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# Literacy is necessary to understand Fact-Checking: An empirical research using survey experiments

Keywords:

Fact-checking, Media literacy, Information literacy, Backfire effect, Social media

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### Abstract

Regarding the impact of fact-checking, extensive research has been conducted on the correlation between fact-checking and individuals' political beliefs, but this issue is difficult to address by policy. This study investigates the relationship between the effectiveness of fact-checking and literacy, as well as the relationship between the effectiveness of fact-checking and the types of media used to disseminate this information. These variables can be addressed through policy measures. We conducted the survey via the internet. Participants were tasked with making true or false judgments about real instances of misinformation before and after fact-checking. The results highlighted the significance of information literacy in achieving accurate perceptions through fact-checking. Secondly, in the case of COVID-19-related misinformation, fact-checking proved more effective on government websites than on social media. Thirdly, many individuals incorrectly identified misinformation as true even after fact-checking. These findings underscore the risk of indiscriminately disseminating fact-check results on social media, as doing so could potentially have the opposite effect if the recipients lack the requisite literacy.

## 1. Introduction

This study aims to foster the practice of fact-checking. Specifically, we identify the relationship between fact-checking and literacy of information, as well as effective media for broadcasting fact-checking. These matters can be addressed through policy measures, and their implications for society are significant. This study is not intended to recommend that the government actively intervene in fact-checking. The policy responses proposed in this study are primarily intended for implementation by media organizations, platform companies, and non-profit organizations.

Fact-checking refers to the process of examining the accuracy of information, news, or statements circulating in society, documenting that process in articles, and sharing accurate information with people. This is an essential initiative in today's society as it is inundated with misinformation. The issue of misinformation gained prominence during the 2016 U.S. presidential election. Misinformation supporting Trump was shared a total of 30 million times, while misinformation supporting Clinton was shared a total of 8 million times (Allcott and Gentzkow, 2017). Amid the COVID-19 pandemic, the World Health Organization (WHO) declared misinformation an “infodemic,” a problem requiring attention comparable to the infectious diseases themselves.

Japan grapples with a plethora of misinformation. For instance, during the 2020 U.S. presidential election, misinformation suggesting that Mr. Biden was rigging the election pervaded Japan. Moreover, countering misinformation has evolved into an increasingly critical issue amid the pandemic. According to a survey conducted by the Ministry of Internal Affairs and Communications, approximately

72% of respondents reported exposure to COVID-19-related misinformation (Ministry of Internal Affairs and Communications, 2020). A separate survey carried out in Japan in 2020 showed that 28.2% of participants reported encountering political misinformation, while 45.2% had been exposed to COVID-19-related misinformation (Yamaguchi et al., 2020). As indicated, misinformation presents a pressing concern in both political and COVID-19 contexts.

Since the launch of the Fact Check Initiative Japan (FIJ) in 2017, numerous media entities and experts have cooperated to carry out fact-checking. However, these efforts have not fully permeated society. In Japan, 71% of survey respondents reported never having heard the term “fact-checking” (Yamaguchi et al., 2020). Given this situation, it is crucial to contemplate suitable policy responses to facilitate smoother dissemination of fact-checking results within society.

## 2. Research question

### 2.1 Literature review

In recent years, several empirical studies have been conducted on fact-checking and debunking information (for meta-analyses, see Lewandowsky et al., 2012; Walter et al., 2020; Walter and Murphy).

The issues presented are as follows. First, it is related to individuals' beliefs, particularly political beliefs. That is, the effect of corrective information depends on whether its content is consistent with an individual's political beliefs (Nyhan and Reifler, 2012; Swire et al., 2017; Wood and Porter, 2018). Naturally, pro-attitudinal information is more effective (Walter et al., 2020). This is called motivated reasoning (Nyhan and Reifler, 2012). It

has also been shown that fact-checking is sometimes selectively ingested and spread based on an individual's belief (Shin and Thorson, 2017).

Second, the backfire effect was noted in relation to this point. The backfire effect occurs when individuals encounter fact-checking results conflicting with their beliefs, which consequently strengthens their faith in the original misinformation. For example, Republican supporters of the U.S. invasion of Iraq in 2003, even after correcting that the information about the existence of Weapons of Mass Destruction (WMD) in Iraq was false, still strengthened their misbelief in the misinformation about the existence of WMD in Iraq (Nyhan and Reifler, 2010). The above points are based on a study of how an individual's political beliefs (liberal or conservative) relate to the effects of corrective information. Despite great academic interest, there are some challenges concerning policy implications. This is because policymakers generally cannot manipulate individual beliefs.

