

## **Inoculations Reduce the Effects of Misleading Information on Social Media**

An Experimental Study on the Effects of Self-Affirmation and Inoculation on the Rejection of Misleading Information in a Social Media Context

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### Abstract

The aim of this study was to contribute to the field of research regarding the continued influence effect of misleading information (Ecker, Lewandowsky, Swire, & Chang, 2011). Misleading information continues to influence decision-making, even after the information is proven to be incorrect. A possible explanation for this continued influence effect is psychological reactance (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012). People may perceive a correction of misleading information as an attack on freedom to choose how to behave, think or act and may be stimulated to restore this freedom (Brehm, 1966). The most promising way to diminish the continued influence effect is with preexposure warnings (Lewandowsky et al., 2012). With this technique, people are prepared (i.e., inoculated) for an upcoming persuasive attack, just like a vaccine prepares the human body for a virus (McGuire & Papageorgis, 1962). So far, only a few papers examined this inoculation theory of resistance for communication purposes. The inoculations were only partly effective, and none of them was able to eliminate the continued influence effect. Perhaps not only the corrections are perceived as a threat to freedom, but the inoculations as well. Resistance to the inoculation may explain why the techniques tested in earlier research were not successful. One way to reduce resistance to inoculation is to camouflage the persuasive attempt with an indirect persuasion strategy. The study of Dekker (2018) serves as the base of this study. She tried to diminish resistance to the inoculation with narrative persuasion, but this technique turned out to be ineffective. The current study tries to achieve Dekker's goal by using another indirect persuasion strategy, namely self-affirmation (Knowles & Linn, 2004).

Participants in this study's experiment were divided over four conditions. Participants may have received a self-affirmation task and/or an inoculation before they were exposed to the misleading information. This misleading information stated that scientist succeeded in the artificial creation of a mouse. All content was shown in a social media context (i.e., Facebook). The self-affirmation/inoculation condition was expected to result in the highest rejection of the misleading information. Self-affirmed people are said to be more open to persuasive messages (Zuwerink Jacks & O'Brien, 2004), and are likely to be more open to the inoculation used in this study. Results showed that the inoculations were indeed effective in reducing the effects of misleading information, but self-affirmation showed counterproductive effects. However, the resistance to the inoculations were relatively low, so there was not much resistance to decrease in the first place. Nonetheless, this study was the first to analyze the effectiveness of an inoculation in a social media context, which may serve as the base for future research.

## Introduction

Information that is understood and encoded in the mind may continue influencing people's decision making, even when the information turns out to be incorrect. For instance, a study conducted in 1998 claimed a link between autism and some childhood vaccine. Several health instances including the UK Department of Health immediately referred to the lack of evidence, but 20% to 25% of the public still believed in the link between the vaccine and autism four years later, in 2002 (Lewandowsky et al., 2012). This is called the continued influence effect that is often resistant to retraction and correction of the information (Ecker et al., 2011b). False information that appears to be untrue and is spread to deceive people, can be identified as misleading information (Dekker, 2018; Ecker et al., 2011b).

In this post-truth era where people often rely on their own truth rather than on facts (Giglietto, Iannelli, Rossi, & Valeriani, 2016; Lewandowsky, Cook, & Ecker, 2017), only a small amount of people can differentiate fake news from real news (Roozenbeek & Van der Linden, 2018). Social media make the distribution of misleading information even easier. Attractive messages are shared and believed without a check for correctness (Allcott & Gentzkow, 2017). The possibly incorrect information that is shared might affect people's ability of evidence-based decision making (Roozenbeek & Van der Linden, 2018), because choices are based on misleading information, even when people are confronted with the incorrectness of this information.

Previous research has found some successful techniques for limiting the continued influence effect of misleading information (e.g., Ecker et al., 2011b; Lewandowsky et al., 2012), but none of them found a solution to eliminate it completely. It is possible that the techniques did not manage to fully defeat the continued influence effect because they focused on retracting information *after* people were exposed to it. It turned out to be hard to retract information once it was encoded in memory (Lewandowsky et al., 2012). A promising cure for limiting the continued influence effect is warning people about the misleading information *before* they are exposed to it, which is described in the inoculation theory of resistance.

