

Does incorporating social media messages into television programs affect the validation of incorrect arguments?

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Abstract

The present study explores the impact of including social media messages on learning from television programs that broadcast pseudoscientific claims. Seventy-seven university students were allocated to one of three experimental conditions: viewing television content with messages supporting the claim, with opposing messages, or without any messages presented. Memory retention did not differ among the conditions. However, social media messages influenced validation of the arguments claimed in the video. The participants who watched the video with opposing messages showed significant decrease in positive attitude toward the pseudoscientific technology that claimed to be effective in the video. Additionally, the participants who watched the video with supporting messages made fewer critical comments and showed willingness to donate more to the activity using the pseudoscientific technology. The impact of including social media messages and the process of attitude change are discussed.

Keywords: social media messages; learning from television programs; incorrect arguments; validation of argument; attitudes; retention.

Introduction

Learning from television programs with social media messages

One of the major sources for everyday learning is television. Since television programs are designed with various styles, it is not easy to define the processes of learning from television in general. Thus, we begin by focusing on a relatively simple program that broadcasts experts' explanations. Although the style is simple, we can find many examples of the type of television programs in which experts like scholars and scientists explain topics of interests such as politics, technology, and science.

The present study investigates how social media messages impact learning from the "experts' explanation" type of show. It is shown that people often access social media while watching television. It is also getting popular to include social

media posts on the screen during such programs (Inuzuka, Tanaka, & Tsubakimoto, 2017; Barra & Scaglioni, 2014). In this case, the social media messages, which typically include hashtags, are searched and presented. (See Figure 1 for an example of how these feeds may be presented.) The programs usually include messages that consist mainly of text, such as posts on Twitter. Although the relationships between social media and viewing television programs have begun to be explored widely (e.g., Anstead & O'Loughlin, 2011; Ceron & Splendore, 2018; Miao, 2018; Waddell & Bailey, 2019), few studies investigate their impact on cognitive processes (e.g., Cameron & Geidner, 2014; Maruyama, Robertson, Douglas, Semaan, & Fucett, 2014; Maruyama, Robertson, Douglas, & Raine, 2017). Thus, we still lack evidence to discuss their effects on learning.

In the present study, we focus on the impacts of social media messages on validation as well as memory retention. Validation is one type of integration process that requires activation of one's prior knowledge and unfolding a logical argument (e.g., Halldorson & Singer, 2002; Lea, Mulligan, & Walton, 2005; Singer, Halldorson, Lear, & Andrusiak, 1992). The inclusion of social media messages may impact the validation process of the viewers; the messages can activate viewers' knowledge or provide new information that is effective for appropriate validation. These social media messages, however, cannot always be effective for validation. The messages contain various opinions (D'heer & Verdegem, 2015), and irrelevant and inappropriate messages can be included as well as helpful ones. Previous studies failed to investigate how qualitatively different messages impact viewers' learning. Thus, the present study investigates the effects of different types of social media messages on viewers' memory retention and validation of arguments provided in television programs.

Learning from multimedia sources and the effects of including social media messages

While the "experts' explanation" type of television program may seem simpler than other styles, the situation can be

described as learning from multimedia materials. Watching the program, the viewers integrate the information presented in the speech and other visually presented materials such as graphs and illustrations. When social media messages are incorporated into the program, the viewers must integrate more information presented visually in the text of social media messages.

The literature on multimedia learning suggests that the inclusion of social media messages may interfere with viewer comprehension since the messages may contain incoherent information. Mayer (2009) suggested a “coherent principle” in which learners understand a topic better when irrelevant and seductive elements are removed from the learning materials. The coherence principle can be explained by the split-attention effect theory; a multimedia resource results in less learning when it splits learners' attention (Sweller & Chandler, 1996). This attention split is more likely to occur when the resource contains information sharing the same modality and when it is not coherent with the other information presented (Mayer, 2009; Mayer & Moreno, 1998).

Consideration of the coherence principle led us to assume that the presentation of messages interferes with learning since these messages are not consistent with the main information of the contents. Inuzuka, Tanaka, and Tsubakimoto (2017, 2018), however, suggested that the effects of presenting social media messages on memory retention were limited. They compared the memory retention scores of participants who watched video material including and not including social media messages. Participants paid attention to the messages when presented but showed no significant difference in retention scores between the two groups.

The gap between the coherent principal and the results of Inuzuka et al. (2017, 2018) can be interpreted from the standpoint of the difference in the level of comprehension. Research on multimedia learning suggested that violation of the coherent principal mainly influences the integration of learning materials and the learner's knowledge (Mayer, 2009). Thus, we can assume that Inuzuka et al. (2017, 2018) showed no significant effects of including social media messages since they examined memory retention, which did not require integration of the knowledge.