Therefore, the third and fourth points are the focus of this study. The third point relates to literacy, as it relates to information. If we can clarify the type of literacy involved in accepting fact-checking, it will be possible to implement policy responses. Regarding the relationship between misinformation identification and literacy, Jones-Jang et al. (2021) astutely categorize literacy into four domains—news literacy, media literacy, information literacy, and digital literacy—and investigate the effects of each. The results indicate that only information literacy significantly contributes to the identification of misinformation.

On the other hand, few studies have considered literacy as a variable in examining the effect of fact-checking, and the results have been inconsistent.

Vraga et al. (2020) and Tanihara et al. (2022) conducted two of the few existing studies on this subject. Vraga et al. (2020) performed an experiment where subjects were exposed to tweets containing misinformation and their corrections, following tweets that invoked news literacy. This study, however, did not establish that invoking news literacy significantly influences information correction. The authors posited that tweets invoking news literacy may have been lost in the timeline noise. Tanihara et al. (2022), employing the categorization by Jones-Jang et al. (2021), divided literacy into the aforementioned four categories and investigated their influence on the effect of fact-checking. The results demonstrated that individuals who reconsider their views when fact-checking results are presented via mass media tend to have higher news literacy. In contrast, those who change their minds when fact-checking results are presented through social media exhibit low information literacy. A significant issue in this study is that media and news literacy were self-reported and not adequately measured. It is also perplexing that individuals with low information literacy tend to accept fact-checking results from social media more readily than those with high information literacy. Given that the survey design did not explicitly identify the corrected information as fact-checking, Tanihara et al. (2022) suggested that individuals who alter their views based on corrected information from social media are susceptible to the information and tend to change their minds without thorough examination.

Fourthly, the medium's impact differs: in line with McLuhan's (1964) assertion "the medium is the message," reactions may vary based on the medium delivering corrective information. Identifying the most effective media for fact-checking could enable more potent policy

responses, focusing on highly effective platforms. Tanihara et al. (2022) offered insights here but only differentiated between mass and social media, without inferential statistical analysis of the two.

### 2.2 Research gaps

The research gap in related studies, with respect to policy implications, can be summarized as follows. First, many studies have focused on variables that are difficult to address in policy terms, such as individual political beliefs. Second, the few studies examining relationship with literacy have produced inconsistent results. Third, the identification of specific media types where fact-checking is effective is lacking.

Therefore, this study contributes to related research and policy by adopting the following approach. First, we designed a survey experiment that transforms literacy items into a test format and specifies that the presented corrective information has undergone fact-checking. Second, we categorized the media into four groups (online news, social media, newspapers, and government websites) and randomly divided participants into these groups for the survey experiment. As discussed below, by incorporating an interaction term for each medium into the regression model, we can identify individual characteristics that respond to fact-checking and the differential effects of each medium. The following research questions (RQs) were set for this study based on the above:

RQ1: How does individual literacy influence the effectiveness of fact-checking?

RQ2: Are there differences among media concerning the effectiveness of fact-checking?

As both RQ1 and RQ2 do not have consistent effects in previous studies, we do not set specific hypotheses. We examine the effects of each variable in an exploratory manner.

### 3. Methodology

#### Participants

This study utilized data from an internet survey conducted in Japan in 2022 by the Center for Global Communications at the International University of Japan. The survey period spanned from February 18 to February 23, 2022. The survey was disseminated to 8,394 respondents via My Voice.com Inc. and its partners, garnering 5,987 responses. After eliminating responses from samples that answered cursorily as indicated by trap questions, the final sample size was set at 5,569. This survey, however, was designed such that about 90% of the respondents had been exposed to the misinformation presented in the preliminary survey. Consequently, the analysis was weighted according to the percentage of respondents who had encountered misinformation in the pre-survey. In the preliminary survey, 40.9% of the respondents encountered one or more pieces of misinformation. Conversely, in the main survey, they accounted for 90.1%. Therefore, weighting was employed to adjust for this discrepancy. The sample sizes are presented in Table 1.