This theory posits that in the same way a vaccine protects people from a virus, an inoculation can protect people against a persuasive attack (McGuire & Papageorgis, 1962). Both Ecker, Lewandowsky and Tang (2010) and Van der Linden, Leiserowitz, Rosenthal and Maibach (2017) reported that prior warning (i.e., inoculating) about the upcoming misleading information can reduce the continued influence effect partly, but that the misleading information still dominates decision-making. A possible explanation for this ongoing effect of

misleading information is found in the field of resistance and persuasion, specifically in the theory of psychological reactance (Brehm, 1966). This theory postulates that people have a general need for both independence and autonomy (i.e., negative face), and acceptance, approval, and being perceived as competent (i.e., positive face). These needs result in a desire of freedom to choose how to behave. Perceived threat to this freedom may prompt resistance and motivations to restore freedom (Brown & Levinson, 1987; Jenkins & Dragojevic, 2011). An inoculation may be perceived as a threat to freedom, and yet may produce resistance to the inoculation instead of to the misleading information (Dekker, 2018).

The existence of resistance to inoculation has not been proven yet but applying the self-affirmation theory conducted by Steele (1988) to inoculation is a potential technique to examine this. With this technique, people's self-confidence and self-esteem are boosted prior to a persuasive message. This can be done by acknowledging important values (i.e., the self-concept) of the person in question, who are expected to feel respected and taken seriously in return. In other words, the need for positive face will be met. According to Pittman and Heller (1987), protection of the self-concept from threat and change is the key motivator for resistance to persuasion to occur. Individuals may feel threatened when their stability is challenged and resist change (Zuwerink Jacks & O'Brien, 2004). This motivation to resist persuasion can be reduced by bolstering the self-concept before the persuasive attack (L. Janssen, personal communication, June 4, 2018).

Measuring someone's attitude prior to and post misleading information with or without an inoculation can determine whether resistance occurs. This study aims at reducing possible resistance to the inoculation. Self-affirmation manipulates the need to protect the self-concept by boosting confidence and self-esteem (Knowles & Linn, 2004). Via self-affirmation, the need to be resistant is taken away (Knowles & Linn, 2004; Zuwerink Jacks & O'Brien, 2004) and people are said to be more open to a persuasive message (Fransen, Verlegh, Kirmani, & Smit, 2015).

The aim of this study is to further develop the inoculation theory developed by Van der Linden et al. (2017) and the hypothesis of resistance to inoculation by Dekker (2018) by comparing an inoculation with self-affirmation and an inoculation without self-affirmation. The inoculation with self-affirmation is expected to result in less resistance to the inoculation and is therefore expected to encourage resistance to the misleading information. Little research has examined the effect of reducing resistance to the inoculation to induce rejection of the misleading information and, to my knowledge, no research has yet investigated the role of self-

affirmation in reducing resistance to the inoculation. Furthermore, no earlier research has examined the effects of an inoculation in a social media context. These expectations yield the following research questions:

RQ<sub>1</sub>: To what extent is it possible to inoculate people against the effects of misleading information?

RQ<sub>2</sub>: To what extent does resistance to the inoculation play a role in the successfulness of an inoculation against misleading information?

RQ<sub>3</sub>: To what extent does self-affirmation play a role in the successfulness of an inoculation in reducing resistance to this inoculation and increasing resistance to the misleading information?

### **Literature review**

The term ‘misleading information’ is used in the introduction but can be interpreted in multiple ways. In general, it can be divided in two broad categories: misinformation and disinformation (Dekker, 2018; Fallis, 2015; Giglietto et al., 2016). Misinformation is not purposely created to deceive people but is false by accident or the creators honestly believe in the authenticity of their claims. Disinformation, on the other hand, is created to mislead people, such as the case that will be used in this study. ‘Misleading information’ addresses both misinformation and disinformation further on. Social media make the distribution of misleading information even easier and its effects even larger (Allcott & Gentzkow, 2017), so this paper will examine the effects of misleading information on social media.

