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Investigating Trustworthiness and Conflict in Historical Multiple Texts: From Eye-Tracking Data of Source and Content Processing

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Abstract: Online reading is one of the sources to acquire knowledge, but learners may encounter conflicting texts during reading. Thus, learners need to distinguish the source's trustworthiness and determine which perspectives to believe. However, previous studies have focused more on the source than on the content and more on science than on history in eye-tracking fields. Therefore, the purpose of this study is to investigate how readers perceive conflict and process source and content when reading historical multiple texts with varying degrees of trustworthiness. 11 participants were recruited and presented six historical texts under three different conditions: high-trustworthiness, low-trustworthiness, and trustworthiness-differences. Their eye movement was recorded. The results indicated that the readers rated the low-trustworthiness condition as having more conflict than the others. Additionally, the low-trustworthiness condition had less first-pass reading time than the trustworthiness-differences condition. Readers spent more rereading time on the content than on the source only in the trustworthiness-differences and low-trustworthiness conditions. When reading text with low trustworthiness, the reader spent more first-pass reading time on the source than on the content and spent more rereading time on the content than on the source. These findings have several implications. Firstly, readers were overwhelmed and needed guidance on which information to believe, leading to the perception of more conflict when reading low-trustworthiness conditions. Second, the readers were aware that the source seemed untrustworthy, leading them to decrease reading time to process the following content. After confirming the source's trustworthiness, readers tended to reread the content to resolve the conflict. Lastly, low-trustworthiness sources decreased processing time in the following content, indicating that readers regulate their reading patterns depending on the text's trustworthiness. Overall, this study provides insights into how readers process historical multiple texts with varying degrees of trustworthiness.

Keywords: multiple-text, eye-tracking, conflicting, historical topic

1. Introduction

As technology advances, people can get much but conflicting information on the Internet. To comprehend an issue deeply, readers need to read more than one text to validate the trustworthiness of the information (Goldman & Scardamalia, 2013; Jarodzka & Brand-Gruwel, 2017). When reading multiple texts, readers need to select, process, and evaluate the relevant ones to form meaningful mental representation (Bråten & Strømsø, 2009).

In the context of multiple-text use, reading strategies are associated with evaluating the trustworthiness (Braasch & Bråten, 2017). When reading conflicting information, readers perform better if they evaluate the source's authorship, intent, and related affiliation (Anmarkrud et al., 2014; List & Alexander, 2019). However, content processing is equally essential but seems to be neglected in the eye-tracking field (Salmerón et al., 2018). When judging trustworthiness, readers should rely on both the source and content simultaneously

(Barzilai et al., 2020). Therefore, the aim of this study is to extend previous research by investigating the effect of trustworthiness differences, content, and source on eye movement processes when reading conflicting information.

2. Literature Review

2.1 Conflicting information in multiple texts

The information between texts can be a complementary, redundant, or conflicting relationship, and the conflicting information has been the focus of much research attention (Primor & Katzir, 2018). Previous research has proved that readers pay attention to the source information and memorize them (Braasch et al., 2012; Kammerer et al., 2016; Rouet et al., 2020). Braasch and Bråten (2017) proposed the discrepancy-induced source model (D-ISC model) to explain this phenomenon. The incoherence provoked by conflicting information leads readers to focus on source information to explain why the conflict happened, resulting in deep memory encoding of the source information.

When encountering conflicting information, evaluating the source's trustworthiness is one of the approaches to reconciling this situation. For instance, Bråten et al. (2011) instructed readers to read various texts on climate change from different sources, including textbooks, newspapers, magazines, and official documents. The readers rated textbooks and official documents as trustworthy and paid more attention to these sources than others. Gottschling et al. (2019) required the experimental group to read two conflicting scientific texts, one written by a professor working for a company and the other by a university professor, while a control group read two scientific texts written by university professors. Their results revealed that readers rated the text from the company as less trustworthy than the text from the university. Previous research on this topic seems to focus more on scientific than historical issues which need further investigation.

2.2 Eye-tracking in multiple-text reading

Eye-tracking has been used to investigate the moment-to-moment attentional distribution (Rayner, 2009). Researchers usually define the source information as the area of interest to examine readers' attention when reading the conflicting information (Braasch et al., 2012; Gottschling et al., 2019; Kammerer et al., 2016). For example, Kammerer et al. (2016) explored whether readers paid attention to processing the source information when reading conflicting information on web pages. The result revealed that readers had longer total fixation duration on the source information when reading conflicting web pages than consistent ones. Gottschling et al. (2019) used first-pass reading time and rereading time to examine readers' cognitive process when reading conflicting information. Their findings revealed that the trustworthiness differences in information caused readers to spend more time rereading the low-trustworthiness source.