Table 1 Sample size

	male	female
20-29	430	474
30-39	524	531
40-49	598	695
50-59	614	624
60-69	546	533

## Research Design

The misinformation utilized in the survey experiment reflects actual misinformation circulated in society. We specifically employed the following two types of misinformation, both of which were determined to be “False” by fact-checking conducted by FIJ’s partner organizations:

*1. The current cabinet decided to abolish the plastic bag fee system (related to politics).*

*2. The French government began vaccinating children against the coronavirus without parental consent starting in September 2021 (related to COVID-19).*

Participants who were already aware of the above two news items before the survey were excluded from the analysis. Participants encountering the news items for the first time were asked whether they perceived the news to be accurate. The choices were: “1 = It is correct information,” “2 = It is misinformation / unsubstantiated information,” and “3 = Do not know / cannot say either.” Subsequently, the respondents were presented with corrective information regarding the news and asked again about their perception of it. Specifically, we created scenarios in which corrective information was posted on online news, social media, newspapers, and government websites, and assigned the sample to each of the four randomly divided groups. For instance, the group for whom the correction information was posted on online news responded to the following questions:

*The following information was published in an online news article. The Recycling Promotion Office of the Ministry of the Environment, the department in charge, categorically denied that the current cabinet had made a decision regarding the*

*abolition of plastic bag fees, stating, “There is no such fact.” In light of this information, how would you reconsider the following news? “The current cabinet decided to abolish the plastic bag fee system.”*

For the remaining three groups, the questions were posed by replacing “was published in an online news article” with “was posted on social media,” “was published in a newspaper article,” and “was posted on a government website,” respectively. The options were “1 = It is correct information,” “2 = It is misinformation / unsubstantiated information,” and “3 = Do not know / cannot say either.” Those who chose 2 were accurate, indicating that they had arrived at the correct perception of the information. In the process described above, participants were queried about their opinion on the two pieces of misinformation before and after fact-checking. After the survey’s completion, respondents were notified by email that all listed news were false.

## Cross tabulation

The results of the survey experiment are depicted in Tables 2 and 3. Table 2 indicates the respondents’ perceptions of the news without the presence of fact-checking. Concerning the political news, approximately 62% of the respondents selected “It is misinformation / unsubstantiated information,” suggesting that over half of the respondents identified the misinformation. In regard to the COVID-19-related news, the distribution of responses prior to the introduction of fact-checking revealed that over half of the respondents, around 59%, answered “Do not know / cannot say either.” This implies that forming a judgement on this was more challenging compared to political

Table 2 Cross-tabulation (before fact-checking)

	Politics-related news	COVID-19-related news
It is correct information.	1.6%	1.5%
It is misinformation/unsubstantiated information.	61.2%	38.3%
Do not know/ Can not say either	37.2%	60.3%
n	4,857	5,238

Table 3 Cross-tabulation (after fact-checking)

	Media (Politics)			
	Online news	Social media	Newspaper	Government website
It is correct information.	17.1%	18.7%	17.5%	18.6%
It is misinformation/unsubstantiated information.	53.3%	51.8%	54.7%	57.6%
Do not know/ Can not say either	29.6%	29.5%	27.8%	23.8%
n	1,214	1,205	1,220	1,218

  

	Media (COVID-19)			
	Online news	Social media	Newspaper	Government website
It is correct information.	13.4%	14.8%	13.7%	16.4%
It is misinformation/unsubstantiated information.	50.4%	50.8%	53.9%	52.4%
Do not know/ Can not say either	36.2%	34.4%	32.4%	31.2%
n	1,288	1,301	1,320	1,329

news.

Table 3 depicts the distribution of judgments after exposure to fact-checking through various media. As for the politics-related news, While the percentage of respondents answering “Do not know / cannot say either” for political news decreased, the proportion of respondents maintaining incorrect beliefs increased. The percentage of respondents attaining correct comprehension was slightly reduced post-correction. In terms of COVID-19-related news, the percentage of those responding “Do not know / cannot say either” decreased significantly. While the number of respondents stating, “It is misinformation / unsubstantiated information” (indicating correct comprehension) increased, the percentage who answered, “It is correct information” also rose.

This presents the surprising outcome that in

both news categories, even when confronted with fact-check results, some respondents persisted in their belief in the original information. While the corrected information seems to have assisted in discerning the veracity of the information, it did not necessarily result in correct comprehension. As it is crucial to elucidate this situation, further analysis will be conducted in subsequent sections.