### **The continued influence effect**

The problem with misleading information is that it continues to influence people’s decision making even after it is proven untrue, replaced with the truth or even when people remember the correction (Ecker et al., 2011b; Ecker, Lewandowsky, Apai, 2011). This problem can be labeled as the *continued influence effect* (Johnson & Seifert, 1994). Many studies (e.g., Ecker et al., 2010, 2011b; Johnson & Seifert, 1994) confirm the continued influence effect. For instance, Ecker et al. (2011b) examined whether strength of encoding or strength of later retractions affected the continued influence effect. Participants read a warehouse fire script that has been used in other studies as well (e.g., Johnson & Seifert, 1994). This script initially stated that the fire was caused by volatile materials in a closet, which was later retracted by stating that the closet was empty. Strengths were manipulated with repetitions of either the initial

explanation or the retraction. They measured its effects by asking participants ten open-ended questions, such as ‘What could have caused the explosions?’ (Ecker et al., 2011b, p. 572). Results showed that many repetitions of the retraction could not eliminate the continued influence effect, not even when the initial explanation had few repetitions.

The aim of this current study is to investigate how this continued influence can be diminished, because reliance on misleading information may have extensive consequences when people base their decisions on facts that are not or only partly true. To stay with the example provided in the introduction – that vaccines may cause autism – parents decided not to vaccinate their children. This had disastrous consequences for both individuals and their direct environment. Children got diseases that could have been prevented easily. Many unnecessary hospitalizations followed, and some children even died. In addition, large amounts of money were needed to clean up the mess the disaster left behind (Larson, Cooper, Eskola, Katz, & Ratzan, 2011; Lewandowsky et al., 2012).

**Explanations and decreasing techniques.** Lewandowsky et al. (2012) provided four possible explanations for the continued influence effect. This study focusses on one of these explanations, namely psychological reactance. They also provided four possible techniques to decrease the continued influence effect, but the technique ‘preexposure warnings’ seems most promising and is further explored in this study. Firstly, the other explanations and techniques will be briefly discussed, and it will be clarified why they are not suitable for this study.

One of these explanations is the creation of mental models. People create mental models in their mind to be able to explain what caused a situation (Johnson & Seifert, 1994), to find intentionality and causality (Gottschall, 2012). If the retraction of misleading information does not fulfill all parts of the mental model, people are left with a gap and continue to rely on the misleading information. In sum, people prefer incorrect information over incongruent information (Ecker et al., 2011a, 2011b; Johnson & Seifert, 1994; Lewandowsky et al., 2012). In the case of the study of Ecker et al. (2011b), the retraction stated that the closet was empty and no alternative information of what caused the fire was provided. According to this explanation of the continued influence effect, people will continue to rely on their own mental model that the volatile materials caused the fire, otherwise they do not know what did.

The reliance on self-created mental models might be diminished with providing an alternative narrative that fills all the gaps. This correction must be plausible and preferably explain why the original information needed to be corrected. The narrative has even more chance to succeed when the explanation is simple. People may reject the correction if it is too

difficult to understand; relying on the misleading information is easier. Nonetheless, presenting too many arguments causes a backfire effect (Lewandowsky et al., 2012).

In extension of the creation of mental models, fluency and familiarity of the retraction also determine whether people continue to rely on misleading information. Retractions that make sense, are fluent and are coherent, decrease reasons to question validity. However, familiarity with the original story is more important than the fluency and coherence of the retraction. An untrue story is preferred over facts when people are familiar to this story (Lewandowsky et al., 2012). Ecker et al. (2011b) could have tried to retract the information that the fire was caused by volatile materials by stating that ‘no volatile materials were present, because the closet was empty’. In this specific statement, something that people are familiar with (i.e., that volatile materials were present) was repeated, which results in even more reliance on the information and an ineffective retraction.

Providing an alternative narrative may not be enough to concur familiarity with a story. Nevertheless, repeating the retraction may close the deal. People possibly become more familiar to the retraction than to the original story. However, Ecker et al. (2011b) proved that the repetition of a retraction has minor effects. Therefore, this finding cuts the technique of repetition as a possibility to reduce reliance on misleading information.

