Information processing and the ability to detect online misinformation about climate change

Lorenz Ostermann

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Supervisors: Dr. M. Kuttschreuter Dr. Ir. P.W. de Vries

Psychology of Conflict, Risk & Safety Faculty of Behavioral Management and Social Sciences University of Twente

Abstract

Online misinformation is a phenomenon that emerged in around the middle of this decade. It is not only used for political or financial gain, but also targets scientific topics such as climate change. This poses a threat to the scientific consensus as this online misinformation evokes distrust in scientific institutions and it also strives to politicise this scientific topic. Literature has suggested that individual factors such as information processing determine an individual's likelihood to endorse or detect fake news. It was hypothesised that a heuristic information processing style relates to inability to detect fake news, whereas a systematic information processing style relates to the opposite. In this correlational survey research, 107 people mainly from Germany and the Netherlands participated. They filled in an online questionnaire which measured the aforementioned information processing styles. They were then asked to rate the message credibility of both two real online news stimuli, and two fake online news stimuli which reported or misinformed about the topic of climate change. The results delivered no evidence for both hypotheses. These results are discussed at the end of this paper alongside the shortcomings of this study and subsequent recommendations for future research.

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1. Introduction

1.1 The era of online fake news

In the second half of this decade, the act of deliberate misinformation has arrived on a new medium - the internet. Commonly referred to as 'fake news', this kind of modern misinformation is defined as fabricated news items that are disguised as being from credible sources and which are disseminated via social media with the goal to manipulate the public for political, ideological, or financial gain (Lazer et. al, 2018). One of the most striking examples for this is the 2016 US presidential election. A study by Allcot and Gentzkow (2017) has identified that the average US-citizen was exposed to a number of one to three fake news stories one month before the 2016 election was carried out.

1.2 Fake news in the context of climate change

Furthermore, apart from political or ideological issues, fake news also targets scientific topics. Despite the scientific consensus about climate change as a man-made phenomenon, this issue has recently become politicised and is now also subjected to misinformation campaigns that claim the opposite of the truth (Van der Linden, Leiserowitz, Rosenthal, & Maibach, 2017). This is particularly visible in the United States, where the belief in climate change has experienced a polarising divide along the left-right political landscape (Hoffman, 2011). In the context of Europe, such a political divide was found to be less pronounced but still existent (Humprecht, 2018). In recent political developments, it is visible that right-wing populist parties which fuel climate-scepticism are on the rise in Europe. In the 2019 European elections, the Dutch party 'Forum for Democracy (FvD)' has gained a share of 10.96% of the Dutch votes (European Parliament, 2019). The party's leader has recently spoken out against climate policies, calling it 'climate madness' (Den Hartog, 2019). Moreover, the German party 'Alternative for Germany (AfD)' has received similar results, with a total of 11% of the German voters (European Parliament, 2019). This party has links to a faux climate science organisation which spreads doubts about climate science (Schaller & Carius, 2019). In their programme, the AfD also deny climate change to be caused by human activity (Alternative für Deutschland, 2019). Furthermore, the French National Rally party (RN) has received 23.31% of the French votes, making it the strongest French party in the European elections (European Parliament, 2019). This party has previously described the United Nations Framework Convention on Climate Change (UNFCCC) as being a 'communist project' which reveals the party's critical stance towards climate change policy.

The surge of the aforementioned parties who are critical of climate change policy shows that Europe might be drifting towards increasing political polarisation of the topic of climate change. It also indicates that misinformation about climate change has entered mainstream European politics. Therefore, this study lays its focus on fake news in the context of climate change.

1.3 The hazardous potential of fake news

Fake news does not come without its negative effects on individuals and on western society as a whole. In their study, Pennycook, Cannon and Rand (2018) have found that repeated exposure to fake news stories increases the individual's perceived accuracy of such fake news. This notion is alarming considering that 37% of Dutch citizens are using social media on a daily basis as their primary news source (Pew Research Center, 2018). Hence, this percentage of people are likely to be exposed to fake news. As Lazer et. al (2018) pointed out, fake news has the potential to encourage cynicism, apathy and even extremism. Furthermore, Lazer et. al (2018) state that online bots play a crucial role in the dissemination of fake news in that they automatically share news from specific sources without reading them. Lazer et. al (2018) also stated that these bots were utilised to steer the election outcomes of both the 2016 US election and the 2017 French election. Corresponding to that, according to a US Government congressional testimony, online bots have been successfully deployed on Facebook and Twitter by Russian agents with the goal to wage political influence campaigns during the 2016 election (Senate Committee on the Judiciary, 2017). This indicates, that the dissemination of online fake news can be utilised by foreign agents to undermine the democratic sovereignty of a democratic state.

1.4 Susceptibility to believe misinformation

Now that fake news and its impact are illustrated, one might wonder how it is possible for fake news to be appraised as the truth and which individual factors determine that. Previous and recent research suggests that susceptibility to believe fake news is associated with reduced capacity for analytic reasoning and active open-minded reasoning (Bronstein, Pennycook, Bear, Rand, & Cannon, 2018). The authors explain analytic reasoning as a counterweight to intuitive or affective responses an individual might exert when exposed to a stimulus such as news items, which then lowers the likelihood of endorsement of the news item's message. Additionally, the authors define open-minded reasoning as the ability to actively search for alternative explanations, which has the potential to revise and change previous mindsets (Bronstein et al., 2018). Overall, it is suggested that an intuitive cognitive style is one of the risk factors for an individual's endorsement of false information. Corresponding to that, Bakir and McStay (2017) illustrate that fake news are mostly of deliberate affective nature, aimed at provoking emotions within the audience. Furthermore, Rochlin (2017) described that the window of what people accept as news has been shifted toward a 'belief and emotion-based market'.

