to enhancing the public's level of awareness and understanding of the incident[1]. This not only helps to eliminate possible public panic and uncertainty, but also effectively prevents and mitigates social derivative risks[2-3]. The message framing is a specific expression of information developed by a message publisher by selectively presenting, emphasising and organising elements of the message[4]. It can influence the receiver's interpretation and reaction to the information. In the field of information framing research, scholars have proposed a variety of framing design ideas. LEVIN et al. further classified framing

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effects into selection framing effects, attribute framing effects, and target framing effects through interdisciplinary meta-analysis methods[5]. Dan and Raupp et al. categorised media frames for health risk reporting into 15 different types[6].

Further, the message framing is a prerequisite and intervention strategy for influencing behavioural change[7]. The message framing effect suggests that different ways of presenting and expressing information should be designed to elicit different levels of identification and acceptance from the public at the psychological level, thereby changing the level of public compliance with the policy at the behavioural level[8]. Public compliance, as the target group's attitude and behavioural response to a policy, is a key factor in determining the effectiveness of an information dissemination strategy[9].

With regard to the content of the presentation of the information framework, the tendency of the public to pay attention to the content conveyed by the information framework generates different levels of reception and behavioural preferences[10]. It has been found that the level of explanation of information is a key factor influencing public acceptance of policies[11]. When information is presented at a higher level of explanation, it can be more effective in reducing individual resistance to the policy, thus promoting policy acceptance and support[12].In this study, we distinguish between two types of information frames on the content dimension. The interpretive framing focuses on providing detailed explanations of the causes, contexts and impacts of an event, aiming to deepen the public's understanding of the nature and context of the event. The action framing focuses on conveying the coping strategies and action steps taken after the event. By demonstrating positive responses and clear directions for action, such frames help to increase the depth and level of detail that the public pays attention to when encoding and decoding information, and enhance individual acceptance of and support for relevant policies.

In addition, this study distinguish between two information framing in the time dimension to explore the differential impact of information release timing on public compliance behaviour. In-action response refers to the release of information during a sudden power outage, while post-action response refers to information response after power is restored. In crisis situations, timeliness is seen as one of the key principles of effective communication[13]. The organisation should respond quickly and proactively provide information in the wake of a crisis. It helps to provide the public with a clear framework of the event and reduces public anxiety and panic. It can also help the public to better understand the nature of the crisis event, the scope of its impact and the response to it.

Moreover, when responding to emergencies such as sudden power outages, information response strategies need to take into account the combined effects of various factors such as the content of the information response, the expression of the wording, and the timing of the response. At the initial stage of a blackout, the public is generally interested in immediate information about the current situation and the emergency measures taken by the organisation. The timely delivery of such information can help to reduce panic and anxiety among the public, and can also increase public confidence in the organisation's ability to respond. After power supply is restored, the public's at-

tention may shift to a deeper understanding of the causes and consequences of the incident. At that stage, the organisation should provide detailed findings on the cause of the power outage.

In summary, this study aimed to examine the differential impacts of the interaction of different information frames on public compliance behaviour, using "interpretive framing vs. action framing" and "in-action response vs. post-action response" as specific intervention strategies in the context of the content design of information dissemination for sudden power outage events. According to the above comments, the following three assumptions were proposed: information dissemination framework significantly influence public compliance behaviour during sudden power outages (H1); different information dissemination frameworks have differential effects on public compliance behaviour (H2); action framing is more conducive to improving public compliance behaviour than interpretive framing (H2a); in-action response is more conducive to improving public compliance behaviour than post-action response (H2b); there was an interaction effect between the content dimension and time dimension of the information dissemination framework (H3).

2 Methods

2.1 Participants and Procedure

The target population of this study is the general public in mainland China. We used the convenience sampling method to ensure that the sample is broadly representative, and collected data from a nationwide sample through an online survey platform called Credamo (https://www.credamo.com). Compared with the traditional offline questionnaire filling method, the platform has a sample database of more than two million participants, and can accurately push the research experiment to the subjects through the platform. Prior to conducting the formal survey, all participants were informed that the survey was anonymous and that they could withdraw at any time during the survey. Participants who completed the questionnaire were offered a cash prize. It is worth noting that to increase the statistical power and reliability of the dataset, operation checks and completion time checks were performed during the questionnaire completion process. Overall, a total of 983 questionnaires were distributed in this study, and 291 invalid questionnaires that took too long or too short to answer and failed the test questions were excluded, obtaining 692 valid questionnaires with an effective recovery rate of 70.4%.