These studies suggest that readers allocate attentional resources to source information when processing conflicting information. However, the discussion about content processing seems less in the eye-tracking field of multiple-text use.

2.3 The current study

The conflicting multiple texts make readers concentrate on the source information for resolving the conflict. Previous studies have been conducted with scientific texts. It needs to be clarified how readers process multiple historical texts, especially considering the content and sources simultaneously. Therefore, the aim of this study is to investigate readers' attentional distribution when reading multiple historical texts with conflicting information. The trustworthiness of the sources was manipulated into three conditions: high-trustworthiness, low-trustworthiness, and trustworthiness-differences conditions. Two research questions were proposed:

RQ1: How conflict do readers perceive when reading different multiple-text conditions?
RQ2: How do readers process the source and content reflected from the eye-movement data when reading different multiple-text conditions?

3. Method

3.1 Participants

It was an exploratory study, and only 11 participants were recruited from the University in Northern Taiwan. All the participants passed the calibrations. This study was conducted with a within-factorial subject design. Every participant was instructed to read all conditions. The present order was counterbalanced across the participants.

3.2 Materials

The participants were given six texts regarding the same historical topic. Table 1 presented detailed information about these texts: either high trustworthiness, meaning that the source was from the government, or low trustworthiness, meaning that an anonymous person paraphrased the source. Three texts shared the same viewpoints, while the other three opposed those viewpoints. Each text consisted of two paragraphs: source and content. The source was positioned before the content, as presented in Figure 1. The six texts were paired into three conditions: high-trustworthiness, low-trustworthiness, and trustworthiness-differences. Two texts were displayed on the screen at the same time.

Table 1. *Overview of the six texts*

	Multiple-text condition					
	Trustworthiness-differences		Low-trustworthiness		High-trustworthiness	
No.	1	2	3	4	5	6
Trustworthiness	Low	High	Low	Low	High	High
Viewpoints	A	B	A	B	A	B
Number of words in the source/content	103/80	100/80	102/80	101/80	101/81	103/79

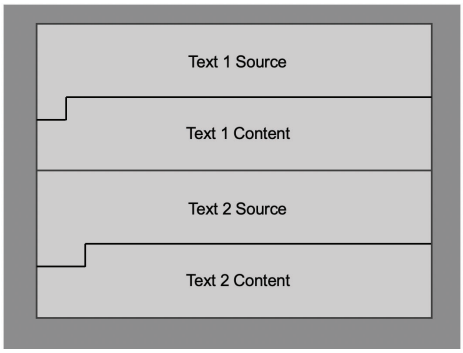

Figure 1. The display of text condition.

3.3 Apparatus, area of interest, and eye movement measures

The eye movements were recorded by an EyeLink 1000 desktop remote eye-tracker system (SR Research Ltd., Canada) with a sample rate of 1000Hz. The distance between the monitor and the participants was 60 cm. Each Chinese character was 24 × 24 pixels, and the space between lines was 32 pixels. Figure 1 presented four AOIs (areas of interest) defined in each trial: two sources and two content. Two eye-movement measures were first-pass

reading time (FPRT) and rereading time (RRT). FPRT is the sum of the durations of all first-pass fixations before leaving the AOI. RRT is the sum of the durations of all returning fixations after first-pass fixations on the AOI. To control the length of paragraphs, eye-movement measures were divided by the number of characters (Stadtler et al., 2020).

3.4 Measures

After reading each condition, the participants were instructed to answer three questions using a 5-point Likert scale. One of the questions inquired about the sense of conflict between the two texts, while the other two questions referred to judging the trustworthiness of each text.

3.5 Procedure

The procedure in the experiment consisted of two sections. In the first section, the participants were provided with concise instructions on the eye-tracking procedure. They were positioned in front of a monitor with a chin rest to avoid head movements. The participants were calibrated with nine points. In the second section, participants were instructed to read three conditions. In each condition, the texts were conflicting with each other. Once the participants finished each condition, they were required to rate each text's sense of conflict and trustworthiness. After the completion of the tasks, the participants were dismissed.

4. Result

4.1 The rating of trustworthiness and sense of conflict

To answer RQ1, we used repeated measure t-test to examine the trustworthiness in each condition and repeated measures ANOVA to examine the differences between the multiple-text conditions in the sense of conflict. The means and standard deviations (in parentheses) are presented in Table 2.