1.4.1 Information processing

The previously explained points indicate that fake news endorsement might be mediated by individual characteristics regarding how information is received and processed. Chaiken (1980) described two distinct styles of individual information processing, namely systematic and heuristic. Both of those styles determine under which criteria an individual assesses the validity of a message that he/ she is presented with. The systematic information processing style (SIPS) requires more cognitive effort, in that individuals critically dissect and evaluate the message's core arguments in relation to its conclusion. The content itself of the message is the main basis of the recipient's judgment of its validity (Chaiken, 1980). This information processing style can be linked to concepts described earlier such as analytic reasoning and active open-minded reasoning.

In contrast to that, the heuristic information processing style (HIPS) relies on different criteria. According to Chaiken (1980), message recipients with the HIPS pay more attention to external variables such as the identity of the source, or other cues that do not contain any of the message's actual content. Such a recipient might for instance judge the validity of a message based on how much he/ she trusts or likes the source from which the message is coming or even the visual attractiveness of how the message is delivered. This information processing style requires far less cognitive effort than the aforementioned one.

1.5 Research question and hypotheses

Since there is little explicit research on the relationship between information processing and susceptibility to fake news, it is worthwhile to investigate whether such a link exists. This could help in understanding which cognitive factors make individuals more likely to endorse such fake news and could potentially deliver a basis for future interventions that can help to prevent endorsement of misinformation. This study aims at investigating which role these information processing styles play in relation to an individual's capability to detect whether an online news item is potentially distorted or misleading. Therefore, the following research question is formulated:

RQ: To what extent are individual information processing styles related to the capability to detect misinformation regarding online news items?

When comparing Chaiken's concepts to the above-described research on modern misinformation, one can argue that on the one hand individuals with a SIPS are more likely to be aware of the deceptive nature of fake news. Hence, the following hypothesis is formulated: *H1: A systematic information processing style correlates positively with the capability to detect online deception.*

On the other hand, a HIPS can be said to lead individuals to fall victim to misinformation. Therefore, the second hypothesis is as follows:

H2: A heuristic information processing style correlates negatively with the capability to detect online deception.

2. Methods

2.1 Design

This research was designed as a correlational survey study. The study contained a convenience sample. Those participants were asked to fill in an online questionnaire. Moreover, fake news items as well as true news items were used in this study as stimuli in order to measure the participant's level to detect misinformation.

2.2 Participants

This study comprised a convenience sample of 107 people. 66 of those participants were female, 40 were male, and 1 participant selected 'other' as their gender. Most of these

participants were recruited via the University's Test Subject Pool System 'SONA'. Moreover, the researcher sampled additional participants via convenience. This was done by asking fellow students, social peers, and family for cooperation. Additionally, participants were gathered by sharing the study in social media groups of the University of Twente. The participants' ages ranged from 18 to 56 years. However, 89.6% of the participants were 18-25 years old with the mean being 22.8. A total of 35 participants have participated via the SONA system, which means that at least 35 participants are students at the University of Twente.

In total, 127 responses were recorded. However, 20 of those had to be deleted, since these participants did not complete finishing the questionnaire rendering their data useless. In the final sample, 81.3% of the participants had German as their mother language. 7.5% gave Dutch as their mother language and 9.3% had other mother languages including Spanish, Russian, Finnish, Portuguese, Danish, Norwegian, Polish and Bulgarian.

2.3 Materials

A total of four stimuli were used in this study. All of those shared the same topic of Climate Change in Europe. There were two Facebook posts and two Twitter posts. One of the Twitter posts and one of the Facebook posts were fabricated by the researcher. The remaining two were real ones derived from the internet.

The fake posts were created using Adobe Photoshop to make sure that the web pages looked as realistic as possible. The first fake news stimulus shows the Facebook account of a fictional news organisation named the 'European Geographic' (See Appendix L). It should be noted that this name was chosen to simulate a bogus-version of the 'National Geographic' using the same trademark icon of the original news outlet. This is one of the first hints for the viewer to doubt the credibility of this stimulus. Furthermore, the content of the post itself was intended to be as affect-driven as possible. This was done by drawing a direct line between the March 2019 Christchurch mosque shootings and the European Fridays for Future climate protests. A second hint towards the misleading nature of this post is the fact that this claim is not supplemented by any source or reference. The image that complements the text intends to reflect a deliberate out of context comparison between far-right extremists and young environmentalists. Therefore, the pictures chosen show the aforementioned groups who both make similar hand gestures but in a different context. Given that this direct visual comparison is far-fetched and out of context, it poses as a third hint for the viewer to identify it as misinformation.

The second fake news stimulus contains a Twitter profile of '@BBCW0rld' which also aims at simulating a bogus-version of an established media outlet (See Appendix N). There is a total of four hints that could lead an individual to doubt the credibility of this stimulus. Firstly, note that the account name is similar to the original one (@BBCWorld) with the exception that the 'o' is replaced with a zero. Secondly, this Twitter profile does not have a 'verified icon' as most reputable news sources online have. This signifies that it is not an official profile by the BBC. The profile description is the same as the original in order not to make the cues too overt. Additionally, the theme cover of the profile is a pro-environmentalism image which says 'Our Planet Matters'. This was done because this fake news stimulus is distinct from the previous one. This fake news stimulus is not biased against climate activism, but rather tries to financially exploit it. The Tweet contains a fake prospect about a flood that is said to hit the Netherlands in late 2019 due to climate change. This warning is not supplemented with any source which is the third hint. After that, the Tweet calls for donations which are said to finance a flood prevention programme. This direct call for donations is considered the fourth, and most overt hint.