2.2 Survey Experiment Design

To investigate the effect of information dissemination frames on public compliance behaviour in sudden power outages, we conducted an online experiment using a between-group design: content dimension (interpretive framing vs. action framing) × time dimension (in-action response vs. post-action response). Participants were randomly

assigned to one of the four experimental groups and were required to answer questionnaire questions after reading the relevant scenario material. The flow of the experiment is shown in Figure 1.

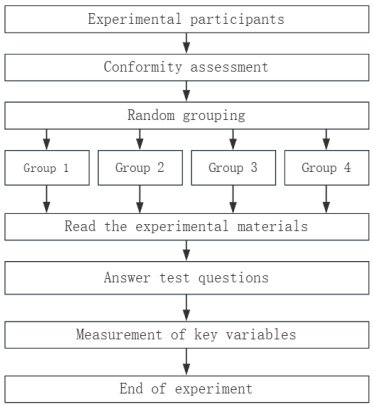

Fig. 1. Experimental procedure.

The first part of the experimental materials is the experimental instruction. The second part is the experimental scenario material. In addition to the basic information of the sudden power outage event, the interpretive framing focuses on providing a detailed explanation of the causes, background and impacts of the event, which is expressed as follows: "After urgent verification, this sudden power outage is due to the recent summer extreme hot weather leading to a surge in electricity demand, and the high load of power equipment causing some of the area of the sudden power failure". The action framing focuses on communicating the response strategy of the incident and the action measures taken by the relevant departments, which is expressed as follows: "State Grid S City Power Supply Company responded quickly and is organising fault investigation and repair work, striving to restore power supply to the affected areas in the shortest possible time, please be patient". In the third part, participants were required to answer questions related to the variables. This study was approved by the Institutional Review Board.

2.3 Measurements

Public Compliance Behaviour.

Public compliance behaviour was measured by 7 multiple-choice questions such as “I would forward notification of an unexpected power cut to individuals or groups who may be affected.” “I would post about an unexpected power cut on social media.” The scores ranged from 1 (extremely disagree) to 7 (extremely agree). In the internal consistency checking, the Cronbach's alpha of the Public Compliance Behaviour Scale was 0.751 (>0.7), indicating that the scale has a high reliability. The mean of the scores of the scale question items was taken as the overall score of public compliance behaviour.

Control Variables.

The control variables in this study included gender (male/female), age (18-24, 25-34, 35-44, 45-54, 55 and above), education (high school or below, junior college, bachelor degree, master degree and above), household size (1-2, 3-4, 5-6, 7 and above), outage experience (yes/no), average outage frequency (less than 1 per year, 2-4 per year, more than 5 per year), average outage duration (less than 1 hour per event, 1-3 hours per event, 3-6 hours per event, more than 6 hours per event), receive outage notification frequency (never, seldom, occasionally, often and always).

3 Results

3.1 Descriptive Results

Characteristics of the participants are shown in Table 1. A total of 381 participants were male (55.1%) and 311 were female (44.9%). About 22.1%, 42.6%, 30.8%, 3.8%, and 0.7% of the participants were aged 18-24years, 25-34years, 35-44years, 45-54years, and 55 years and above, respectively. Educational attainment was concentrated in junior college (36.6%) and bachelor degree (44.7%). About 63.7% of the participants had a family size of 3-4 persons. About 80.6% of the participants experienced power outages, with the average frequency of outages concentrated in 2-4 times per year (48.1%), the average duration of outages concentrated in 1-3 hours per outage (47.1%), and the percentage of participants who received notification of outages each time (19.2%) was relatively low.

Table 1. Characteristics of sample.

Variables	Frequency/Range	Percent/Mean (SD)
Gender		
Male	381	55.1
Female	311	44.9
Age(year)		
18-24	153	22.1
25-34	295	42.6
35-44	213	30.8
45-54	26	3.8
>55	5	0.7
Education		
High or below	94	13.6
College	253	36.6
Bachelor	309	44.7
Master and above	36	5.2
Household size（persons）		
1-2	66	9.5
3-4	441	63.7
5-6	154	22.3

>7	31	4.5
Outage experience		
Yes	558	80.6
No	134	19.4
Outage Frequency		
-	134	19.4
less than 1 per year	200	28.9
2-4 per year	333	48.1
more than 5 per year	25	3.6
Outage Duration		
-	134	19.4
less than 1 hour per event	102	14.7
1-3 hours per event	326	47.1
3-6 hours per event	109	15.8
more than 6 hours per event	21	3.0
Receive outage notification frequency		
-	134	19.4
never	5	.7
seldom	63	9.1
occasionally	183	26.4
often	174	25.1
always	133	19.2