The validation of false arguments

Viewers activate their prior knowledge, integrate the information presented, and validate the arguments (e.g., Halldorson & Singer, 2002; Lea, Mulligan, & Walton, 2005). Validation of an argument is especially important when it comes to learning from television programs since the issues tackled in television programs are often relevant to viewers' lives and require them to decide what to believe and what to do. Additionally, and more importantly, the media do not always provide fair and correct arguments. Consideration and validation of potentially biased information are among the most important practices in surviving the information age.

Research shows that people display difficulty rejecting information even when the texts they read are inconsistent with prior knowledge and even patently false (e.g., Gilbert, Krull, & Malone, 1990; Gilbert, Tafarodi, & Malone, 1993). Gerrig and Prentice (1991) revealed that it took longer to vilify a false statement as “incorrect” when participants read the statement discussed as truth in a narrative text. These studies suggest that learners accept what they have processed as truth first and resolve the validation afterwards. Rapp (2008) suggested that, when providing fake information within a context that casts doubt on correct information, the verification becomes even more difficult for learners.

To extend the above discussion, it is necessary to note that the above studies employed information regarding which the correctness of the arguments was apparent to the learners. Television programs, however, usually focus on issues on which learners do not possess much prior knowledge. In this case, the validation of incorrect argument becomes a more difficult and complex task that demands more deliberate consideration. Thus, we must employ an index other than reaction time. Consideration of new ambiguous topics should and can be measured more qualitatively using participants' attitudes toward the topic, decision making, and the explanation of the situation related to the issue.

The impacts of presenting social media messages

We can predict that the presentation of social media messages changes the way viewers validate presented arguments. Maruyama et al. (2017) investigated the effects of referring to social media messages when watching a discussion on the television. They revealed that viewers' attitudes were different in the direction of the social media messages. Similarly, Cameron and Geidner (2014) explored the effects of social media feeds on viewers' opinion formation. They indicated that participants' opinions were found to conform to the majority opinion presented in the messages. These studies suggest that conformity process in which viewers may follow the majority of the people.

The above studies are limited, however, as they did not investigate the situation in which learners are required to validate incorrect arguments. When watching a discussion in which both sides of the argument can equally be justified, the viewers' consideration and decision making would depend on what the majority says. Thus, conformity can best describe the impacts of social media messages, as depicted by Maruyama et al. (2017). However, the same may not be true when the argument claimed by the specialist on the television program is incorrect. Thus, this study aimed to examine whether the impacts of social media messages are valid when new and incorrect information is presented and to explore if the impacts are caused by conformity.

Aim of the study

The present study focused on how the incorporation of social media into television programs affects memory retention and

validation of incorrect arguments. More specifically, we examined the effects of social media messages by presenting either opposing or supporting messages for the pseudoscientific claims. We hypothesized the following:

- (1) The presentation of the social media messages does not interfere with memory retention that does not require integration of knowledge.
- (2) The presentation of social media messages impacts viewers' validation of pseudoscientific claims. Namely, the viewers change their attitudes in the direction of the social media messages, and the viewers react differently to the situation in which they must make some decision.

Method

Participants

Seventy-seven undergraduates participated in this study after providing informed consent and were assigned to one of three conditions: Supporting, Opposing, and Without message. As a reward for their participation, they received a 500 Japanese yen (approximately \$4.50) cash voucher.

Materials

Fake television program The video material used by Inuzuka et al. (2017) was edited for the purpose of the present study (Figure 1). The original video was produced to mimic a scientific talk show. We omitted some parts of the video so that only the claim of one scientist (an actor) remained. Following the procedure above, the video material used in the present study was approximately eight minutes long. The scientist stated that “Effective Microorganisms” (EM) are effective for improving water quality. “EM” is a pseudoscience based on the idea that a particular collection of microorganisms can solve virtually all health and environmental problems. We chose the topic because it is relevant to participants’ lives and yet unfamiliar to them.

Fake social media messages We included fake social media messages that simulated Twitter posts in the video material presented to the participants in the Supporting and Opposing message conditions. The messages consisted of text with each containing one or two short sentences. We designed three types of messages: opposing, supporting, and neutral (Table 1). Neutral messages were developed for when neither supporting nor opposing messages were appropriate. Neutral messages were, therefore, included in both Opposing and Supporting conditions and were presented at the same time in both conditions. Opposing and supporting messages were included in the corresponding conditions, and each message was inserted at the bottom of the screen (Figure 1) approximately five seconds after the relevant topic was mentioned by the scientist. The participants assigned to the Without messages condition watched the video not including the messages.