The result of the t-test showed a significant difference in the trustworthiness-differences condition, indicating the second text had high trustworthiness than the first text ($t(10) = -3.31$, $p < .01$).Additionally, the high-trustworthiness condition had higher trustworthiness than the low-trustworthiness condition ($t(10) = 3.46$, $p < .01$).

The results of RM-ANOVA showed that the sense of conflict differed significantly across the multiple-text conditions ($F(2,20) = 4.93$, $p = .018$, $\eta^2 = 0.16$). The post-hoc comparisons showed that the low-trustworthiness condition made readers perceive more conflict than the high-trustworthiness condition ($t = 3.12$, $p < .05$), while other comparisons were not significant.

Table 2. *Means and SD for the trustworthiness and sense of conflict in each condition*

	Multiple-text conditions					
	Trustworthiness-differences condition		Low-trustworthiness condition		High-trustworthiness condition	
No.	1	2	3	4	5	6
Trustworthiness	2.27 (0.79)	3.91 (0.94)	3.18 (1.08)	2.45 (0.69)	3.00 (0.89)	3.73 (1.01)
Sense of conflict	3.45 (1.29)		4.09 (0.83)		3.00 (1.00)	

4.2 Eye-movement measures

To answer RQ2, we analyzed two eye-movement measures using linear mixed model (LMM) with lme4 package (Bates et al., 2015). In this study, participants and texts were regarded as random effects. Two fixed effects were the multiple-text conditions with three levels (trustworthiness-differences, low-trustworthiness, and high-trustworthiness) and the

paragraphs with two levels (source and content). Two dependent variables were first-pass reading time and rereading time. Table 3 presents the means and standard deviations (in parentheses) for eye-movement measures in each condition.

Table 3. *Mean and SD for eye-movement measures in each condition of texts*

	Multiple-text conditions					
	Trustworthiness-differences condition		Low-trustworthiness condition		High-trustworthiness condition	
Paragraphs	Source	Content	Source	Content	Source	Content
First-pass reading time	41.24 (46.81)	29.67 (39.47)	26.46 (32.27)	14.48 (27.59)	30.29 (32.52)	30.03 (34.90)
Rereading time	60.22 (55.87)	100.40 (55.01)	66.19 (64.32)	110.68 (60.09)	73.81 (54.58)	70.59 (42.62)

The result of first-pass reading time showed that the low-trustworthiness condition had less first-pass reading time than the trustworthiness-differences condition (b = -14.98, SE = 6.9, t = -2.16, p < .01). Other comparisons were not significant.

The result of rereading time showed that the main effect of the paragraphs was significant (b = 27.28, SE = 8.22, t = 3.31, p < .01), indicating that the readers spent more time on the content than on the source. However, this effect was moderated by the multiple-text conditions because of the two-way interaction effect (b = -43.40, SE = 8.22, t = -2.15, p < .05).

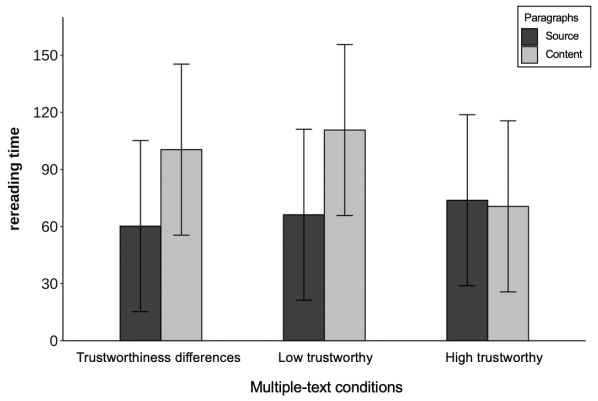

Figure 2. The interaction effect of multiple-text conditions and paragraphs on rereading time.

In Figure 2., post-hoc comparisons showed that readers spent more time on the content than on the source only in the trustworthiness-differences condition (b = -40.18, SE = 14.2, t = -2.82, p < .01) and the low-trustworthiness condition (b = -44.50, SE = 14.2, t = -3.12, p < .01). These findings were inconsistent with previous studies, which revealed that when reading two conflicting texts, readers would shift their attention to the source to reconcile the conflict (Braasch et al., 2012; Kammerer et al., 2016). We speculated that readers would regulate their depth of reading patterns based on the source's trustworthiness. If readers were aware of the untrustworthy texts, readers might decrease the processing time in the following content. To test this hypothesis, we merged these three conditions to analyze these six texts with either high or low trustworthiness, and each text contained two paragraphs. In other words, two independent variables (trustworthiness and paragraphs) and two dependent variables (first-pass reading time and rereading time) were analyzed.

