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Miscellaneous

The Power of Data Journalism: The Effects of Data-Driven News Reports in Correcting Climate Change Misinformation

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Abstract

The alarming increase of misinformation poses a significant threat to complex issues such as climate change, especially considering the proliferation of new media, which has significantly contributed to the dissemination and reception of misinformation. The present study aimed to examine how a corrective news article featuring data visualisation influences the reduction of misconceptions and the correction of misinformation regarding climate change after readers are exposed to the stimulus. The study investigated how readers' preexisting beliefs influence the mitigation of misconceptions when exposed to news content. This study adds to ongoing conversations about creating corrective news reports to reduce the negative impacts of misinformation surrounding climate change. A quasi-experimental study was carried out online involving 186 members of the Egyptian community. The results indicate that data journalism can reduce the cognitive dissonance that causes audiences to accept misinformation. The findings indicate that data-driven journalism utilising interactive graphs is effective in altering the public's existing beliefs and knowledge while also demonstrating its ability to persuade and counter misinformation. The audience with low to moderate prior knowledge of climate change may demonstrate a diminished ability to thoroughly analyse and compare the information presented.

Keywords

Misinformation, readers' misperception, prior beliefs, prior knowledge, data journalism, climate change, data visualisations.

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1. Introduction

Researchers and policymakers have highlighted the problem of misinformation. The divide between the scientific community and the media has led to ongoing scepticism about climate change (Cheng *et al*., 2021). Misinformation about climate change is strongly linked to scepticism and denial surrounding the issue (Treen *et al*., 2020). Individuals must identify strategies employed in climate disinformation that distort scientific facts and mislead the public (Holmes *et al*., 2020). This is particularly relevant in the context of former US President Mr. Trump's indifferent tweets regarding scientific truth and his misunderstanding of global warming, which contributed to the United States' withdrawal from the Paris Agreement (Allen & McAleer, 2018).

Comprehensive solutions are necessary due to the complexity of misinformation, which is interconnected with cultural, psychological, and technological factors (Cook, 2022). The five techniques for denying science known as FLICC (fake experts, logical fallacies, impossible expectations, cherry-picking, and conspiracy theories) were the most effective. Numerous fallacies and rhetorical strategies distort scientific findings related to climate change and other disciplines (Cook, 2022).

Recent scientific evidence suggests that corrective information is generally effective in enhancing belief accuracy when it is received by respondents (Nyhan, 2021). Prior beliefs may influence this information (Mena, 2021). Corrective information often fails to produce the intended effect, thereby impeding the media's capacity to mitigate misperceptions by addressing readers' information (Mena, 2021). Successful corrections may not eliminate the enduring impact of misinformation on public opinion. The findings indicate that corrections detailing the origin of misinformation are not inherently more effective than straightforward corrections (Connor Desai & Reimers, 2023). A study indicated that when users were presented with factual information, they discarded their misconceptions and showed greater agreement with the facts (Wood & Porter, 2019).

A study indicates that algorithmic and social corrections are equally effective in reducing misconceptions (Bode & Vraga, 2015). Researchers similarly analysed the impact of infographics and data visualisation on correcting misinformation. Research indicates that participants exposed to interactive graphs demonstrated greater accuracy and generated more ideas than those who viewed static graphs (Geidner *et al*., 2015). This confirms data journalism and visualisation's ability to counteract widespread misinformation (Guan & Wang, 2022).

However, the ability of data journalism to reinforce the limitation of entrenched misconceptions is not apparent in interconnected and complex issues like climate change, owing to the intrinsic nature of shifting perceptions. Climate change is regarded as a multifaceted problem. This issue is significant and associated with various international interests.

Given the complexity of this interconnected global issue, nations focus on areas that have the greatest potential for mitigating and adapting to climate change. The effectiveness of these responses is largely contingent upon the media's impact on public comprehension of climate change. Although climate change is extensively reported in developed nations, the methodology of climate change coverage in these countries remains unexamined (Naguimbing-Manlulu, 2021).

The Egyptian audience is a significant focus because of Egypt's distinct environmental challenges and its influential media landscape within the Arab region. Egypt encounters considerable climate-related challenges, including rising sea levels and agricultural impacts, necessitating public awareness (Mahmoud, 2017; Hamdy Abdelaty *et al*., 2023), particularly due to its diverse population and the substantial influence of Egyptian media in the Middle East. The prevalence of climate misinformation in Egypt underscores the significance of media tools, particularly data visualisations, in rectifying misconceptions (Abdallah & Youssef, 2023). Egypt's dedication to climate action, evidenced by its hosting of COP27 and initiating the National Climate Change Strategy 2050, demonstrates its proactive engagement in tackling regional and global environmental issues (Abdellatif, 2023). These factors render Egypt a significant subject for examining the impact of media on public perceptions of climate change in vulnerable regions.

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Therefore, the current study investigates the extent to which corrective narratives presented in textual narrative and corrective narratives presented in static and interactive infographics and graphics can correct misinformation and alter the prior beliefs of the Egyptian audience regarding climate change.

2. Misinformation and Beliefs and Their Relation to Corrective Stories

Misconceptions represent erroneous beliefs that contradict publicly accessible evidence. These beliefs are shaped internally by cognitive biases, incorrect deductions, and influences from external sources such as media coverage. Other forms of erroneous beliefs often lack evidential support, even when individuals recognise the truth (Flynn *et al*., 2017).