All in all, these two stimuli are aimed at creating a balance between fake news that ideologically tries to condemn climate change activism, and fake news that on the surface endorses climate change activism but at the same time exploits it financially. However, both of them strive to come as close as possible to how Rochlin (2017) describes the modern Overton window for news, namely, a 'belief and emotion-based market'

As it will be described later in this paper, the true aim of this study is disguised. For this reason, two real online news stimuli were included in this study (See Appendix J & O). This is done to prevent the participants from realising that the study explicitly investigates fake news. Furthermore, the implementation of real online news stimuli also allows to control whether the participants are biased to rate online news stimuli with high or low credibility regardless of whether they are fake or real. The real online news stimuli are distinct from the fake ones in that they deliver references that support the points that they are making. Furthermore, unlike the fake stimuli, the real ones do not intent to further any agenda be it for financial or ideological gain.

2.4 Instruments

The two information processing styles were measured using an 8-item questionnaire that was derived from previous research by Griffin, Neuwirth, Giese and Dunwoody (2002). However, the questionnaire was slightly modified by integrating the topic of climate change into each item. The questionnaire is answered by means of a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Four of those items measured systematic information processing which were: "After I encounter information about climate change, I am likely to stop and think about it.", "If I need to act on this matter (climate change), the more viewpoints I get the better.", " After thinking about climate change, I have a broader understanding.", "When I encounter information about climate change, I read or listen to most of it, even though I may not agree with its perspective.". A reliability analysis showed that the scale for SIPS has poor reliability (four items, $\alpha = .31$).

The remaining four items measured heuristic information processing. These were: "There is far more information on this topic than I personally need.", "When I see or hear information about climate change, I rarely spend much time thinking about it.", "When I encounter information about climate change, I focus on only a few key points.", "If I need to act on this matter (climate change), the advice of one expert is enough for me.". A reliability analysis has revealed that this subscale for HIPS has poor reliability (four items, $\alpha = .50$). Each of those HIPS items has a direct counterpart in the SIPS scale as they are worded in a similar manner. Both the HIPS and the SIPS scales' items were presented to the participants in a randomised order.

The capability to detect fake news was measured by using a message credibility scale which was proposed by Appelman & Sundar (2015). After inspecting each news stimulus, the participants were asked the question "How well do the following adjectives describe the content you just read?". Appelman & Sundar (2015) have found that the adjectives *accurate, authentic,* and *believable* reflect message credibility the best. Accordingly, the participants were to rate those adjectives by filling in a 7-point Likert scale ranging from 1 (describes very poorly) to 7 (describes very well). The message credibility scale has shown good reliability (three items, $\alpha = .87$).

The credibility scales which were applied for the fake news stimuli were reversed. The reversing of the fake scores allows to rename the credibility scores for both the fake and real stimuli into 'accuracy of credibility rating'. Therefore, the higher the total score of message credibility rating, the higher the accuracy of message credibility rating.

A graphical analysis of the Q-Q Plots (See Appendix C) indicates that the scores for each variable are normally distributed. Given that some outliers are visible, especially for Systematic information processing, normality was further investigated by inspecting skewness and kurtosis of each variable. Those range for all variables between 1 and -1 which delivers more evidence for a normal distribution. A significance test for skewness and kurtosis was excluded, since this should not be used in large samples (Field, 2013, p.185).

2.5 Procedure

Before the study was executed, it was approved by the BMS Ethics Committee of the University of Twente. The correlational survey was filled in by the participants in an online environment. All of the participants were given an informed consent form which they had to agree with before they could participate (See Appendix D). Their participation was entirely voluntary, and students were rewarded with course credit. First, the participants were shown an introductory text which introduced the researcher's role and the aim of the subsequent study. However, it disguised the true aim of the study by telling the participants that it was about investigating differences in user preferences regarding social media platforms in the age of Climate Change. Correspondingly, the study itself had the title "Facebook vs Twitter in the age of Climate Change". This was done to prevent the participants from being primed to actively look for cues that distinguish the fake from the real stimuli. Following that, each participant agreed to an informed consent form before being able to access the survey. After that, general subject data was gathered, namely the participant's age, gender, and mother tongue. Following that, the bogus aim of the study was yet again emphasised as the participants were introduced to the first questionnaire. Shortly after, each participant's style of information processing was measured by employing the 8-item questionnaire. The subjects had to rate each item by selecting one of the five points of the Likert scale. After this, the first of the modified online news items was shown to them. There were no explicit instructions on how the participants have to approach the stimuli, it was merely announced beforehand that they are about to see a news item on climate change. There was no time restriction for viewing the news item. After the participants continued to the next page, they were given the 3-item message credibility scale. Here, they had to rate each stimulus on a 7-point Likert scale. This process was repeated for three more stimuli so that each news stimulus' message credibility was rated individually. It was also explicitly said that there are no correct or false answers and that the researcher was interested in the participants' opinions and feelings.