In terms of the medium, the percentage of correct responses for political news increased in the sequence of online news < social media < newspapers < government websites. For COVID-19-related news, the percentage of correct responses escalated in the order social media < online news < newspapers < government websites. However, in both instances, the difference is minor, and a thorough analysis in the upcoming section is required to determine its statistical significance.

The foregoing results reveal an unexpected increase in the percentage of individuals who incorrectly identified misinformation as “correct” in both political and COVID-19-related news, even after undergoing fact-checking. To delve further into this issue, Table 4 presents a detailed account of the pre-fact-checking decisions made by those who misidentified misinformation post-fact-checking. For instance, approximately 46.3% of those who initially labelled the COVID-19-related misinformation as “correct information” continued to do so even after exposure to fact-checking. This phenomenon may be explained by the previously mentioned backfire effect, wherein respondents initially misled by misinformation remain misled, fact-checked information, thereby sustaining their original misconception. However, the backfire effect fails to explain the cases of those respondents who initially identified the news as “misinformation/ unsubstantiated information” or “do not know/ cannot say either”, but later reversed their decision to “correct information”. In these cases, respondents initially rendered the correct judgment, but subsequently arrived at an incorrect understanding after encountering fact-checking. We tentatively term this the “adverse effect of fact-checking”. To illuminate the characteristics of individuals who develop incorrect perceptions after fact-checking, we proceeded with a regression analysis.

## Regression Analysis

Building on the results from the previous section, we will conduct a regression analysis to discern the characteristics of those forming correct or incorrect perceptions based on fact-checking. The method of variable creation is as follows.

### Independent Variables

#### Media literacy and information literacy

To address RQ1, we established literacy as an independent variable, incorporating two forms of literacy: media and information. For media literacy, we referenced Kodera (2017), who structured both domestic and international measurements of media literacy. The questions, presented in a test-like format, gauged respondents’ understanding of six properties of media: the constructive nature of media messages, the media’s capacity to shape “social reality,” the commercial aspects of media, the ideological and value-based transmission of media, media style and language, and the non-uniform interpretability of the recipient. Media literacy measurements are as follows. Respondents were asked to respond to each of the following questions using a four-point scale, from “1 = strongly agree” to “4 = strongly disagree”. The questions were presented in random order.

- [1] Online news is neutral and objective.
- [2] The “average person” depicted in the news represents an average Japanese individual.

Table 4 Cross-tabulation (before and after fact-checking)

		Politics-related news	COVID-19-related news
		After fact-checking	
		It is correct information.	It is correct information.
Before fact-checking	It is correct information.	26.7%	46.3%
	It is misinformation/unsubstantiated information.	22.2%	21.5%
	Do not know/ Can not say either	10.9%	10.1%

- [3] The range of opinions online closely reflects societal reality.
- [4] Television programs are produced with viewer responses in mind (reverse-coded).
- [5] TV and internet content can be influenced by the preferences of sponsors (reverse-coded).
- [6] The media provides viewers with value judgments of what is “good” and “bad” (reverse-coded).
- [7] The same event is reported identically in mass media (newspapers, TV, etc.) and online news.
- [8] Different images used in the same TV news broadcast can generate different impressions (reverse-coded).
- [9] If the news is the same, the elements that most people focus on should be identical.

The Association for College and Research Libraries (ACRL) defines information literacy as “a set of abilities requiring individuals to ‘recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information.’” (ACRL 2000: 2). Based on this definition from the ACRL, Podgornik et al. (2016) devised a test-style questionnaire. We arranged it specifically for Japanese respondents.

(1) From the following options, select one piece of unprocessed, raw data:

- [1] The number of UN member states at the end of 2020, [2] Weather map, [3] Population data presented in a table, [4] Population data represented in graphs

(2) Which of the following statements about restaurant X does not include the author’s opinion? Select one.

- [1] Restaurant X is situated far from the station,

- [2] Restaurant X opened in 2005, [3] Don’t visit restaurant X because it isn’t good, [4] Restaurant X should discontinue 24-hour operations for the health of its employees

(3) Which of the following statements about Shohei Otani does not include the author’s opinion? Select one.