The two concepts are closely related; misinformation results in misunderstandings and the formation of false beliefs. Moreover, ongoing exposure to misinformation continues to shape beliefs and attitudes even after it has lost credibility. The recurrence of misinformation enhances its perceived credibility among the public, despite the possibility of verifying its accuracy (Fazio *et al*., 2015).

Research indicates a consensus that individuals are more inclined to accept documented misinformation that aligns with their preexisting beliefs (Del Vicario *et al*., 2016). A study by Chang and Van (2023) indicates a correlation between fact-checking and individuals' trust in misinformation, as well as an increased resistance to correcting misinformation. This finding is linked to the backfire effect, characterised by the reinforcement of an opinion regarding a false belief when faced with factual information (Nyhan, 2021).

According to the theory of cognitive dissonance, individuals encounter cognitive dissonance upon receiving information that conflicts with their established beliefs. Consequently, individuals often evade information that conflicts with their preexisting beliefs and ideas. Individuals modify the conflicting cognitive component to alleviate cognitive dissonance, which induces psychological discomfort. Therefore, an increase in cognitive dissonance correlates with a heightened motivation to alter cognitive elements in order to alleviate the dissonance (Oshikawa, 1968).

A study by Lwin *et al*. (2021) has demonstrated that mainstream media plays a crucial role in addressing misinformation. Major newspapers are essential in informing and educating the public about misinformation, especially during crises. The current high demand for information, coupled with a lack of available data, can create a knowledge gap that contributes to the proliferation of fake news, misinformation, and erroneous beliefs within the general public. Therefore, it is crucial to restrict misinformation (Tasnim *et al*., 2020).

Researchers concur that the restriction of misconceptions is not easily accomplished (Lewandowsky *et al*., 2017). A study by Wood and Porter (2019) demonstrates that individuals do acknowledge accurate information, even when it contradicts their beliefs. A study confirms that uninformed individuals are more likely to revise their beliefs when presented with corrective information (Li & Wagner, 2020). A study by Vidigal and Jerit (2022) found that public perception of an issue's importance significantly influences individuals' ability to correct their beliefs. The effect of correcting misinformation is diminished among misinformed individuals who view the issue as personally relevant, indicating a greater tendency to resist correction.

Studies have explored various strategies to mitigate the lasting impact while avoiding a backfire effect (Wood & Porter, 2019). Evidence-based corrective stories were identified as the most common strategy for correcting information (Cook *et al*., 2022; Lewandowsky *et al*., 2017). Numerous experimental studies have shown that fact-checkers corrective information effectively addresses misinformation (Chen *et al*., 2018). Research indicates that individuals may experience a tipping point when confronted with information that contradicts their beliefs, suggesting a potential shift in their prior positions and perspectives (Bode & Vraga, 2015), increasing their willingness to alter their beliefs.

Furthermore, studies indicate that methods to correct misinformation can significantly decrease the prevalence of incorrect beliefs, though complete elimination is seldom achieved

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(Wood & Porter, 2019; Bode & Vraga, 2015). The findings align with Cook (2022), who utilised a graphic illustration to demonstrate that humour effectively reduces misinformation, especially regarding climate change phenomena, when conveyed in a graphical format. This finding is supported by a study by Garreton *et al.* (2023), which indicates that storytelling through data visualisations generates a stronger emotional response than simple illustrations, thus promoting a change in individuals' attitudes toward the issue. A further study has established that interactive graphics are more effective in reducing misconceptions compared to static graphics (Geidner *et al.*, 2015). A previous study has shown the effectiveness of pervasive data journalism in countering misinformation, particularly among individuals with a moderate level of misinformation (Guan & Wang, 2022). This finding aligns with another study indicating that data visualisation in news articles diminishes misconceptions among readers with below-average prior knowledge of a specific issue (Mena, 2021).

Additionally, novel data visualisation methods offer alternative and complementary strategies for comprehending the world through data, particularly in times of crisis (Lim *et al.*, 2023). Visualisations have become integral to storytelling in digital journalism, facilitating reader interaction and enhancing emotional engagement (Lopezosa *et al.*, 2022; Lim *et al.*, 2023). This study employed visual tools, including graphs and maps, to effectively convey information regarding climate change. This facilitates a comparison of the effectiveness of textual and visual content in combating misinformation, consistent with findings that visual representations diminish misinterpretation and increase engagement (Hullman & Diakopoulos, 2011).

3. Hypotheses of the Study

After reviewing the theoretical framework on misinformation, we propose the following research hypotheses:

- H1. Corrective news stories containing data visualisation would reduce readers' misconceptions and correct their misinformation about climate change after exposure to the stimulus.
- H2. Corrective news stories containing data visualisation (interactive and static infographics, graphics, and charts) would reduce misconceptions more than news stories free from data visualisation (textual story).
- H3. Prior beliefs would decrease the effect of data visualisation as news content on reducing misconceptions.