After the participants rated the last online news stimulus, they have been debriefed (See Appendix P). The debriefing text revealed that the true aim of the study was disguised. Following that, the true aim was fully disclosed to the participants. Given that the participants have been deceived before filling in the questionnaire, they have been offered the opportunity to withdraw their informed consent, which they initially agreed upon. In case a participant chose to withdraw consent, the corresponding data of that very participant was deleted from the dataset and was not used for the data analysis. This however was not done as all participants chose not to withdraw their consent.

2.6 Data analysis

The data that was acquired was of quantitative nature and therefore analysed by means of the programme Statistical Package for Social Sciences 25 (SPSS 25). Before the data analysis was executed, several reversed items had to be rescaled. This applied to the messagecredibility scales concerning the two fake news stimuli. This was done to simplify later comparison of the credibility rating of the fake and the real stimuli. After that, the minimum, maximum, means and standard deviations were calculated for all items of the HIPS as well as the SIPS scale. These values were also calculated for the accuracy of credibility rating for the fake and real stimuli.

Furthermore, the minimum, maximum and average scores of the accuracy of credibility rating for the real and fake stimuli have been divided by the number of items in order to illustrate those scores in accordance with each of their Likert-scales.

Since normal distribution was assumed as outlined in the instruments section, parametric one-sided Pearson correlation tests have been employed to test the two hypotheses.

3. Results

3.1 Descriptive Statistics

The scores of the variables are illustrated in Table 1. As it can be seen, the average scores for each item of the HIPS scale are lower than the average of the SIPS scale's items. This indicates that the participants in this sample were more likely to have incorporated the systematic information processing style. Moreover, the average accuracy of credibility rating differed only a small amount between the fake stimuli (M=4.29, SD= 7.1) and the real stimuli (M=4.71, SD= 5.34). Furthermore, it can be said that at least one participant rated the fake stimuli with a high credibility score (Min.=1.34) which in turn is close to the lowest possible score of accuracy of credibility rating.

Table 1. Descriptive statistics of information processing items and accuracy of credibility rating (for fake and real stimuli)

	Min	Max	Mean	SD
HEUR1: If I need to act on this matter (climate change), the advice of one expert is enough for me.	1	5	2.04	0.92
HEUR2: There is far more information on climate change than I personally need.	1	5	2.71	1.09
HEUR3: When I encounter information about climate change, I rarely spend much time thinking about it.	1	5	2.26	1.04
HEUR4: When I encounter information about climate change, I focus on only a few key points.	1	5	2.69	0.99
SYST1: When I encounter information about climate change, I read or listen to most of it, even though I may not agree with its perspective.	1	5	3.59	0.84
SYST2: If I need to act on this matter (climate change), the more viewpoints I get the better.	1	5	4.08	0.89
SYST3: After thinking about climate change, I have a broader understanding.	1	5	3.70	0.77
SYST4: After I encounter information about climate change, I am likely to stop and think about it.	1	5	3.47	0.98
Accuracy of credibility rating (Fake items)	1.34	7	4.29	7.1
Accuracy of credibility rating (Real items)	2.5	6.34	4.71	5.34
Total accuracy of credibility rating	2.67	6.41	4.5	9.07

Note. N = 107

3.2 Inferential statistics

The first hypothesis emphasised that there is a positive correlation between the systematic information processing style and the capability to detect online misinformation. Due to the poor internal consistency of the scale for SIPS (four items, $\alpha = .31$), the items could not be combined into the one factor they purported to measure. Therefore, the hypothesis was tested by employing four one-sided Pearson correlation tests between each item of the SIPS scale and the accuracy of credibility rating of the fake stimuli. The first item of this scale, namely: "When I encounter information about climate change, I read or listen to most of it, even though I may not agree with its perspective." showed to correlate significantly with the accuracy of credibility rating for the fake stimuli [$r_s(107)=.17$, p<.05]. This means that participants who scored high on this question were more likely to accurately rate the fake stimuli's credibility low. It is also noteworthy that the effect size of the aforementioned correlation is not of strong nature. According to Evans (1996) the effect size of the first correlation can be described as very weak.

This however is the only item that supports the first hypothesis. This is because the remaining three items of the SIPS scale correlate insignificantly with the accuracy of credibility rating for the fake stimuli (See Appendix A).

The second hypothesis stated that there is a negative correlation between the heuristic information processing style and the capability to detect misinformation. Here, the internal consistency of the HIPS scale is also poor (four items, $\alpha = .50$), which means that this hypothesis was also tested on an item-level. Four one-sided Pearson correlation tests were used to investigate the relationship between each item of the HIPS scale and the accuracy of credibility rating for the fake stimuli. The scale's first item which read "If I need to act on this matter (climate change), the advice of one expert is enough for me." showed a significant negative correlation [$r_s(107)$ = -.25, p< .01]. This means that the higher participants score on this item, the lower they score on the accuracy of credibility rating for the fake stimuli.

Similar to the previous hypothesis, merely the first of the four HIPS items support the second hypothesis as the remaining three items only show significant correlations with the accuracy of credibility rating for the fake stimuli (See Appendix A).

All in all, the results deliver only small support for either of the hypotheses. As three out of four items of both scales stand in contradiction to what the two hypotheses predicted, it can be concluded that there is a majority of evidence which rejects the hypotheses. Therefore, both hypotheses are rejected.