The failure of controlled memory processes can explain the ineffectiveness of retractions as well. The retrieval of information may activate parts of the misleading information instead of parts of the retraction. The memory may fail to correctly attribute a source, i.e., determine which parts come from misleading information and which from retractions, or the memory may fail to determine the validity of information that is automatically activated, because the process happens so fast. Additionally, the memory may fail to stop automatic activation of the misleading information after someone refers to it (Lewandowsky et al., 2012). An example will clear the last aspect; when you read ‘The skirt I bought was red. I mean blue’, reference to ‘the color’ will automatically activate both red and blue. This explanation will probably not be solved with providing an alternative narrative.

The last and, for this study, most important explanation why retractions may not eliminate the continued influence effect is psychological reactance (Lewandowsky et al., 2012). Generally, people do not like to be told what to do. According to the theory of psychological reactance conducted by Brehm (1966), people want to be free to choose how to think, react or behave. A perceived attack on freedom may result in motivation to reject persuasion. In this study, persuasion gets the form of a persuasive message. Thus, a perceived attack on freedom

may result in motivation to reject a persuasive message. This motivation is called reactance (Dillard & Shen, 2005). A retraction can be perceived as an attack on freedom to choose what to do and may therefore activate reactance. People continue to rely on misleading information because they reject the corrective information.

Forewarning people that upcoming information is misleading may succeed in reducing the continued influence effect (Ecker et al., 2010; Lewandowsky et al., 2012). This technique prevents the absorption of misleading information instead of trying to retract it after it already is encoded. Ecker et al. (2010) found that providing a general warning that misleading information is coming is not enough; additional information on the specific effects of the misleading information is needed. Exposure of warnings before misleading information seems to be more effective than after (Chambers & Zaragoza, 2001; Ecker et al., 2010; Schul, 1993).

Studies regarding the retraction of misleading information have failed to eliminate its influence. Some techniques were partly successful, but none were able to fully conquer the continued influence effect. With the possible explanations of this effect in mind, only psychological reactance is still standing and suitable for this study. The other three explanations have been proven to be unsuccessful. This makes psychological reactance the most important explanation of the continued influence effect for this study. Forewarning people about upcoming misleading information seems to be the most promising technique for decreasing the continued influence effect. Yet, this study aims at reducing psychological reactance to the corrective information by forewarning people that misleading information is coming before it is encoded. Forewarning can also be seen as inoculating people, explained in the inoculation theory of resistance (McGuire & Papageorgis, 1962).

### **Inoculation theory of resistance**

The inoculation theory finds its origin in the field of medicine. The injection of a weakened form of a virus stimulates the body to create defense mechanisms to the virus on a minor scale. This prepares and enables the body to attack the real virus when it enters the body. For communication purposes, injecting people with a weakened form of a persuasion before the real persuasion is shown, might prepare and enable people to attack this persuasion ((McGuire & Papageorgis, 1962). In this case, the injection will be the warning for the misleading information that is coming. People already try to defend themselves against the misleading information, because the inoculation prepared them. This defensiveness can result in rejection of the misleading information.

This inoculation theory of resistance is supported in previous studies (Compton & Pfau, 2004, 2008, 2009; Godbold & Pfau, 2000). These studies have shown the effectiveness of an inoculation in different fields of research. For instance, Godbold and Pfau (2000) successfully used the inoculation theory to reduce alcohol use among adolescents, and Compton and Pfau (2004) investigated the inoculation theory for advertisements; they found that inoculations can be used to increase resistance towards credit card marketing.

Despite the effectiveness of an inoculation in many fields of research, only a few studies examined the effectiveness of an inoculation against misleading information (Cook, Lewandowsky, & Ecker, 2017; Dekker, 2018; Ecker et al., 2010; Van der Linden et al., 2017). Ecker et al. (2010) were one of the first to study the effects of an inoculation for misleading information. Participants were confronted with a made-up car accident, with elderly people versus young hockey players behind the wheel. The study used two forms of inoculations: a specific warning and a general warning. The specific warning explained in detail what the continued influence effect is, while the general warning only warned people that not all information is checked and true. Their effects were checked by asking participants nine fact-recall questions, two manipulation-check questions and nine inference questions (e.g., ‘Why do you think it was difficult getting both the injured and uninjured passengers out of the minibus?’, referring to the passengers’ age). Results showed that the general inoculation was less effective than the detailed inoculation. Both inoculations reduced negative effects when people could recall them. However, negative effects were only reduced, and the continued influence effect was not eliminated in this study.