3.1. *How does prior knowledge affect information perception?*

Data processing theories indicate that individuals process messages with varying degrees of exertion. John Racioppo, a social neurologist, and Richard Petty, a professor at the University of Chicago, developed the Elaborated Likelihood Model (ELM) (Petty *et al.*, 1986). The model seeks to explain how individuals process stimuli differently and how the outcomes of these processes result in varying attitudes and behaviours. When information is provided to an audience, they are persuaded. Thus, they exert mental effort to process and evaluate the message, retain it in memory, and ultimately accept or reject it.

The cognitive capacity of the audience determines which channels they will utilise. The model proposes two information processing paths: the central and peripheral. The central route follows the high elaboration channel, in which the audience makes a greater effort to scrutinise the message's content instead of taking it lightly. In contrast, the peripheral route follows the low elaboration channel, in which the audience exerts minimal effort to verify the message (Petty *et al.*, 1986).

People's prior knowledge may affect their capacity for information processing (Petty *et al.*, 1986). Instead, the interaction of the individual with the content determines their comprehension and interpretation, superseding the significance of their prior knowledge. This suggests that the degree of interactivity with the topic or issue contributes to comprehending the content.

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Similarly, a study by Lazard and Atkinson (2014) showed that individuals with high prior knowledge focus on the deeper conceptual level of representations, whereas those with low prior knowledge focus on the surface level of representations. In other words, individuals with prior knowledge pay attention to the most important aspects, while those with low prior knowledge focus solely on superficial details. This finding was further supported by a study highlighting the role of prior knowledge in acquiring new conceptual knowledge (Chen *et al*., 2018). Additionally, the study by Lazard and Atkinson (2014) emphasised that using infographics, which integrate graphics and text, increases audience engagement with message content and stimulates individuals to think more deeply in evaluating the messages. Furthermore, both prior knowledge and individuals' participation affect their capacity for information processing.

In addition, selective exposure to information is affected by situational factors, such as perceived threat, and personal elements, such as participation in the topic. Even when contradictory opinions are presented side-by-side, individuals still favour information supporting their beliefs (Liao & Fu, 2013). Moreover, a study by Metzger *et al*. (2015) has demonstrated that individuals are exposed to news sources that align with their views and perceive them as more credible than those contradicting them. Conversely, a study by Pandey *et al*. (2014) focused solely on the effects of data visualisation and found that data visualisations did not affect the attitudes of individuals interested in a particular issue.

After reviewing the literature, it can be concluded that no studies have compared the impact of simultaneously integrating interactive and static infographics, graphics, and charts into news stories with text-only news stories devoid of data visualisation. In addition, they did not investigate whether prior beliefs and prior knowledge contribute to processing and correcting erroneous information regarding a complex issue, such as climate change.

The current study examines the effect of news stories containing data visualisation (interactive and static infographics, graphics, and charts) compared to text-only news stories on reducing climate change misconceptions. It also seeks to determine the extent to which prior beliefs and knowledge influence misunderstanding correction. Consequently, the following questions could be postulated:

RQ1. Does the news story with data visualisation (interactive and static infographics, graphics, and charts) more significantly impact correcting misconceptions than the news article without data visualisation?

RQ2. Do Prior beliefs about climate change influence the relationship between data visualisation in news stories and the reduction of misperceptions among readers?

4. Methodology

4.1. *Experimental Approach and Study Design*

Internet-based, quasi-experimental research has been conducted to test hypotheses and answer research questions. The study utilised two news articles, including data visualisation (interactive and static infographics, graphics, and charts) and the other text-only. Both narratives were compared for their effectiveness in dispelling climate change misinformation among the Egyptian audience.

The manipulation was analysed to determine how these news stories could be considered data journalism. This made it clear to respondents that data journalism is a form of journalism reliant on data analysis. Therefore, they were required to identify whether the article they were reading was an example of data journalism. It was discovered that respondents distinguished between the news stories presented using data journalism and those that were regularly presented.

The questionnaire was prepared in Arabic for the audience of the Egyptian Arab Republic. Questions about evaluating prior knowledge have been formulated based on information from the NASA Climate Change Platform and data from the United Nations Climate Change Portal. A group of experts and academics from the fields of media, communications, and geography

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reviewed the questionnaire before its implementation. In order to reach a high level of consensus, suggested modifications have been implemented, and the final version of the questionnaire has been reached.

4.2. *Evaluation Instruments and data analysis*

A set of scales was performed: issue involvement scale, respecting scientific authority scale, prior knowledge scale, and prior beliefs scale. These scales have been provided to respondents respectively. Subsequently, in order to dispel misconceptions about climate change, one group of respondents was given news stories with data visualisation (interactive and static infographics, graphics, and charts), while the other group was given text-only news stories. Both formats contained identical information. Respondents were then asked to re-answer the same questions they had previously answered before exposure to the stimuli.

Background: The selection of the two journalistic articles was a carefully planned decision to compare two distinct methods of presenting climate change information: text-only (traditional journalism) and data visualisation (modern journalism). This contrast is essential for examining how different media formats influence audience perception, particularly regarding misinformation. This quasi-experimental study was designed to analyse the impact of these formats based on established methodological principles (Yin, 1981, 2009). Following Eisenhardt (1989) and Pettigrew (1990), theoretical sampling was applied to choose cases with the most potential for theory expansion. As Yin (2009) states, "Case studies, like experiments, are generalisable to theoretical propositions and not to populations." Therefore, the formats were selected to represent distinct journalistic strategies that reveal insights into their effects on readers.