3.3 Additional analyses

Some other noteworthy correlations have been observed although they were not initially necessary to answer the hypotheses. As the previous section suggested, the second hypothesis can be rejected. However, it can be seen that there are significant negative one-sided correlations between three items of the HIPS scale and the accuracy of credibility rating in terms of the real online news stimuli (See Appendix A). Firstly, the first item of the HIPS scale "If I need to act on this matter (climate change), the advice of one expert is enough for me" showed such a significant negative correlation $[r_s(107)=-.23, p<.01]$. Secondly, the third item of the HIPS scale "When I encounter information about climate change, I rarely spend much time thinking about it." also showed such a correlation $[r_s(107)=-.36, p<.01]$. Lastly, the fourth item of the HIPS scale which read "When I encounter information about climate change, I focus on only a few key points." also showed a significant negative correlation $[r_s(107)=-.26, p<.01]$. These results imply that participants who scored high on the aforementioned items of the HIPS scale tend to rate the real news stimuli with lower credibility.

When looking at the inter-item correlations of the message credibility scale for the real and fake items, some significant correlations have been observed (See Appendix B). Generally speaking, the message credibility subscores of the real news stimuli did not correlate significantly with those of the fake news stimuli. However, the first credibility item of the first fake stimulus, namely 'accurate' correlates significantly with the second credibility item of the first real news stimulus which was 'authentic' $[r_s(107)=.22, p=.01]$. It also correlates significantly with the first real stimulus' third credibility item 'believable' $[r_s(107)=.28, p<.01]$. The first credibility item of the first fake news stimulus also correlates significantly with the first item 'accurate' of the second real stimulus $[r_s(107)=.18, p=.03]$.

Furthermore, the third credibility item 'believable' of the first fake news stimulus correlates significantly with the third item 'believable' of the first real news stimulus [$r_s(107)$ = .202, p= .019]. This item also correlates significantly with the first credibility item 'accurate' of the second real news stimulus [$r_s(107)$ = .21, p= .015].

These aforementioned correlations are all positive, which means that the higher the participants scored on the credibility items for the first fake news stimulus the higher they scored on some of the credibility items for the first and the second real news stimuli. All of the remaining correlations between the credibility items of the fake stimuli and those of the real stimuli are insignificant (See Appendix B).

Finally, the credibility ratings for the fake stimuli have been re-reversed in order to correlate it with the credibility ratings of the real stimuli. This was done to explore whether participants were biased to rate all stimuli either exclusively high or exclusively low regardless of the stimuli being fake or not. Here, a two-sided Pearson correlation test was employed to explore the possibility of that aforementioned bias. This test found an insignificant negative correlation [$r_s(107)$ = -.04, p= .33] which indicates that the credibility ratings of the real stimuli do not determine the credibility ratings of the fake stimuli. Therefore, the possibility of the aforementioned bias can be excluded. The full table of those correlations can be found in Appendix B.

4. Discussion

4.1 Conclusion

The aim of this research was to investigate whether there was a link between the style of information processing and the capability to detect misinformation on social media. Literature suggested that susceptibility to endorse fake news is related to reduced capacity in analytic reasoning and in active open-minded reasoning (Bronstein et al., 2018). Furthermore, Bakir & McStay (2017) stated that fake news primarily prey on affectivity and provoking emotional responses. This link conceptually overlapped with the definition of heuristic information processing proposed by Chaiken (1980). Hence it was hypothesised that a HIPS correlates negatively with the capability to detect online misinformation, and that a SIPS correlates positively with it. This was tested in an online environment where the 107 participants had to first fill in an information processing questionnaire. Then, they had to rate the credibility of each of the four online news stimuli, two of which were real, and two of which were fake.

Due to reliability issues of the information processing scale, the sub-items of both SIPS and HIPS were analysed instead of combining them into two concepts. The results show poor evidence for the first hypothesis in that only one item of the SIPS scale correlates significantly with the accuracy of credibility rating for the fake stimuli.

The same can be said for the second hypothesis, since also just one item of the HIPS scale showed a significant negative correlation with the accuracy of credibility rating for the fake stimuli. Hence, both hypotheses are rejected.

4.2 Considerations

As both hypotheses are rejected, one needs to explore possible explanations on why the results turned out the way they did. In terms of methodological explanations, one might consider the modification of the items of the SIPS and HIPS. Here, the topic of climate change was inserted into each item of the scales. This means that the scales did not explicitly measure information processing styles, but rather information processing styles in the context of climate change. As it will be mentioned later, these scales suffer from poor internal consistency. This indicates that the participants did not produce comparable scores for the items who measure the same construct. Based on this, one can infer that the general interest in the topic of climate

change is too low for the participants to answer the scale consistently. According to a survey by YouGov Survey plc. (2019), environmental policy and animal welfare is the second most important issue for young Europeans between the ages of 16 and 26. However, it is questionable whether this applies to climate change and more specifically to university students. There is no research on European university students' attitudes towards the topic of climate change and therefore, it is recommended for future research to investigate this particular population.

Whereas only one out of four of the HIPS items showed a significant negative correlation with the accuracy of credibility for the fake items, it is in fact the opposite when it comes to the real items. Here, three out of the four items correlated negatively and significantly with the accuracy of credibility rating for the real stimuli. These findings could be explained by looking at how the real items differ from the fake ones. It can be seen that the fake items imitate established and recognisable news sources such as the BBC or the National Geographic. However, one of the real items' source, the 'EU Environment Agency' may be a legitimate source, but it could be that it is not as renowned as the sources that the fake items copied. This could be because of the fact that this source is not a mainstream media outlet, bu rather a sub-institution of the European Union. According to the definition of HIPS, people who process information heuristically pay much attention to source attractiveness among other things (Chaiken, 1980). Based on what was outlined before, it could be said that the 'EU Environment Agency' can be regarded as 'unattractive' due to the lack of recognisability.