Retention test A retention test was developed with six quiz items (e.g., “What was the name of the two rivers that

Scientist A claimed that EM cleaned up?”). The tests were administered after participants had watched the video.

Attitude questionnaire To assess the participants’ validation of the video contents, whether the participants agreed with the effectiveness of EM was measured using a questionnaire. The attitude questionnaire was administered before and after the participants watched the fake video. It consisted of two subscales with three items each: positive attitude (e.g., “I think EM will somehow do some good”) and careful attitude (e.g., “We need more investigation on the effectiveness of EM”). The participants were asked to answer the items on seven-point Likert scales.



Figure 1. A frame from the video material that mimics the television program displaying a social media feed saying, “So, the ‘power of nature’ means using microorganisms. Right?”

Table 1. Examples of fake social messages used in the study.

	Example
Supporting (33)	It is important to use an enriched compound of specific types of organic matter. I understand.
Opposing (33)	After all, I think EM is condensed organic matter. If so, there might be a risk of causing more pollution.
Neutral (21)	I agree that it is important to discuss in a scientific way.

Note: The numbers in parentheses are the numbers of each type of message. Supporting messages were presented only to the participants in the Supporting condition and opposing messages to those in the Opposing condition.

Explanation and decision-making task Additionally, we developed a test in which a short story was introduced to qualitatively assess the consideration and validation of the argument. In that story, the following scenes were introduced: "You are considering making a donation, and a man comes and explains that NGOs are planning water quality-improvement activities using EM." The participants were asked to decide how much they would donate to that NGO (0–5000 JPY, approximately 40 USD). Participants were also asked to write comments and questions for the man in the story.

Evaluations of the messages The participants in the Opposing and Supporting message conditions rated three questionnaire items on an 11-point scale: (1) the extent to which the social media messages were against the claim, (2) how much attention they paid to the messages, and (3) how much they considered the contents of the messages.

Procedures

Each participant was tested individually in a laboratory. Each session lasted approximately 30 minutes. After participants had signed a consent form, the experimenter introduced the video, explaining, "The video is a digest of a television program. In the program, a scientist will explain how they try to clear water pollution." The experimenter then instructed the participants to watch the television show and learn from it. Each participant was randomly assigned to one of the three conditions: Supporting, Opposing, and Without messages. No instruction regarding the social media messages was given, so the participants were not aware of the differences among the conditions. After watching the video, participants responded to the retention test and attitude questionnaire. There was no time limit for completing the questionnaires, but participants did so within 10–15 minutes.

Results

The evaluation of messages

Three participants were excluded from the following analysis since they reported that they knew about EM in advance. To confirm that the different types of social media messages were delivered to the participants, we employed the participants' rating for the extent to which the social media messages were against the claim. The difference between conditions was significant, $t(45) = 10.0, p < .001, d = 2.97$. The mean scores were significantly higher than the neutral score ($t(22) = 9.56, p < .001$) in the Opposing condition and lower than the neutral score ($t(22) = -5.31, p < .001$) in the Supporting condition.

Additionally, the participants' rating for the extent of attention ($t(45) = 2.13, p < .05, d = 0.63$) and consideration ($t(45) = 3.82, p < .001, d = 1.136$) of the messages also differed between two groups, indicating that the participants assigned to the Opposing condition rated themselves as paying more attention and considered the messages.

The effects of message presentation on retention test

Each retention test item was scored with two points, and the total was used as the retention test score (Table 3). Fully correct answers were given two points, and partially correct answers, such as giving only one name of a river when two should be named, were given one point. The difference in retention test score among the conditions was analyzed with a one-way ANOVA. The result indicated no significant difference among the experimental conditions, $F(2,70) = 1.45$.

The effects of message presentation on attitude

For the analysis of attitude change, we used the average scores of positive and careful attitude questionnaire items. The mean scores for each subscale are shown in Table 3. The impact of message presentation was analyzed with two-way mixed ANOVAs. The dependent variables were positive and careful attitude scores, and the independent variables were conditions (Opposing, Supporting, and Without messages), time of measurement (pretest and posttest), and the interaction effect of two independent variables.

The results of careful attitude score showed no significant main effects of experimental condition ($F(2,71) = 1.78$) and time ($F(1,71) = 0.421$), and there was no significant interaction effect either ($F(2,71) = 0.745$).