Purpose: The primary purpose of selecting these two articles is to examine the differential impact of text-only versus visual information in correcting climate change misinformation. As noted by Eisenhardt (1989), case study research is ideal for theory-building in underexplored areas, such as data journalism's influence on public perception. This controlled comparison isolates the effects of each format on belief modification, cognitive processing, and credibility, aligning with Yin's (2009) view that "the case study does not represent a 'sample,' and the goal is to expand and generalize theories."

Units of Analysis: The units of analysis in this study are the individual responses of audience members to two journalistic formats –text-only and visual content– and their effectiveness in correcting climate change misinformation. Yin (2009) describes a case study as ideal for examining real-life phenomena beyond researcher control following Yin's (2009) case study approach. This method contributes to theory development on media influence, as case studies generalize theoretical insights rather than populations (Eisenhardt, 1989; Welch *et al.*, 2011).

Participants provided informed consent and were informed that data would only be used for scientific research. The confidentiality of data was maintained, and participants were in no way placed at risk. In addition, participants were permitted to withdraw from the experiment without penalty whatsoever. Responses have been collected anonymously, and no identifying information has been requested except for the informed consensus.

4.3. *Sample*

The study was conducted in 2022, with data collected on a large scale to ensure credibility and accuracy. To increase statistical power (Onwuegbuzie & Collins, 2007), data were collected from 186 participants, a sample size consistent with effective quasi-experimental designs reported in previous research. Quasi-experimental studies often rely on smaller sample sizes due to the tested intervention's controlled and focused nature. As Cohen (1988) highlights, a sample size of 100-200 participants is generally considered adequate for detecting medium to large effect sizes in social science research, especially in studies with targeted interventions. Moreover, while larger samples may improve generalizability, research by Campbell and Stanley (2015) and Shadish *et al.* (2002) supports that well-designed studies with controlled variables can yield

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significant findings, even with smaller samples. Studies have shown that quasi-experimental research can yield reliable and statistically significant results even with sample sizes below 300, particularly when there is rigourous control over variables and experimental conditions (Rosner, 2006; Apuke *et al*., 2022). Also, the approval of the university Scientific Research Ethics Committee for the research has been received (FPGCS-ASUREC/RHDIRB2020110401/CCMS-1-102022). Participants were divided into two random groups. The first group, involving 93 participants, was exposed to the textual news story free from data visualisation, whereas the second group, involving 93 participants, was exposed to the news story containing data visualisation. Supporting examples from prior studies validate the effectiveness of similar sample sizes in quasi-experimental research (for instance, Deters & Mehl, 2012; Junco *et al*., 2010; Zhao *et al*., 2023; Ma & Zhang, 2021). These studies confirm that quasi-experimental designs can be effective with modest sample sizes when methodological rigour is upheld.

In order to ensure a representative and diverse sample, participants were contacted through multiple channels, including targeted social media campaigns, email invitations, and online forums related to climate change and environmental topics. These platforms allowed us to reach individuals likely to have varying levels of prior knowledge and interest in the topic, thus contributing to the heterogeneity of the sample. A total of 300 individuals were initially invited to participate in the study. Of these, 186 participants agreed to participate and completed the study, while 114 either declined or did not complete the tasks. The final sample was composed of participants who voluntarily agreed to participate after reviewing the consent form, which outlined the study's purpose, procedures, and confidentiality measures.

Participants were randomly assigned to one of the two experimental groups (text-only vs. visual content) to ensure that any differences in the results could be attributed solely to the type of content they were exposed to rather than to any preexisting biases or characteristics. Proper randomisation ensures no a priori knowledge of group assignment, as allocation concealment is critical in avoiding selection bias. This helps maintain the integrity of the results, as knowledge of group assignment may influence behaviours or expectations that could affect the outcomes (Schulz & Grimes, 2002). To achieve randomisation, we utilised the online random number generator from GraphPad, which is a widely used tool in experimental research for generating randomized assignments (https://www.graphpad.com/quickcalcs/randomize1/). This tool allowed us to enter the total number of participants (186) and divide them evenly into two groups. By using this method, we ensured that the assignment process was automated and free from human bias. According to (Reichardt, 2002), random assignment "creates two or more groups of units that are probabilistically similar to each other on average."

To further ensure that the randomisation process was carried out rigourously, we followed a specific protocol designed by the research team. This protocol included the following steps:

Participant Consent and Identification: Participants were assigned unique IDs to anonymize responses after consenting.

Random Assignment Procedure: Participants were allocated to one of the two groups (text-only or visual content) using GraphPad's random number generator, which maintained balance in group sizes by distributing participants evenly (Weir & Lees, 2003).

Monitoring and Verification: The research team monitored the assignment process to verify balanced distribution and immediately addressed any irregularities to uphold study integrity.

Furthermore, descriptive statistics revealed that 44.1% (n= 41) were male, 55.9% (n= 52) were female, 34.4% (n= 32) were rural residents, and 56.6% (n= 61) were urban residents. Given the age range, descriptive statistics showed that 63.4% (n= 59) were from 20 to less than 40 years old, 36.6% (n= 34) were between 40 to less than 60 years old, and 54.8% (n= 51) held a bachelor's degree.