The same cannot be said about the second real item in which Greta Thunberg is the main source of information. Although a controversial character, one can assume that Greta Thunberg is widely recognised in the public, especially in the younger generations due to intense international media coverage since the beginning of her movement. Furthermore, Thunberg is 16 years old which could make her more relatable to the participants because the sample mainly consisted of people aged 16-25. What this now means for the low credibility scores is ambiguous. It could be that she was of low source attractiveness to the people who rated her post low in credibility, because she does not represent a mainstream or established media outlet. Furthermore, one can argue that the controversy that surrounds her movement relates to lower source attractiveness as well.

The results in this study also show several inconsistencies with previous literature. In the introduction, it was outlined that individuals who incorporate a SIPS critically dissect a message's content and its relation to the conclusion (Chaiken, 1980). Chaiken (1980) also stated that for a SIPS, the message's content is the main focus on the basis of which individuals determine the message's validity. It was then assumed that these characteristics reflect analytic reasoning and open-minded reasoning which are factors that reduce an individual's likelihood of endorsing fake news (Bronstein et al., 2018). When looking at the results, one can argue that this rationale is not plausible in that is not reflected in the results at all. The flaw might lay in the assumption that SIPS is comparable to the aforementioned factors which reduce an individual's endorsement of fake news.

The same theoretical problems can be assumed about the results regarding HIPS. Primarily, the assumed correlation between HIPS and the capability to detect misinformation in fake news stimuli is not in line with the previously outlined rationale. It was previously stated that endorsement of fake news relates to reduced analytic thinking and lack of openminded reasoning (Bronstein et al., 2018). This was then the basis for the assumption that this overlaps with a HIPS which by definition requires less cognitive effort and is mainly focussed on external cues that are not related to the actual content of a message (Chaiken, 1980). Here, one can reason that reduced analytic thinking or reduced open-minded reasoning does not reflect the same cognitive concept as heuristic information processing does. The initial assumption that there is an overlap between those two concepts can therefore be refuted by these results.

4.3 Strengths and Limitations and suggestions for future research

This research has some strong as well as some weak points to it. Firstly, it can be said that it has laid its focus on a well-defined population. The final sample mainly consisted of Dutch and German participants whose age was accumulated somewhere between 18 and 25. Secondly, the fake news stimuli were visually and content-wise carefully constructed to reflect misinformation in a realistic manner. Thirdly, this study is the first research on the relationship between information processing and the ability to detect online misinformation in the context of climate change. Although there were a number of limitations, it yields some suggestions on how future research on this topic could be constructed. These points are outlined in the following paragraphs.

Some questions have been raised over the normality of the data distribution. A Shapiro-Wilk test (See Appendix B) has raised some concerns about the distribution of the data of both the systematic information processing style (p=.03) and the heuristic information processing style (p=.046). Results of this test suggested that the data is not normally distributed. However, a Shapiro-Wilk test can be significant in large samples even though the data is normally distributed (Field, 2013, p.184). Additionally, as outlined before, an examination of the

variables' Q-Q plots (See Appendix C) delivered evidence for a normal distribution. These graphical indicators led the author to the conclusion that the results of the Shapiro-Wilk test are outweighed; hence a normal distribution was assumed and parametric tests were chosen.

Arguably the most impactful limitation of this study is the poor reliability of the scales for HIPS and SIPS. Here, the Cronbach's α for both scales is lower than acceptable. Statistical analysis has shown this poor level of reliability does not increase if any item was deleted. In fact, the internal consistency of the scale for SIPS tends to become even lower if the first or the third item is deleted. In case of the scale for HIPS, the internal consistency decreases if any item of this scale was deleted. This indicates that there is no problematic item in either of the scales that could be accountable for the low reliability.

As the items could not be identified as problematic, one could consider the whole scale as being problematic. This might be due to the fact that the scales have been modified by inserting 'climate change' directly into each item. Among other problems, this might be one of the causes for the low internal consistency of both scales. As the interest for the topic itself might have been rather low for the sample, it is possible that this is the reason for the participants not to answer the items of the scales in a consistent manner.

As the scale for information processing was aimed at measuring two measure two distinct processing styles, it was expected that the scores for the HIPS items contrast with the scores of the SIPS items. When correlating each item of both scales (See Appendix A), it can be seen that merely the first item of the SIPS correlates negatively and significantly with all items of the HIPS scale. Only the third and fourth item of the SIPS scale correlates in this manner with the third item of the HIPS scale. When looking at these results, one can assume that the participants did not fully see the fundamental distinction between the two concepts measured in these questionnaires. However, when comparing the wording of the HIPS items with that of the SIPS items, it is noteworthy that they are worded in direct contrast to each other as it was outlined earlier in the Instruments section. Therefore, it is not safe to assume that the participants were not able to understand that the questionnaire measured two distinct concepts.

Hence, the remaining explanation for the inconsistency within these scales is that not all participants might have answered the questionnaire in a genuine and/ or attentive manner. This is also because the study was set in the online environment SONA in which mainly firstyear students are motivated to participate in is studies, since those are obliged to gather a certain amount of credits by the end of the year. In total, 35 participants signed up for the study via SONA. Therefore, it could be that some of those participants randomly and inattentively went through the online questionnaire to easily obtain the credits. To control for that, it might have been wise to include items that measure attentiveness such as 'This is an attentiveness check. Can you please select strongly disagree?'. By mixing in such items in the information processing questionnaire, the researcher would have been able to exclude any participant that responded incorrectly to these attentiveness items. If future research was to try and investigate this study's topic further, it will be advisable to include such attentiveness control items if it was conducted in an online experiment.