Cook et al. (2017) tried to inoculate people against two different kinds of misleading information: messages that used fake experts and messages that argued that discussions regarding a particular topic were happening while this was not true. This topic was climate change and they used the misleading Oregon Petition in their study. This petition claimed that no consensus existed among scientist regarding human-caused climate change. The fake petition stated that 31.000 scientists had signed the petition. Nevertheless, the signatures contained names of people that were already deceased (e.g., Charles Darwin) or names of people that were no scientists (e.g., the Spice Girls). They found that the continued influence effect could be reduced with inoculations that explained that the line of reasoning in a message is inaccurate and with inoculations that highlight scientific consensus. And again, the continued influence effect was only reduced, not eliminated.

In addition to the study by Ecker et al. (2010), Van der Linden et al. (2017) used a detailed inoculation and a general inoculation in their study as well. They examined the effect of misleading information about climate change and used the Oregon Petition in their study, just like Cook et al. (2007) did. They created a detailed inoculation that specifically argued why the upcoming information was misleading. For instance, they explained that many of the people who ‘signed’ the petition were no researchers (e.g., the Spice Girls) or already diseased. This detailed inoculation differs from the detailed inoculation of Ecker et al. (2010) in that Ecker et al. (2010) provided information on the general effects of misleading information with two examples and Van der Linden et al. (2017) explained why the specific information that is coming is misleading, without mentioning the continued influence effect. The general inoculation of Van der Linden et al. (2017) contained arguments that some disagreement about human-caused climate change exist among scientist, without directly referring to the Oregon Petition, while the general inoculation of Ecker et al. (2010) only stated that not all facts are double-checked before released. Both inoculation conditions (general versus detailed) showed to be effective in reducing the continued influence effect of misleading information, but the detailed inoculation was most effective. The continued influenced was, like the other two studies, not eliminated but decreased. All three studies disregarded social media, while these media are the fastest, and perhaps most effective, in distributing misleading information.

Dekker (2018) extended the research by Van der Linden et al. (2017). She hypothesized that these studies could not find an inoculation technique that fully eliminated the continued influence effect, because people may become resistant to the inoculation as well.

### **Resistance to inoculation**

Literature has shown that inoculations were only partly successful in eliminating the continued influence effect (Cook et al., 2017; Dekker, 2018; Ecker et al., 2010; Van der Linden, 2017) and this phenomenon may be explained by resistance to the inoculation itself. The purpose of an inoculation is to prepare people for the misleading information that is coming by making them defensive beforehand. This defensiveness can result in rejection of the misleading information.

When looking back at the reasons why retractions of misleading information were not successful in eliminating the continued influence effect, psychological reactance was the most important and most suitable explanation. Retractions can be perceived as an attack to freedom to choose how to behave, think or act. This perceived attack will presumably result in continued reliance on misleading information (Lewandowsky et al., 2012). This same reasoning can apply

to why inoculations were not effective in previous studies. The inoculation can be perceived as an attack to freedom as well. Motivations to restore this freedom might result in rejection of the inoculation and acceptance of the misleading information. Additionally, the inoculation can produce resistance to the misleading information, followed by rejection of the misleading information.