Participants were added to a WhatsApp group after being informed about the informed consent model to ensure their voluntary participation. Instruments were pre-submitted to the two groups to assess their climate change knowledge level. Then, their responses were recorded to determine their misinformation level before exposure to the stimulus.

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The two groups were then exposed to a stimulus containing accurate information regarding climate change. The exposure phase consisted of multiple sessions. The order of the correct responses in the questionnaires has been altered to avoid the memorization effect. The instruments were then post-submitted separately to participants in each group. Participants were finally informed of their results and the purpose of the experiment. Version 25 of the Statistical Data for Social Science (SPSS) Programme was utilised for the statistical data analysis. The statistical analyses utilised were standard deviation, mean, paired samples t-test, independent samples t-test, and correlation coefficient.

The pre-post-experimental design has been used to achieve the aim of the study. The design aimed to determine whether the participants' scores increased or decreased after exposure to the stimulus.

5. Measurements

A group of measurements has been performed to maintain the experimental control; these measurements can be accessed through Google Form: https://forms.gle/qbTYifu5GQhcWVfq8. The measures used could be explained as follows:

5.1. *Correcting Climate Change Misinformation Test*

The test was submitted to a pilot sample involving ten of the audience who were not among the study participants. The test aimed at calculating the following:

Internal consistency: The correlation coefficients have been calculated to determine the relationship between each dimension and the scale's total score. Previous climate change knowledge was found to have an internal consistency of 0.721, while climate change misconceptions had an internal consistency of 0.743. The correlation coefficients of the scale were found to be strong, and its statistical significance is < 0.05. Therefore, the test's validity coefficient is high.

Test Stability: Cronbach's Alpha Coefficient was used to calculate the scale's reliability by estimating the internal consistency between the statements. It was found to be 0.723, a high value for the scale's stability. Therefore, the test was accepted and used for the study.

5.2. *Issue Involvement Scale*

The scale was adopted from the study of (Mena, 2021). Participants were asked to assess the risk posed by climate change to themselves, others, and future generations. The respondents' responses were categorised using the Three-Point Likert Scale. Responses ranged from disagree (1) to agree (3).

5.3. *Prior Knowledge Scale*

Participants were asked to answer 12 questions related to climate change. Questions were developed utilising information from the NASA Climate Change Platform and data issued by the United Nations Climate Change Portal. Multiple options were provided for respondents to choose from, and the correct answers were recorded. Results showed that the mean was 5.33, and the standard deviation was 1.55.

5.4. *Prior beliefs Scale*

The scale was used to measure the participants' misconceptions about climate change before being exposed to the stimulus. The scale items were adopted from the study of (Cook *et al*., 2022). It comprised 17 questions relating to climate change. The responses to the scale items were as true or false. The results revealed a mean of 4.94 and a standard deviation of 2.07.

5.5. *Readers' Misperception Scale*

The scale was used to measure the participants' misconceptions about climate change after exposure to the stimulus. The scale items were adopted from a previous study (Cook *et al*., 2022). It comprised 17 questions relating to climate change. The responses to the scale items were as true or false. Results showed that the mean was 5.00, and the Standard Deviation was 2.00.

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6. Results

The first hypothesis postulated that a corrective news story containing data visualisation would reduce readers' misconceptions and correct their misinformation about climate change after exposure to the stimulus. Examining the hypothesis, participants' scores on prior knowledge and Prior beliefs about climate change as an independent variable were measured before and after exposure to the news story containing data visualisation. The t-test for measuring the differences between the mean scores of the participants of the second experimental group in the pre-and post-test proved that participants' correction of misinformation about climate change had increased, and their misconceptions decreased. T-value and P-value for the prior knowledge test were 21.637 and 0.000, respectively. T-value and P-value for the prior beliefs test were 9.282 and 0.000, respectively. The t-value and P-values for the test's total scores were 14.000 and 0.000, respectively. The results confirmed a statistically significant difference at a level less than 0.05.

Table 1. Results of the paired samples t-test comparing the mean scores of related samples from participants in the second experimental group on the pre- and post-tests for correcting misinformation about climate change.

Paired Samples Test							
	Pretest. Postest	Mean	N	Std. Deviation	t	df	Sig. (2-tailed)
prior knowledge	graphics. Pretest	5.09	93	1.932	21.637	92	0.000
	graphics. Postest	11.05	93	1.930			
prior beliefs	graphics. Pretest	13.44	93	6.042	9.282	92	0.000
	graphics. Postest	21.30	93	5.769			
Total	graphics. Pretest	18.53	93	6.463	14.000	92	0.000
	graphics. Postest	32.35	93	7.292			

Source: Own elaboration.

Comparing the mean scores of the pre-and post-tests revealed an increase in the post-test mean scores across all test dimensions. Prior knowledge had a mean of 11.05, and prior beliefs had a mean of 21.30. These results demonstrate the effectiveness of the news article containing data visualisation in correcting climate change misinformation. Using Cohen's Equation, the effect size was determined to be 1.4, demonstrating the effectiveness of data journalism containing interactive and static infographics, graphics, and charts. Thus, the initial hypothesis was confirmed.

Table 2. Results of the independent samples t-test comparing the mean scores of participants in the test for correcting misinformation about climate change.