Another limitation of this study is the impaired legibility of the first real online news stimulus. As it can be seen below in Appendix J, the Twitter post can be considered legible in its raw form. However, after inserting it into the Qualtrics file, the resolution of the image itself decreased slightly. This left most aspects of the post legible, apart from the source that is added below the heat map. Hence, it can be said that the stimulus is flawed, as participants were possibly not able to inspect the source description which was earlier described as a crucial and distinctive aspect of the real stimuli.

Moving on to the fake news stimuli, it is noteworthy that the inclusion of only two of those may be too few especially given that this study's main focus was laid upon fake news. It can be said that the results would have been of more informative value if more of those fake stimuli were included. Therefore, a recommendation for future research would be the inclusion of more fake news stimuli.

To summarise, this study was not able to properly investigate the role of information processing regarding the capability to detect online misinformation in the context of climate change. This study can be seen as an example of how the manipulation of a scale can render the results highly unreliable and invalid. For this reason, none of the results are generalisable. However, as this study is the first one to investigate fake news specifically in the context of climate change, it delivers some starting points on how to address this issue in future research.

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6. Appendix

A: Pearson correlation table between each HIPS and SIPS item and the accuracy of credibility ratings for the real and fake stimuli

x		1	2	e	4	5	9	6	00	6	10
1. HIPS item 1	Correlation coefficient	1						5			
2. HIPS item 2	Sig. (1-tailed) Correlation coefficient	.171*	1								
	Sig. (1-tailed)	0.039									
3. HIPS item 3	Correlation coefficient	0.098	234**	1							
	Sig. (1-tailed)	0.157	0.008								
4. HIPS item 4	Correlation coefficient	.260**	230**	206*	1						
	Sig. (1-tailed)	0.003	600.0	0.016							
5. SIPS item 1	Correlation coefficient	238**	-225**	-255**	393**	1					
	Sig. (1-tailed)	0.007	0.010	0.004	0.000						
6. SIPS item 2	Correlation coefficient	-0.142	-0.120	-0.136	-0.098	250**	1				
	Sig. (1-tailed)	0.073	0.109	0.081	0.157	0.005					
7. SIPS item 3	Correlation coefficient	0.109	-0.026	161*	-0.048	0.115	0.078	1			
	Sig. (1-tailed)	0.131	0.397	0.049	0.312	0.118	0.211				
8. SIPS item 4	Correlation coefficient	0.126	0.031	204*	0.014	0.052	-0.099	.249**	1		
	Sig. (1-tailed)	0.097	0.377	0.018	0.444	0.296	0.155	0.005			
Accuracy of credibility rating	Correlation coefficient	230**	-0.140	-359"	260**	302**	237**	-0.008	-0.026	1	
(Real items)	Sig. (1-tailed)	0.008	0.075	0.000	0.003	0.001	0.007	0.469	0.395		
Accuracy of credibility rating	Correlation coefficient	-251**	0.031	-0.094	-0.113	.173*	0.124	0.137	0.137	0.043	1
(Fake items)	Sig. (1-tailed)	0.005	0.377	0.167	0.124	0.037	0.102	080.0	0.079	0.330	
Note. N = 104 *. Correlation is si, **. Correlation is s	gnificant at the 0.05 level (1-tailed). ignificant at the 0.01 level (1-tailed).										

B. Additional tables

a. Shapiro-Wilk test

	Statistic	df	p-value
Heuristic information	.967	107	.046
processing			
Systematic	.961	107	.003
information			
processing			

		Real stimulus 1 - accurate	Real stimulus 1 - authentic	Real stimulus 1 - believable	Real stimulus 2 - accurate	Real stimulus 2 - authentic	Real stimulus 2 - believable
Fake Stimulus 1 - accurate	Correlation Coefficient	044	221*	.281**	182*	013	109
	Sig. (1-tailed)	.325	.011	.002	.031	.445	.132
Fake stimulus 1 - authentic	Correlation Coefficient	.061	.009	074	114	.002	155
	Sig. (1-tailed)	.267	.463	.225	.122	.493	.055
Fake stimulus 1 - believable	Correlation Coefficient	.000	06	202*	21*	.057	027
	Sig. (1-tailed)	.499	.27	.019	.015	.281	.39
Fake stimulus 2 - accurate	Correlation Coefficient	.08	.042	075	.032	.055	001
	Sig. (1-tailed)	.205	.334	.223	.37	.286	.495
Fake stimulus 2 -authentic	Correlation Coefficient	.16	.121	.041	.083	.112	.020
	Sig. (1-tailed)	.05	.108	.338	.199	.125	.419
Fake stimulus 2 - believable	Correlation coefficient	005	.05	037	.151	007	034
	Sig. (1-tailed)	.481	.305	.352	.061	.471	.363

b. Pearson correlations of message credibility items between fake and real stimuli

**. Correlation is significant at the 0.01 level (one-tailed).

*. Correlation is significant at the 0.05 level (one-tailed).

		Non-reversed accuracy of credibility rating (Fake items)	Accuracy of credibility rating (Real items)
Non-reversed accuracy of credibility rating (Fake items)	Correlation coefficient	1	04
	Sig. (2-tailed)		.66
Accuracy of credibility rating (Real items)	Correlation coefficient	04	1
	Sig. (2-tailed)	.66	

c. Correlation between accuracy of credibility ratings for the real stimuli and accuracy of credibility rating for the fake stimuli

Note. N = 104

C. Figures

a. Q-Q Plots





D. Introductory text

UNIVERSITY OF TWENTE.