- [1] Shohei Otani is an exceptional baseball player, [2] Shohei Otani improved by moving to America, [3] Shohei Otani revolutionized the world of baseball, [4] Shohei Otani declined the National Medal of Honor.

(4) Here is news about the Amazon rainforest: “In 2019, the total area of the Amazon rainforest destruction was 9,166 square kilometers, marking an 85% increase from the previous year. This sharp increase in deforestation coincides with a period when the current President of Brazil relaxed restrictions on the development of the Amazon rainforest, after assuming office.”

From this news, select two statements we can confidently make.

- [1] The area of the Amazon rainforest destroyed in 2019 was larger than in 2018, [2] The current President of Brazil orchestrated the destruction of the Amazon rainforest, [3] The destruction of the Amazon rainforest significantly impacts climate change, [4] The current President of Brazil relaxed regulations on the development of the Amazon rainforest, [5] The destruction of the Amazon rainforest emerged as a major issue for the first time in 2019, [6] One of the significant global issues is the destruction of the Amazon rainforest.

Control variables

In addition to the demographic characteristics,



we used trust in the media as a control variable. This is predicated on the assumption that individuals with higher levels of trust in a given medium are more likely to accept fact-check results presented through that medium. We established four variables corresponding to the four media categories utilized in this study: online news, social media, mass media, and government websites. We assessed trust in each of these media types using a five-point scale.

Dependent variables

As previously mentioned, we established two types of dependent variables. The first determined whether the respondents achieved accurate perception after fact-checking. A binary variable was created by assigning a ‘1’ to those who chose ‘2’ and a ‘0’ to those who selected ‘1’ or ‘3’ from the three options: “1 = It is correct information,” “2 = It is misinformation / unsubstantiated information,” and “3 = Do not know / cannot say either.” It should be noted that those who detected misinformation prior to fact-checking were excluded from the analysis, as the research question appropriately targets those whose perceptions changed after receiving the fact-

checking results.

The second variable was whether the respondents were misled after fact-checking. A binary variable was created by assigning ‘1’ to those who chose ‘1’, and ‘0’ to those who selected ‘2’ or ‘3’ from the given options. For this analysis, the entire sample was included because those who initially responded correctly but subsequently changed their minds after fact-checking, thus leading to incorrect responses, should be considered part of the ‘adverse effect of fact-checking’.

The basic statistics of the variables are listed in Table 5.

Model

The two following models were developed:

$$\begin{aligned} \text{logit}[P(\text{True}_{ij} = 1)] &= \log\left(\frac{P[\text{True}_{ij}]}{1 - P[\text{True}_{ij}]}\right) \\ &= \alpha + \beta_1 \text{Characteristics}_{ij} + \\ &\beta_2 \text{Media\_dummy}_i + \beta_3 \text{Literacy}_i + \beta_4 \text{Trust}_i \end{aligned} \dots (1)$$

$$\text{logit}[P(\text{Fales}_{ij} = 1)] = \log\left(\frac{P[\text{Fales}_{ij}]}{1 - P[\text{Fales}_{ij}]}\right)$$

Table 5 Basic Statistics

Variable	Mean	SD	Min	Max
Gender	1.497	0.500	1	2
Age	43.854	15.022	15	69
Political interest	3.413	1.090	1	5
COVID-19 interest	3.618	1.043	1	5
Media literacy	2.845	0.357	1.667	4
Information literacy	0.696	0.271	0	1
Trust in social media	2.535	0.891	1	5
Trust in online news	3.098	0.841	1	5
Trust in mass media	3.085	1.019	1	5
Trust in government website	3.370	0.918	1	5

$$\begin{aligned}
 &= \alpha + \beta_1 \text{Characteristics}_{ij} + \\
 &\beta_2 \text{Media\_dummy}_i + \beta_3 \text{Literacy}_i + \beta_4 \text{Trust}_i \\
 &\dots \quad (2)
 \end{aligned}$$