Independent Samples Test							
	Groups	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)
prior knowledge	Text	186	6.6774	3.78521	-3.656	370	0.000
	Graphic	186	8.0699	3.55808			
prior beliefs	Text	186	14.6613	7.33436	-3.623	370	0.000
	Graphic	186	17.3710	7.08764			
Total	Text	186	21.34	10.054	-3.992	370	0.000
	Graphic	186	25.44	9.761			

Source: Own elaboration.

The second hypothesis postulated that a corrective news story containing data visualisation would reduce readers' misconceptions and correct their misinformation about climate change more than a textual news story free from data visualisation. Examining the hypothesis, a T-test was performed to measure the differences between the mean scores of the participants of the two groups in the test of correcting misinformation about climate change. The t-value and P-

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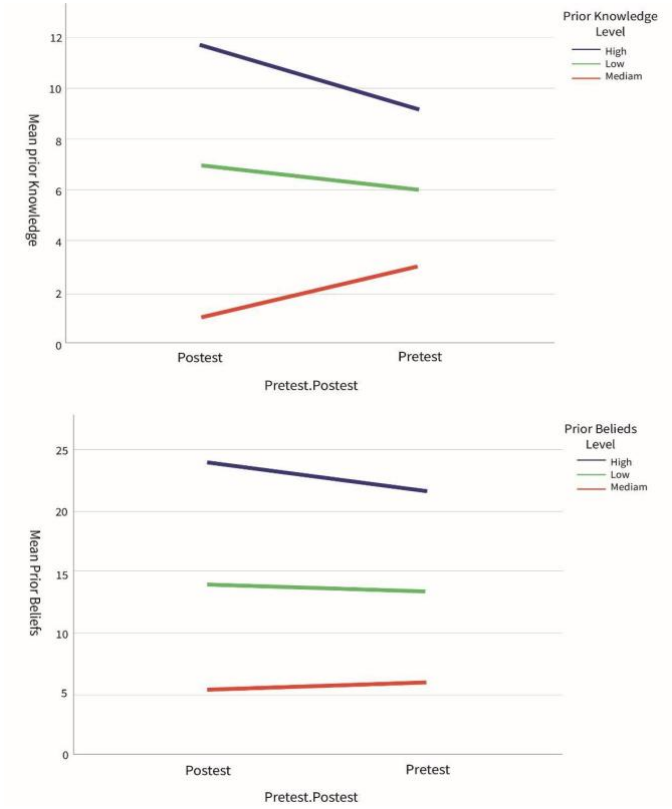
value for the prior knowledge test were 3.656 and 0.000, respectively. The t-value and P-value for the prior belief test were 3.623 and 0.000, respectively. The t-value and P-value for the total test scores were 3.992 and 0.000, respectively. These results revealed a statistically significant difference at p-value <0.05.

In addition, comparing the mean scores of both groups in each test dimension demonstrated that the second group exposed to corrective news stories containing data visualisation had higher mean scores. Prior knowledge had a mean of 8.069, and prior beliefs had a mean of 17.371. Using ETA's Equation, it was determined that the effect size was 0.43, indicating that the interactive news story with data visualisation was more effective at correcting misinformation than the text-only news story. The second hypothesis was therefore accepted.

Figure 1. The Effect of the Participants' Prior Knowledge and Prior beliefs on Reducing the Misconceptions and Correcting Misinformation about Climate Change.



Source: Own elaboration.

Participants' misperceptions have generally decreased after exposure to news stories with or without data visualisation. News articles containing data visualisation affect readers. The prior knowledge and prior beliefs of those with low and intermediate prior knowledge have changed. The mean scores of participants in the data visualisation group with low and intermediate prior knowledge increased. Their core means increased from 5.09 to 11.05; their T-value and P-value, respectively, were 21.632 and 0.000. In addition, they were concerned with correcting their misinformation. As a result, their mean score rose from 13.44 to 21.30, and their T-value and P-value were 9.282 and 0.000, respectively.

Therefore, the participants' existing knowledge and beliefs did not influence their capacity to rectify misinformation. The Elaborated Likelihood Model (Petty *et al.*, 1986) indicates that the central route was utilised for information processing. Participants possessing substantial prior knowledge and established beliefs demonstrated minimal effort in elaboration, opting instead

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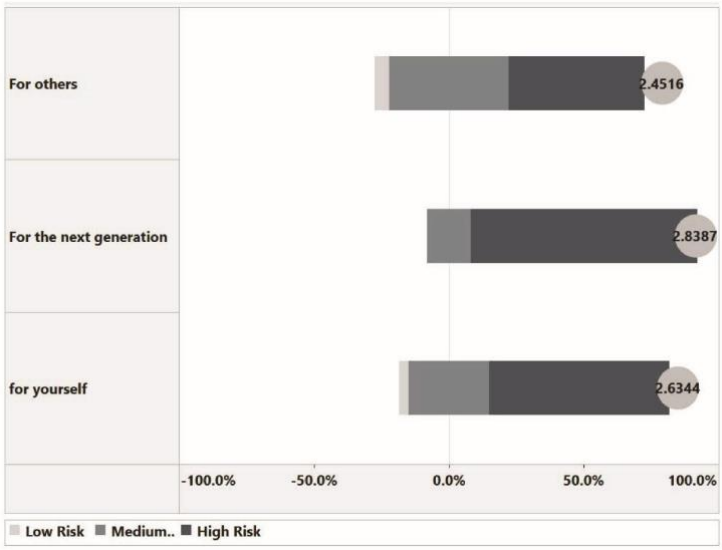
for the peripheral route. It can be concluded that individuals with fixed prior beliefs resist change, even regarding critical issues like climate change.