3.2 Balance Diagnostics

The random assignment of participants is important for investigating the research validity of an experiment. To demonstrate the validity of the randomised grouping of the experiment, we conducted balanced diagnostics using one-way anova and and LSD post hoc test. The results of the balance diagnosis were shown in Table 2. The means of demographic and socio-economic variables in the four experimental groups did not show significant differences ($p>0.05$). This indicates that randomised allocation of participants was achieved between the four experimental groups.

Table 2. Balance diagnostics.

Variables	Group 1	Group 2	Group 3	Group 4	F	p
Gender	1.49	1.43	1.43	1.45	0.472	0.702
Age	2.19	2.18	2.2	2.15	0.093	0.964
Education	2.47	2.39	2.41	2.38	0.505	0.679
Household size	2.23	2.22	2.23	2.18	0.228	0.877
Outage experience	1.23	1.21	1.16	1.17	0.982	0.401
Outage Frequency	1.76	1.63	1.71	1.65	1.587	0.191
Outage Duration	2.16	2.06	2.12	2.00	1.316	0.268
Receive outage notification frequency	3.56	3.73	3.67	3.66	0.691	0.558

Note. Group 1 = In-action response × Interpretive framing, Group 2 = In-action response × Action framing, Group 3 = Post-action response × Interpretive framing, Group 4 = Post-action response × Action framing.

3.3 Analysis of Difference between Groups

To verify that there is variability in participants' public compliance behaviour across intervention conditions. This study conducted a one-way anova on the four experimental groups. The results were shown in Table 3. There was a significant difference in the means of the public compliance behaviour of the four experimental groups, indicating that the effects of the different intervention factors differed. Group 2 had the highest mean value of public compliance behaviour, indicating that the use of the information response action framework had the greatest effect on public compliance behaviour during sudden power outages.

Table 3. One-way anova for the experimental group.

Variable	Group	N	M	SD	F	P
Public compliance behaviour	Group1	175	5.07	0.88	5.471	<0.01
	Group2	179	5.38	0.80		
	Group3	176	5.34	0.83		
	Group4	162	5.36	0.77		

Note. Group 1 = In-action response × Interpretive framing, Group 2 = In-action response × Action framing, Group 3 = Post-action response × Interpretive framing, Group 4 = Post-action response × Action framing.

3.4 Main Effect and Interaction Effect Analysis

The main effect of the content dimension and time dimension of the information dissemination framework on public compliance behaviour was tested by using anova. The results are shown in Table 4. Using the content dimension (Interpretive framing = 0, Action framing = 1) as the independent variable, the content dimension significantly affects the public compliance behaviour during the unexpected power outage. In particular, responding with the action framing during the unexpected power outage is more conducive to improving public compliance behaviour compared to the interpretive framing. Using the time dimension (In-action response = 0, Post-action response = 1) as the independent variable, the effects of using In-action response and Post-action response strategies on public compliance behaviour did not show significant differences.

Table 4. Main effect analysis.

Independent variable	Dependent variable Public compliance behaviour			
	df	M	F	p
Content dimension	1	4.652	6.886	0.009

(interpretive framing=0, action framing=1)				
Time dimension (in-action response=0, post-action response=1)	1	2.535	3.751	0.053
Content dimension×Time dimension	1	3.781	5.596	0.018
Adjusted R^2		0.019		
N		692		

In addition, the results of the interaction effects of the content dimension and time dimension are shown in Figure 2. The result show that the interaction effect of content and time dimensions significantly affects public compliance behaviour in the information dissemination framework. In particular, the information dissemination strategy using the action framing is more capable of improving public compliance behaviour during an unexpected power outage.

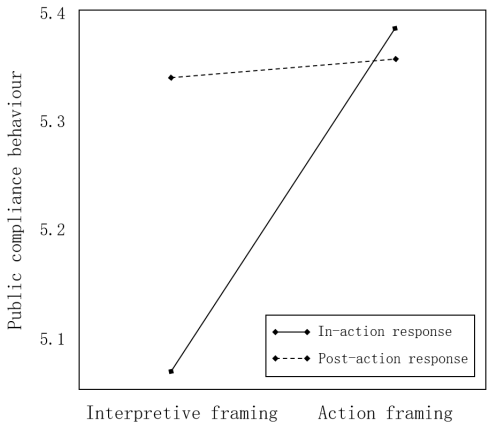

Fig. 2. Interaction effect analysis.