These are logit models. The right-hand variables were standardized, excluding dummy variables. Stata ver. 16.1 was used in the analysis. Each variable has the following meaning:  $True_{ij}$  is a dummy variable indicating whether individual  $i$  was able to identify the news as misinformation after being fact-checked for topic  $j$ . It is 1 if correct, and 0 if not.  $P(True_{ij}=1)$  is the probability that  $True_{ij}$ .  $Characteristics_{ij}$  is the attribute vector of individual  $i$ . Specifically, it is a vector with three variables: gender, age, and interest in the topic. For interest in the topic, we asked about the degree of interest on a five-point scale for both topics.  $Media\_dummy_i$  is a dummy variable indicating that media individual  $i$  received fact-checking. Social media was used as a reference.  $Literacy_i$  is individual  $i$ 's literacy vector. Specifically, it is a vector with two variables: media and information literacy.  $Trust_i$  indicates the

degree to which individual  $i$  trusts each medium outlet. A vector with four variables— trust in online news, social media, mass media, and government websites.  $False_{ij}$  is a dummy variable indicating whether individual  $i$  misidentified misinformation as correct information about topic  $j$  despite it being fact-checked. It is set to 1 if misidentified and 0 if not.

#### 4. Results

Table 6 details the results of Equation (1). Regarding political misinformation, no variations were detected between media conveying fact-checking, while information literacy was significantly positively correlated. For COVID-19-related misinformation, government websites significantly positively impacted the effects, indicating a higher likelihood of correct perception when fact-checking results were presented on this source compared to social media. Both media and information literacy

Table 6 Results of Logit Model Analyses (1)

	Politics-related news			COVID19-related news		
	Coefficient	SE	p-value	Coefficient	SE	p-value
Gender	.141	.156	.368	.299*	.123	.015
Age	.067	.091	.459	-.069	.070	.322
Interest in Politics (COVID-19)	.079	.082	.335	.097	.064	.130
Media literacy	.058	.097	.552	.413**	.074	<.001
Information literacy	.413**	.094	<.001	.690**	.077	<.001
Social media dummy	(reference)			(reference)		
Online news dummy	-.147	.167	.379	-.077	.129	.551
Newspaper dummy	.112	.202	.580	.056	.160	.727
Government website dummy	.100	.197	.610	.317*	.152	.038
Constant	-.662	.293	.024	-.909**	.221	<.001
sample size	1843			3207		
R <sup>2</sup>	.064			.131		

\*\* : p < .01, \* : p < .05

Table 7 Results of Logit Model Analyses (2)

	Politics-related news			COVID19-related news		
	Coefficient	SE	p-value	Coefficient	SE	p-value
Gender	-.197	.119	.097	-.227	.123	.064
Age	.074	.067	.267	.163*	.076	.031
Interest in Politics (COVID-19)	.198**	.069	.004	.087	.074	.237
Media literacy	-.294**	.073	<.001	-.201**	.075	.008
Information literacy	-.214**	.059	<.001	-.209**	.063	.001
Social media dummy		(reference)			(reference)	
Internet news dummy	-.153	.128	.234	-.240	.126	.057
Newspaper dummy	-.086	.154	.577	-.382*	.161	.017
Website of the government dummy	-.005	.148	.974	-.310	.158	.050
Constant	-1.230**	.221	<.001	-1.303**	.212	<.001
sample size		4857			5238	
R <sup>2</sup>		.033			.036	

\*\* : p < .01, \* : p < .05

exhibited positive associations.

Table 7 lists the results for Equation (2), identifying characteristics of individuals who could not identify misinformation despite being presented with fact-checking results. For political misinformation, no variations were noted between the media conveying fact-checking. However, both media literacy and information literacy had significant negative correlations. For COVID-19-related misinformation, the medium of newspapers significantly reduced the likelihood of misperceptions compared to social media. Both media and information literacy were negatively associated.

## 5. Discussion

Our study primarily reveals that information literacy facilitates the acceptance of fact-checking results and mitigates misinterpretation. Among the four literacies presented by Jones-Jang (2021), information literacy stands as the sole

effective one in identifying misinformation. This consistency is fitting as accepting fact-checking results essentially involves discerning truth from falsehood. Information literacy, which includes differentiating facts from opinions and proficient textual comprehension, proves crucial in such judgments. This study underscores the significance of information literacy, suggesting that a more literate public is less susceptible to the detrimental impacts of misinformation—a key insight for policymakers.

Secondly, media literacy fosters the acceptance of fact-checking results and hinders misinterpretation, barring political news in Equation (1). Despite inconsistent results in earlier studies (Vraga et al., 2020; Tanihara et al., 2022), the impact of media literacy became clearer when measured in a test format.

As detailed above, literacy fosters acceptance of fact-checking results and mitigates misinterpretation. These skills should be developed over a medium-to-long-term horizon.