According to the theory of cognitive dissonance (Oshikawa, 1968), individuals who hold contradictory beliefs, values, or attitudes experience mental discomfort. Counterarguments that challenge prevailing views can lead to notable cognitive dissonance. Individuals strongly believing in misinformation often reject corrective information to preserve cognitive consistency. Textual news stories lacking data visualisation influenced participants' attitudes with low prior knowledge and beliefs, while those with high and intermediate prior knowledge and beliefs remained unaffected.

Figure 2. The Danger Resulting from Climate Change.



Source: Own elaboration.

Figure 2 demonstrates that respondents acknowledged the threat posed by climate change. The percentages can be listed in the following order: The first is the danger to others, with a mean of 2.84 and an SD of 0.369; the second is their own danger, with a mean of 2.45 and an SD of 0.598. The mean risk to the subsequent generation is 2.63, and the SD is 0.546.

7. Discussion

The increasing apprehension regarding the dissemination of misinformation within the general populace has initiated a broad discussion on strategies to address this issue (Mena, 2021). The current investigation attempted to address the same problem from an alternative viewpoint. The initial two hypotheses were therefore validated. The findings indicate that visual representation of information, such as interactive and static infographics, graphics, and charts, plays a crucial role in clarifying climate change-related misconceptions for individuals with limited or moderate prior knowledge.

Previous investigations have explored personal beliefs influenced by myths, factual data, and knowledge of preventive strategies (Dakhode *et al*., 2021; Moore *et al*., 2021). Furthermore, a variety of prior studies have produced comparable findings concerning how individuals engage with and perceive misleading news (Hadlington *et al*., 2022). A recent study indicates that presenting corrective information in a data journalism format leads to a more substantial rectification of misinformation and misunderstandings regarding climate change, in contrast to solely narrative approaches. This finding aligns with the study's validated evidence regarding the effectiveness of data journalism in countering misinformation, particularly among individuals with a moderate level of misinformation (Guan & Wang, 2022). Furthermore, an additional

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study has validated that statistical backing and data visualisation reflect the quality of a strong argument (Urban & Schweiger, 2013). This result aligns with another study that confirmed that data visualisation using only a fixed pattern in news reports has reduced misconceptions among news readers with limited prior knowledge about a specific issue (Mena, 2021). Nonetheless, the present study offers a differing perspective compared to the earlier research regarding the correction of misinformation among intermediate-level students. The observed difference can be explained by the present study employing a combination of interactive and static infographics.

Overall, there was a reduction in misinformation among participants in both groups. This study also demonstrated that previous knowledge, existing beliefs, and the degree of interest in the subject matter reduced the influence of data journalism on individuals who are heavily misinformed. Correctional narratives presented in the textual news format did not influence participants who exhibited moderate to high levels of misinformation. This finding aligns with studies showing that people often dismiss information or facts that challenge their established beliefs and hold onto their previous convictions (Del Vicario *et al*., 2016; Chang & Van, 2023). The Elaboration Likelihood Model indicates that participants did not invest significant effort in the elaboration process and opted for a peripheral route (Petty *et al*., 1986). High cognitive thought is linked to an increased emphasis on established beliefs when assessing new information (Tappin *et al*., 2020).

The findings highlight the significance of data visualisation, utilising a clear model to effectively convey the narrative and enhance the appeal of crucial data. Consequently, individuals can visually analyse data showcased through interactive visualisation, recover it, and access it as needed. As a result, the present investigation has shown that engagement with data visualisation has transformed individuals' attitudes and misconceptions, leading to a beneficial impact on their rectification. This outcome can be elaborated upon by the study demonstrating that one of the techniques utilised by journalists to unveil misconceptions and misinformation involves presenting the public with more precise data through static graphical representation (Mena, 2021).

Additionally, the third hypothesis indicates that existing beliefs diminish the impact of data visualisation as a tool for news content in alleviating misconceptions. Furthermore, a recent investigation has revealed that the influence of data visualisations (including both interactive and static graphics) within corrective narratives on reader misperceptions is considerable for individuals with medium and low levels of understanding. The findings indicate that the effectiveness of data visualisations is influenced by the prior knowledge level of the participants. The study focused on individuals with moderate and limited prior knowledge, revealing a positive effect of data visualisations on these participants. Additionally, there was a notable reduction in the percentage of their misconceptions when compared to those who received corrective narratives devoid of data visualisations. This result is significant as it illustrates the influence of data visualisations in diminishing established beliefs regarding climate change. This aligns with findings that suggest infographics are more effective than textual content in dispelling misconceptions (Garreton *et al*., 2023; Guan & Wang, 2022; Mena, 2021).