Dekker's (2018) reasoning is the base of this study. She tried to overcome potential resistance to the inoculation by hiding the persuasive attempt in an inoculation with an indirect persuasion strategy: narrative persuasion. With narrative persuasion, readers are often unaware that they are being persuaded and less likely to activate psychological reactance (Dal Cin, Zanna, & Fong, 2004). Dekker (2018) used a direct inoculation in her study, the same as Van der Linden et al. (2017) used, and she called the inoculation with narrative persuasion an indirect inoculation. In this indirect inoculation, she told the same information as in her direct inoculation, only in a narrative form. Her study started with a pretest where she asked her participants their estimate of the scientific consensus on human-caused climate change. The study ended with a posttest that asked the same question, so she could compare the effects of her manipulation on participants' attitudes. She did not find significant resistance or significant differences in the effectiveness of the two inoculations. This study tries to further develop Dekker's (2018) hypothesis of resistance to inoculation by using another indirect persuasion strategy, since narrative persuasion was not effective.

H<sub>1a</sub>. Higher levels of rejection of the misleading information can be explained by lower levels of resistance to the inoculation.

H<sub>1b</sub>. Higher levels of rejection of the misleading information can be explained by higher levels of resistance to the misleading information.

H<sub>1c</sub>. Higher levels of rejection of the misleading information can be explained by lower levels of resistance to the inoculation yielding higher levels of resistance to the misleading information.

### **Overcoming resistance to the inoculation**

Since people may perceive the inoculation itself as a persuasive attempt, this study tries to make people more responsive to the inoculation, just like Dekker (2018) did. Indirect persuasion strategies, as formulated by Knowles and Linn (2004), take away the need to be resistant and are labeled as omega strategies. These strategies do not try to motivate you to do

something, but they focus on decreasing resistance to not do something. For example, if you are about to bungee jump but you are hesitant to let go, the instructor could say why you should jump: 'You will get the best feeling ever' or he can say: 'You will not die'. You are not likely to get resistant to this last indirect argument because the thing you are resistant to is taken away (i.e., fear of dying). He acknowledges your anxiety but assures you nothing bad will happen.

The biggest advantage of omega persuasion strategies is that people are often not aware of the persuasion and therefore less likely to activate persuasion knowledge (Campbell & Kirmani, 2000). Resistance to an inoculation may be sidestepped by using the omega persuasion strategy 'addressing resistance indirectly'. Instead of using a narrative like Dekker (2018) did, another indirect persuasion strategy will be used in this study. One way to address resistance indirectly and decrease psychological reactance is using self-affirmation. Bolstering the self-concept before a persuasive attack should be effective in reducing psychological reactance (L. Janssen, personal communication, June 4, 2018).

**Self-affirmation theory.** The self-affirmation strategy consists of building confidence by boosting self-esteem and removing any reasons to be hesitant. One way to build confidence is via self-affirmation (Knowles & Linn, 2004). Steele (1988) explains in his self-affirmation theory that when someone feels praised and is certain of his or her own skills, he or she may feel like they can overcome any difficulty. This paper will use self-affirmation through acknowledging participants' most important values. People who have been praised or reminded of their own accomplishments are less likely to resist a persuasive message and are said to be more open to persuasion (Zuwerink Jacks & O'Brien, 2004). This means that people need to be open to the inoculation and not to the misleading information. Therefore, the self-affirmation should be presented before the inoculation to decrease resistance to the inoculation instead of resistance to the misleading information.

H<sub>2a</sub>. The self-affirmation/inoculation condition yields lower levels of resistance to the inoculation than the no-self-affirmation inoculation.

H<sub>2b</sub>. The self-affirmation/no-inoculation condition yields lower levels of resistance to the misleading information than the self-affirmation/inoculation condition.

H<sub>3</sub>. The self-affirmation/inoculation condition results in higher levels of rejection of the misleading information than the no-self-affirmation/inoculation condition.

Since self-affirmed people will probably be more open to persuasive messages, the self-affirmation task in this study needs to make people more vulnerable to the inoculation and less vulnerable to the misleading information. An additional condition with only self-affirmation (i.e., without inoculation) will be used to determine whether possible effects are caused by the inoculation and not by self-affirmation. Participants in this condition will only see self-affirmation and no inoculation before the misleading information is shown.

In line with the studies conducted by Dekker (2018) and Van der Linden et al. (2017), this study will contain a control group in addition to the inoculation and self-affirmation condition. This condition has no inoculation and no self-affirmation. Participants will only see the misleading information. Results from the inoculation conditions will be compared to this baseline measurement, to be able to analyze whether a possible effect was caused by inoculation or self-affirmation.