On the other hand, the analysis of positive attitude revealed significant results. The main effect of time was significant ($F(1,71) = 9.37, p < .01, \eta_p = .117$), showing a decreasing tendency, while the main effect of condition was not significant ($F(2,71) = 1.58$). More importantly, the interaction effect of condition and time reached a significant level (Figure 2, $F(2,71) = 10.22, p < .001, \eta_p = .224$). Subsequent analysis of simple effect revealed that positive attitude was decreased significantly only in the Opposing condition, $F(1,71) = 27.26, p < .001, \eta_p = .532$. The change in other conditions did not reach a significant level ($F(1,71) = 1.42$ for the Without condition and $F(1,71) = 1.21$ for the Supporting message condition). The effects of conditions were significant only at the posttest ($F(2,142) = 8.36, p < .001, \eta_p = .191$), showing a significant difference between Opposing and Without message conditions ($t(142) = 2.35, p < .05, d = 0.943$) and between Opposing and Supporting message conditions ($t(142) = -4.07, p < .001, d = 1.62$). The difference between Without and Supporting message conditions was not significant, $t(142) = 1.68$.

The results of one-way ANOVA conducted on the explanation score showed a significant effect of condition ($F(2,71) = 3.50, p < .05, \eta_p = .090$), and the following multiple comparison (Holm) revealed that the difference between Supporting and Opposing message conditions was significant ($t(71) = 2.55, p < .05, d = 0.710$) with higher scores for the participants in the Opposing message condition.

Table 2. Average scores for evaluation of the messages

	Supporting	Opposing
The messages against the claim	3.86 (1.96)	9.25 (1.51)
Attention paid to the messages	7.25 (2.80)	8.75 (1.56)
Consideration of the message contents	5.46 (2.78)	8.05 (1.31)

Note: The numbers in parentheses are standard deviations.

Table 3. Average scores on the retention test, change in attitude, and critical thinking disposition scales for each experimental condition

	Supporting	Opposing	Without
Retention test	7.71 (2.31)	8.44 (3.17)	7.42 (2.39)
Positive attitude			
Pretest	3.63 (0.58)	3.91 (0.64)	3.68 (0.54)
Posttest	3.84 (1.04)	2.29 (0.79)	3.44 (1.15)
Careful attitude			
Pretest	3.64 (0.43)	3.76 (0.67)	3.75 (0.15)
Posttest	3.64 (0.41)	3.92 (0.41)	3.72 (0.52)
Explanation score	0.72 (1.44)	1.32 (1.41)	0.88 (1.41)
Donation amount (yen)	1750.00 (1161.00)	916.00 (1086.16)	1071.67 (1075.965)

Note: The numbers in parentheses are standard deviations.

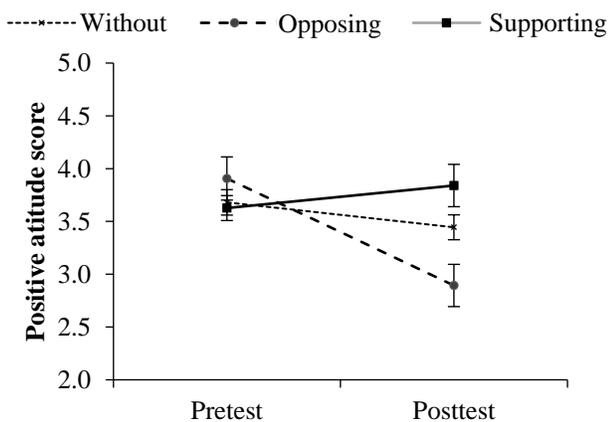


Figure 2. Changes in positive attitude as a function of message presentation. Error bars represent standardized errors.

Explanation and decision-making task

The explanation score was calculated based on the number of critical points included in the answer to the explanation and decision-making task. The participants were given one point each when referring to the following points: (1) suspicious effects of EM, (2) the lack of clear explanations for the mechanism, (3) the lack of consideration of side effects, (4) the need for solid data. Thus, the explanation score for each participant was in the range of 0–4. The donation amount indicated by the participants was also used as an index for the validation. The average scores and SDs are shown in Table 3.

Additionally, the amount of money the participants were willing to donate for the activity using EM was compared among the conditions. One-way ANOVA revealed a significant effect of experimental condition ($F(2,70) = 3.89$, $p < .001$, $\eta_p = .100$). Multiple comparison (Holm) was conducted and showed significant difference between Supporting and Opposing message conditions ($t(70) = -2.64$, $p < .05$, $d = -0.741$). The participants in the Supporting message condition tended to donate more than those who watched the same video with opposing messages.