Media literacy is the ability to critically interpret broadcasted information. In the contemporary era, where information is disseminated through diverse media such as websites and social media, in addition to traditional outlets like television and newspapers, media literacy has become an increasingly crucial skill. Concurrently, fact-checkers should recognize that fact-checking results should be subject to critical analysis. Moreover, fact-checking results should be ingeniously disseminated.

Subsequently, we offer an interpretation of the counterproductive effects of fact-checking. Recent empirical studies suggest that the backfire effect is limited (Wood and Porter, 2018; Swire et al., 2017) and is observed chiefly when targeted information and participants exhibit strong partisanship (Wood and Porter, 2018). The news discussed in this study, the abolition of plastic bags by the ruling and foreign governments' vaccine enforcement for children, may stir strong partisanship, particularly the latter. Yet, the former topic doesn't incite a high degree of controversy. Regression analysis results indicate that, irrespective of the partisanship of specific news, individuals with low information literacy are particularly susceptible to the backfire effect. While related studies have considered individual political beliefs as explanatory variables, addressing this policy-wise is challenging. Contrarily, this study identifies information literacy, a variable that can be addressed by policy, as the cause of the backfire effect. This presents a substantial contribution to the discourse, revealing the potential to artificially curtail the backfire effect.

The aforementioned observations also apply to individuals who had accurate perceptions or suspended judgment before examining fact-

checking results. Although this phenomenon doesn't align with the scope of the backfire effect, our data demonstrate its occurrence. This circumstance presents a challenge for policymakers. Once again, media and information literacy emerge as the solutions. This study unequivocally establishes the vital role of both types of literacy in facilitating the societal penetration of effective fact-checking.

The third issue concerns the impact of various media on fact-checking acceptance. For news related to COVID-19, groups exposed to government websites were more likely to discern the truth than those exposed to social media. Additionally, the group exposed to newspapers was less likely to misinterpret information than those exposed to social media. These observations underline the inherent vulnerabilities of social media as an information medium, as pointed out by Tanihara et al. (2022). In essence, social media has certain limitations as a medium for fact-checking dissemination. To effectively disseminate fact-checking results, it is necessary to develop a reliable platform and systematize the dissemination process. These findings underscore the risk associated with casually broadcasting fact-check results on social media. If the recipients lack literacy, the outcomes could be counterproductive.

## 6. Contributions and limitations

The novelty of this study lies in the following: firstly, we revisited the relationship between literacy and fact-checking, improving the literacy-measuring items. Secondly, we sought to gauge the differential effects of various media by randomly segmenting the sample, focusing on these differences.

This study enriches the literature on corrective

information effects. While related research has primarily centered on individual political beliefs as variables, our study highlights the importance of literacy and the medium of fact-checking dissemination for effective fact-checking communication and misperception prevention. These variables are relatively policy-responsive and ripe for further exploration. Though literacy has yielded inconsistent outcomes in prior studies, our findings underscore its significance in counteracting misinformation. The study also offers fresh insights into the backfire effect. The unfortunate potential for fact-checking to mislead individuals with lower literacy represents a new risk in fact-checking that requires acknowledgement.

The policy implications of our study are as follows: information literacy is crucial for both political and COVID-19-related news, as it is integral to misinformation counteraction. The ability to discern between facts and opinions, and to read and comprehend texts—components of information literacy used in our study—should be stressed in educational curricula. Concerning media, only COVID-19-related news was found to be effectively disseminated via government websites. Particularly considering the ‘adverse effect of fact-checking,’ hastily disseminating information on social media carries the risk of misinterpretations. It is therefore important to convey fact-checking results through accredited media.

This study is not without its limitations, particularly in the design of the survey experiment used to discern different media effects. In the survey, all groups were divided based on the medium at the sentence level—an assumption underlying our experiment. For a more elaborated analysis of different media effects, it would be necessary to present actual

online news screens, social media timelines, newspaper articles, and government website screens, and then solicit respondents’ judgments. Moreover, the research design must acknowledge that fact-checking is a process. Simply presenting short report results, as done in this study, may fail to encapsulate the essence of fact-checking—verifying information truthfulness from various perspectives, sharing the process with the public, and leaving the judgment of fact-checking results up to the individuals. Capturing this complexity in a survey experiment poses a significant challenge.

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