4 Conclusions

Using a representative sample of the Chinese population, this study seeks to determine through a survey experiment whether an information dissemination framework for sudden power outage events improves public compliance behaviour. It reveals that the use of different information dissemination framework in sudden power outage events has differential effects on public compliance behaviour. In the content dimension, the action framing has a more significant effect on the improvement of public compliance behaviour. The time dimension significantly moderated the relationship between the content dimension and public compliance behaviour. The use of the action framing for information response during sudden power outages contributed more to the improvement of public compliance behaviour than the interpretative framing. Therefore, this study may provide new theoretical insights into the impact of information dissemination framework on public compliance behaviour during power outages.

First, in the event of emergencies such as sudden power outages, the basic principles of timeliness, accuracy and transparency should be followed to strengthen information dissemination and correctly guide social opinion. It should consider adopting diversified information dissemination framework for information disclosure to meet the needs and preferences of different social publics in responding to power outage information.

Second, the content of information dissemination for sudden power outages should focus on the disclosure of action-oriented information such as emergency rescue and disposal measures. This may be due to the fact that the public, in the face of sudden power outages, shows a higher degree of concern for the response strategies adopted by the relevant authorities, as well as an urgent expectation for the rapid restoration of normal living order. The timely delivery of such information can not only deepen the public's understanding of and support for the sudden power outages and the repair measures, but also increase the public's willingness and behaviour to comply.

Third, the study highlights the importance of the interaction effect of the time dimension and content dimension. In the crisis situation of a sudden power outage, the use of an action framework for information dissemination is more conducive to improving public compliance behaviour. In addition, the information response strategy for sudden power outages should take into account the nature of the event, the public's expectations, and the effect of information dissemination to flexibly adjust the timing and content of the response.

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References

1. Xue Y, Yu X. Beyond smart grid—cyber–physical–social system in energy future [point of view] [J]. Proceedings of the IEEE, 2017, 105(12): 2290-2292.
2. Liang Z, Yan J, Li J, et al. Risk Assessment of Urban Distribution Network Under Extreme Rainstorm Disasters [J]. Power System Technology, 2023,47(10):4180-4190.
3. Zhang Y, Ding Z, Xie S, et al. Review and prospect of power distribution network resilience enhancement for energy internet[J]. Power System Technology, 2023, 47: 2054-2068.
4. Mollen, s., Holland, R. W, Ruiter, R. A. C., Rimal, R. N., & Kok, G. When the frame fits the social picture: The effects of framed social norm messages on healthy and unhealthy food consumption [J]. Communication Research, 2021, 48(3),346-378.
5. Levin I P, Schneider S L, Gaeth G J. All frames are not created equal: A typology and critical analysis of framing effects[J]. Organizational behavior and human decision processes, 1998, 76(2): 149-188.
6. Dan V, Raupp J. A systematic review of frames in news reporting of health risks: Characteristics, construct consistency vs. name diversity, and the relationship of frames to framing functions [J]. Health, Risk & Society, 2018, 20(5-6): 203-226.

7. Song S, Yao X, Wen N. What motivates Chinese consumers to avoid information about the COVID-19 pandemic?: The perspective of the stimulus-organism-response model[J]. Information Processing & Management, 2021, 58(1): 102407.
8. Tversky A, Kahneman D. The framing of decisions and the psycholoay of choice [J]. Science. 1981. 211(4481):453-458
9. Thaler R H, Sunstein C R. NUDGE: Improving Decisions About Health, Wealth, and Happiness[M]. 2009.
10. Sharot T, Sunstein C R. How people decide what they want to know [J]. Nature Human Behaviour, 2020, 4(1):14-19.
11. Saxton M K, Colby H, Saxton T, et al. Why or How? the impact of Construal-Level Theory on vaccine message receptivity[J]. Journal of Business Research, 2024, 172: 114436.
12. Trope Y, Liberman N. Construal-Level Theory of Psychological Distance [J]. Psychological Review, 2010, 117(2): 440-463.
13. Yi F, Li X, Yu S, et al. Time matters in pandemic risk communication: A moderated effect of information timeliness on stakeholder perception in Singapore[J]. Risk Analysis, 2024, 44(5): 1254-1267.