Discussion

The present study investigated the effects of including social media messages in a television program on which incorrect arguments were claimed. As predicted in Hypothesis 1, the results demonstrated no significant difference in retention. The result was consistent with previous studies using a similar method (Inuzuka et al., 2017; 2018) and with studies of multimedia learning (Mayer, 2009), suggesting that the incorporation of social media messages would not interfere with the memory of what had been discussed in the program. The results for attitude changes and explanation and decision-making tasks also supported our hypothesis about the impact of social media messages on validation of the arguments (Hypothesis 2). The participants who watched opposing messages became less positive about the effectiveness of EM, the pseudoscientific technology. The participants' explanation and decision also showed that those who watched supporting messages were relatively uncritical about using the pseudoscientific technology.

The results of the present study suggested that showing counterarguments in text messages may support the viewers to consider and validate the information shown in the television programs more appropriately. Considering research showing that rejecting incorrect text is difficult for readers (Gerrig & Prentice, 1991; Gilbert et al., 1990; Gilbert et al., 1993; Rapp, 2008), it may be beneficial to incorporate these counter-messages for viewers.

However, it should be noted that the messages included in the study were biased, either supporting or opposing the explanation of the expert in the program. Actual social media messages are supposed to be more varied including both appropriate and inappropriate arguments. As Inuzuka (2017)

showed that presenting varied messages did not significantly change the viewers' attitude, the impacts of appropriate counterarguments may be wiped out when combined with inappropriate messages.

While previous studies (Cameron & Geidner, 2014; Maruyama et al., 2014, 2017) suggested conformity as the mechanism underlying the effects of social media messages on the viewers' attitude change, the present study brought up another possibility. The conformity hypothesis should predict that both opposing and supporting messages will have similar impacts on participants' validation process. However, we found smaller attitude changes in the Supporting condition in the present study. The unequal results in our two conditions may be caused by the qualitative difference in the messages presented. The ratings of the consideration of messages showed that the participants in the Opposing condition considered the messages more than those in the Supporting condition (Table 2.).

The difference may be caused by the effectiveness of the messages; the messages in the Opposing condition provided other perspectives from the expert's explanation while the messages of the Supporting condition provided rephrasing and supplemental information. Thus, the participants may consider the messages of the Opposing condition to be more informative. If the above consideration stands, it can be said that the information contained in the messages is used in the process of deliberation rather than merely conformity. The next step of the research, therefore, should be to clarify if the impacts are caused by the conformity of deliberate consideration.

The results also showed that the attention change led to decision-making in a more realistic situation. The participants in the Supporting condition tended to donate more with fewer questions about the appropriateness of the activity. Although the present study is based on a laboratory examination using a fake television program, the results provided eligible data to discuss the effects of showing biased information. Presenting biased information without counterargument may result in an actual disadvantage.

The present study makes meaningful contributions toward understanding how we learn from a new type of media. The first is the suggestion that incorporation of social media messages affects individuals. The results of the present study broaden the previous studies on social media and television programs by showing that incorporation of meaningful messages would help viewers more appropriately validate the information. The second is the expansion of the research on validation of incorrect information to broader learning contexts. Previous studies mainly focused on information presented in texts and information the participants already knew. The present study highlights information that participants newly learn and suggests that using different media may be an effective way to present counterarguments.

We should note, however, some limitations of the study. First, the instruction for the participants should be less instructive. We instructed the participants to learn from the

television program to make sure they focused on the program, but the instruction may have influenced their attitude and caused better memory retention while they may have spared more attention for the social media messages if not for the instruction. Although we repeatedly found small effects of the social media messages on memory for detailed facts, it is important to test the impacts of those in more natural settings.

Secondly, a more thorough comprehension test should be administered. In the experiment, we used a quiz to test the participants' memory retention. The quiz mainly tapped detailed memory of the program contents. Open-ended questions and analysis of the structure of their memory would enable us to understand the impacts of social media messages on memory in more detail.

Finally, the mechanism of the impacts of message presentation should be investigated in future studies. The impacts of social media messages shown in the present study supported the hypothesis that social media messages provide support for deliberate consideration or evaluation of information. Since the present study does not provide direct evidence to discuss the process of attitude change, there remains one alternative interpretation: conformity (c.f., Maruyama et al., 2017). However, relatively weak impacts of supporting messages suggest that the effects of messages may not be caused by conformity alone. If the participants reacted to the messages in the direction these messages suggest, the participants should change their attitude equivalently in both Supporting and Opposing conditions. The future direction of the study is more detailed investigation of the process of validation: conformity or deliberate consideration.

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