In Figure 3., the result of first-pass reading time (left side) showed the marginally significant interaction effect (b = 21.30, SE = 11.17, t = 1.90, p = .06). The post-hoc comparisons revealed that when reading the texts with low trustworthiness, readers spent more time on the source than on the content (b = 18.59, SE = 7.9, t = 2.35, p < .05) while this

effect was not found in reading the text with high trustworthiness (b = -2.71, SE = 7.9, t = -0.34, p = .73). The result of rereading time (right side) showed the significant main effect of paragraphs, indicating that readers spent more time on the content than on the source (b = 27.15, SE = 8.30, t = 3.27, p < .01). The interaction effect also reached a marginally significant level (b = -31.40, SE = 16.60, t = -1.89, p = .06). The post-hoc comparisons showed that when reading the texts with low trustworthiness, readers spent more time on the content than on the source (b = 42.90, SE = 11.70, t = -3.65, p < .001) while this effect was not found in reading the texts with high trustworthiness (b = -11.4, SE = 11.70, t = -0.97, p = .33).

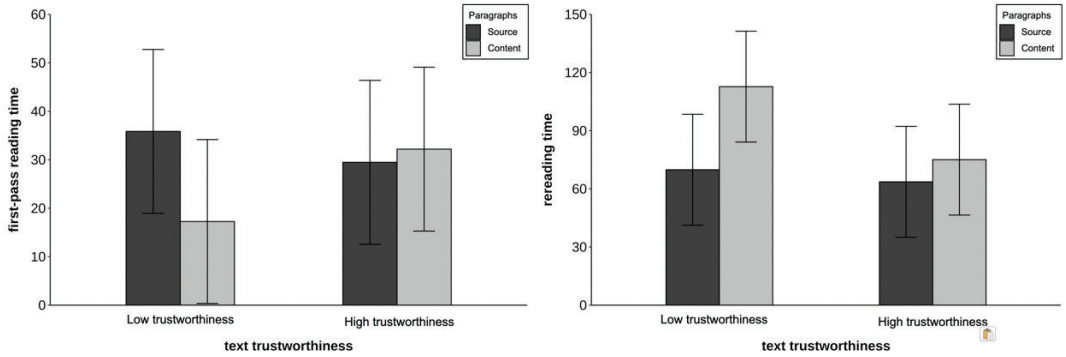

Figure 3. The interaction effect of texts trustworthiness and paragraphs on first-pass reading time (left side) and rereading time (right side).

5. Conclusion

The previous studies have focused more on the source than on the content (Gottschling & Kammerer, 2021; Gottschling et al., 2019); however, the content is also essential for forming an elaborative document model (Perfetti et al., 1999; Salmerón et al., 2018). Therefore, the goal of this study is to investigate readers' attentional distribution when reading a historical topic with conflicting pieces of information varied with trustworthiness.

Three main findings were drawn from the analysis. Firstly, readers rated the low-trustworthiness condition as having more conflict than the other conditions, suggesting that they were overwhelmed and unsure which information to believe; hence, they perceived more conflict. The other conditions provided readers with at least one text to believe, which lessened readers' sense of conflict. Future research should investigate how readers judge conflict.

Second, the eye-movement analysis indicated that the low-trustworthiness condition had less first-pass reading time than the trustworthiness-differences condition, implying that readers were aware that the source seemed less trustworthy; therefore, they decreased reading time to process the following content. This trend was also evident in the mean of first-pass reading time in Table 3, although the difference was not significant. Additionally, the result of rereading time revealed that readers spent more time on the content than on the sources, particularly when reading the trustworthiness-difference and the low-trustworthiness conditions. This suggests that readers tend to reread the content after confirming the source's trustworthiness to resolve the conflict.

Thirdly, we merged these three conditions into six texts with either high or low trustworthiness. We found that only low-trustworthiness texts caused readers to increase first-pass reading time processing the source and rereading time processing the content. This effect was not found in reading high-trustworthiness texts. In other words, low-trustworthiness sources led to decrease processing time in the following content, indicating that readers regulate their reading patterns depending on the text's trustworthiness. This explanation echoed the second finding and should be confirmed by future research.

Some limitations should be noted. Firstly, only 11 participants were recruited. Accordingly, some statistical results only reached marginal significance. Therefore, the sample should be increased to confirm the statistical results. Secondly, we did not collect reading comprehension or memory data, which is essential in the document model

emphasizing the link between the source and the content (Perfetti et al., 1999). Future research should evaluate readers' reading comprehension. In summary, this study provides empirical eye movement data and insight into how readers process sources and content in a historical topic. Future research should continue to explore these issues.

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