Welcome!

Dear participant,

Thank you for choosing to participate in this study. My name is Lorenz Ostermann and I am a third-year Psychology student at the University of Twente. I am conducting this study in the context of my Bachelor thesis in Conflict, Risk and Safety (CRS). The aim of this study is to investigate differences in user preferences regarding social media platforms in the age of Climate Change. You as a participant will be asked to fill in a questionnaire which takes approximately 10 minutes to complete. The data will be used for a statistical analysis which is part of a scientific paper. Before you start the questionnaire, I would like to point out that there are no right or wrong answers. Therefore, I would like to appeal to your honesty in answering them. By doing so, you would be part of providing the best possible data for my research.

Again, I would like to express my gratitude for your time, participation, and honesty.

Lorenz Ostermann

O Proceed

E. Informed consent

UNIVERSITY OF TWENTE.

Informed consent

Please read the following information carefully. Your participation in this survey is completely voluntary and you have the right to withdraw at any time, without having to give a specific reason.

The personal data will be stored anonymously and confidentially. This also includes that your data will not be offered to any third party as it will be used for research purposes only. This also counts for the answers you give to the research-related questions in this survey.

If you seek any further details, feel free to contact the researcher via this e-mail address: I.m.ostermann@sudent.utwente.nl

If you have questions regarding your rights as a research participant or if you want to discuss any concerns that you do not want to share with the researcher, please contact the Secretary of the Ethics Committee of the Faculty of Behavioural, Management, and Social Sciences of the University of Twente via this e-mail:

ethicscommittee-bms@utwente.nl

I have read the above-explained terms and hereby agree to be a voluntary participant of this study.

O Agree

O Disagree

F. Questionnaire on demographic characteristics

G. Information text to disguise purpose of the study





As it was mentioned before, this study investigates social media preferences regarding the topic of climate change. On the next page, you will be presented with a number of statements about climate change. You are requested to rate how well these reflect your own feelings and opinions about climate change ranging from *Strongly disagree* to *Strongly agree*. Please answer those truthfully and note that there are no right or wrong answers.



H. Questionnaire on information processing

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Climate change:

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly ogree	
After thinking about climate change, I have a broader understanding.	0	0	0	0	0	
When Lencounter information about climate change, L facus on only a few key paints.	0	0	0	0	0	
If I need to act on this matter (climate change), the advice of one expert is enough for me.	0	0	0	0	0	
When Lencounter information about alimate change, 1 rarely spend much time thinking about it.	0	0	0	0	0	
There is far more information on climate change than I personally need.	0	0	0	0	0	
When I encounter information about climate change, I read or listen to most of it, even though I may not agree with its perspective.	0	0	0	0	0	
After Lencounter information about climate change, I am likely to stop and think about IL	0	0	0	0	0	
If I need to act on this matter (climate change), the more viewpoints I get the better.	0	0	0	0	0	

I. Introductory text prior to stimuli





On the next pages, you will see a total of four examples of social media posts regarding climate change. Two of those originate from Facebook, and the other two are derived from Twitter. Before proceeding to the next post, you are requested to fill in a small questionnaire about the post you have just seen. Note that there is no time limit for inspecting the posts.



J. Stimulus 1 (real)



EU EnvironmentAgency 🥺 @EUEnvironment



New EEA report on **#climate** change adaptation and disaster risk reduction: Risk of **#forestfires** projected to increase not only in the **#Mediterranean** but also central Europe. goo.gl/hXwBhH

Risk of forest fires in Europe projected to increase



K. Message credibility questionnaire (Twitter)



I think the content of the Twitter post can be described as being

				Neither agree			
	Strongly disagree	Disagree	Somewhat disagree	nor disagree	Somewhat agree	Agree	Strongly agree
believable	0	0	0	0	0	\bigcirc	0
authentic	0	0	0	0	0	\bigcirc	\bigcirc
accurate	0	0	0	0	0	0	0

L. Stimulus 2 (fake)



M. Message credibility questionnaire (Facebook)





I think the content of this Facebook post can be described as being

	Neither agree									
	Strongly disagree	Disagree	Somewhat disagree	nor disagree	Somewhat agree	Agree	Strongly agree			
authentic	0	0	0	0	\bigcirc	0	0			
accurate	0	\bigcirc	0	0	0	\bigcirc	\bigcirc			
believable	0	0	0	0	0	0	0			

N. Stimulus 3 (fake)



O. Stimulus 4 (real)



P. Debriefing

UNIVERSITY OF TWENTE.

Debriefing

Thank you for filling in the questionnaire!

It now is my duty to inform you, that the true aim of this study was disguised. In reality, this study aimed at investigating how different information processing styles correlate with the ability to detect fake news on the internet. In fact, the second and third post that you were shown (European Geographic and @BBCW0rld) were completely fabricated and do not reflect reality in any way or form.

The truth was withheld from you in order to prevent you from being primed to actively assess whether a post was fake or not.

Now that you are informed about this, it is your right as a participant to *withdraw the informed consent* that you signed previously. If you choose to do so, your data will NOT be recorded and NOT be used in any way.

If you do not want to withdraw consent, your data will be used in the statistical analysis for this research and handled in accordance with the informed consent form that you have signed previously.

I hereby declare that

O my data can be used by the researcher

O I withdraw my consent and that my data shall NOT be used