The Elaborated Likelihood Model posits that only prior knowledge and prior beliefs significantly influence the likelihood of data elaboration, with personal connection directly impacting motivations for information processing. Thus, climate change may be viewed as directly and personally relevant to individuals. Consequently, it can be concluded that an individual's personal connection influences their decision-making in information processing through central or peripheral routes. The present study aligns with the Elaborated Likelihood Model regarding audience responses to stimuli, the outcomes of these responses, and their influence on attitude and behaviour modification. The audience's high motivation level may lead to a central processing route characterised by extensive elaboration on the message's content rather than superficial skimming. Consequently, the audience is more inclined to focus on the strengths of the message while disregarding distractions, an attitude that plays a crucial role in

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the acceptance of the message. Conversely, when the audience follows the peripheral route with low elaboration, they may focus on distractions rather than the message's minute details. If the message effectively persuaded the audience, their behaviour would exhibit greater stability and reduced susceptibility to change. These findings contribute to understanding why infographics are more engaging than text (Mena, 2021).

The study indicates that individuals with limited prior knowledge of a specific topic are more vulnerable to misinformation and erroneous interpretations. Conversely, increased knowledge reduces susceptibility to false information and enhances the ability to comprehend and evaluate narratives accurately. This finding is consistent with the research conducted by Lwin *et al.* (2021), which posits that media is essential in addressing misinformation through public guidance and education. Prior knowledge has been shown to affect the understanding of illustrative diagrams and learning new information (Chen *et al.*, 2018). Graphical representations function as an effective means of conveying and elucidating information. However, their impact depends on the reader's level of familiarity with the topic.

Individuals with limited prior knowledge of climate change or similar subjects may struggle to critically analyse and compare the information presented. This increases the likelihood of accepting visual information that contradicts their beliefs. This study has important implications for media outlets and journalistic institutions, highlighting the necessity of guiding the public through data journalism on the critical global issue of climate change. The high demand for and scarcity of information contribute to a knowledge gap that fosters misinformation (Tasnim *et al.*, 2020).

The present study was conducted within the framework established by Mena (2021), which utilised solely static data visualisations. Participants were able to engage with the diagrams, as the study incorporated news articles featuring various forms of data visualisations, including both interactive and static graphics and maps. The research indicated that dynamic data visualisations exerted a greater influence compared to static visualisations, especially among individuals with moderate and low levels of prior knowledge and beliefs. This finding illustrates the effectiveness of data visualisations in addressing public misconceptions, as evidenced by a study indicating that data visualisation exerts a greater emotional influence than conventional illustrative diagrams, leading to a change in individuals' attitudes regarding the relevant issues (Mena, 2021). Moreover, supporting research has clearly demonstrated that interactive diagrams exert a greater influence than static diagrams (Geidner *et al.*, 2015). It is essential to promote interest in climate change-related topics and to present evidence-based results from the scientific community and professionals to the public in a manner that is accessible, engaging, and grounded in data (Álvarez-García *et al.*, 2023).

This study presents experimental evidence indicating that data visualisation can help mitigate misinformation and misconceptions regarding complex and interconnected phenomena, such as climate change. This study indicates that news stories can effectively mitigate misperceptions despite the challenges associated with correcting them (Lewandowsky *et al.*, 2017). Furthermore, employing data visualisations will mitigate these misconceptions among individuals with moderate and limited knowledge.

8. Conclusion

The findings prompt a reevaluation of the effectiveness of data-driven journalism in the contemporary information landscape. This study adds to the body of knowledge regarding the mitigation of misinformation and the role of interactive infographics in data journalism. Researchers proposed and experimentally demonstrated that news reports incorporating both interactive and static data visualisations effectively reduce the spread of misleading scientific information. The findings indicate that data journalism has the potential to address cognitive bias and cognitive dissonance, which contribute to the public's acceptance of misinformation. Studies indicate that corrective stories do not consistently yield effective outcomes.

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Consequently, the current study has contributed to enhancing the use of corrective strategies that consider the application of data journalism based on arguments, explanatory evidence, and scientific dada-based statistical measurements. In addition, the current study has addressed measurements of climate change phenomena based on historical data. As a result, systematic processing was facilitated, and respondents could think more logically, allowing them to refute misinformation effectively. Consequently, these practices can assist government initiatives in addressing individuals' misinformation on the relevant issue by offering framed arguments tailored to those who prefer either low or high levels of elaboration. Individuals exhibiting low elaboration levels may utilise the peripheral route, engaging with arguments, infographics, and various visual representations, whereas those with high elaboration levels are likely to adopt the central route. This study significantly contributes to mitigating the spread of misinformation and facilitating its correction, particularly regarding the critical global issue of climate change.

9. Limitations

The current study has some limitations. First, the results of this study are derived from an experimental design that may lack real-world applicability. The current investigation could be significantly improved by utilising field study methodology. The current study has a limitation in its narrow scope, as it focused exclusively on two types of designs for controlling differences. Future research may investigate various promising avenues, such as analysing the impact of different social media platforms on the public's reception of visualised information and exploring individual characteristics, including age and education, that moderate visual data processing. Additionally, gamification could enhance user motivation and understanding of complex issues like climate change. Increasing sample diversity and examining the long-term effects of visualisations on attitude changes regarding environmental issues may produce significant results. Results could be enhanced by incorporating additional interactive elements, such as graphs, 360-degree videos, and augmented reality experiences.

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