H<sub>4</sub>. The self-affirmation-no-inoculation condition results in lower levels of rejection of the misleading information than the inoculation- and control condition.

The formulated hypotheses are visualized in the conceptual models in Figure 1 and Figure 2.

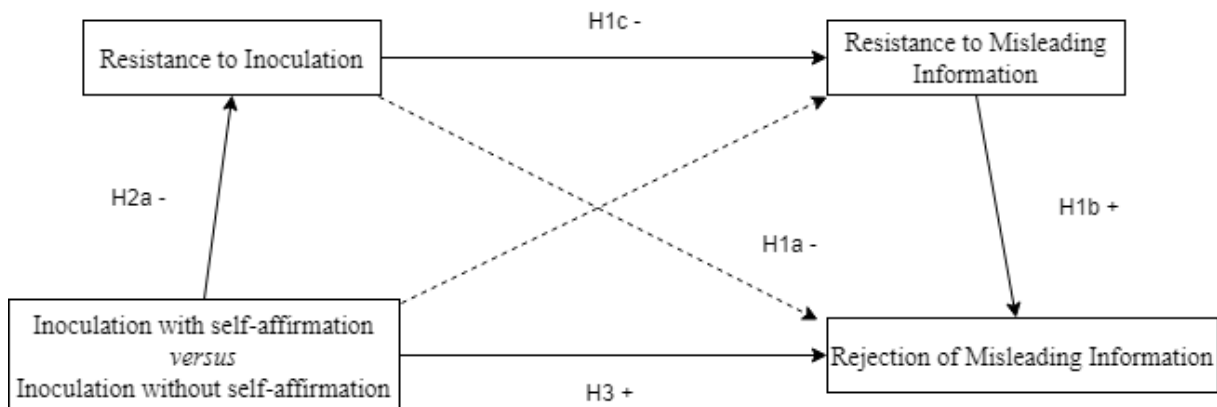


Figure 1. Hypotheses conceptual model for the inoculation conditions.

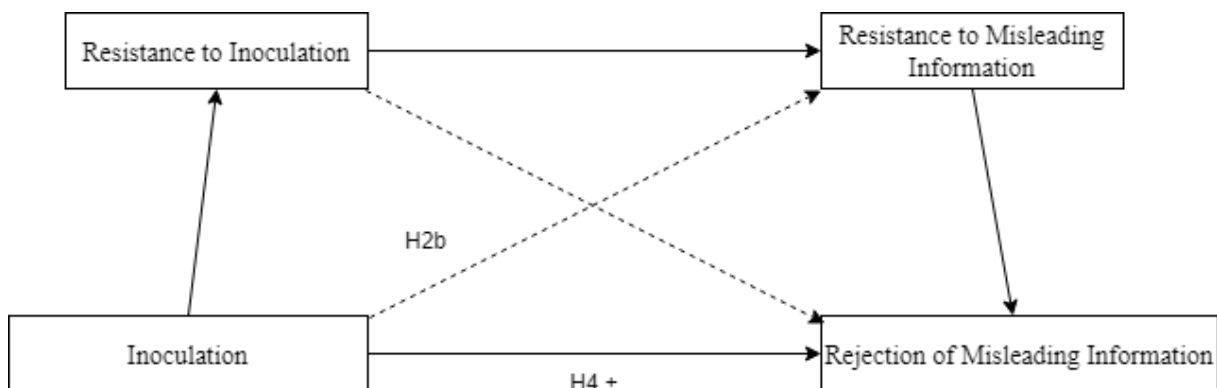


Figure 2. Hypotheses conceptual model for the independent variable 'inoculation'.

### Method

An experiment was conducted to test the hypotheses. In this study, the Rejection of Misleading Information was the dependent variable and Inoculation and Self-Affirmation were the independent variables. The expected mediators were Resistance to Inoculation and Resistance to the Misleading Information. Participants were randomly assigned to one of the four conditions: self-affirmation/inoculation condition, self-affirmation/no-inoculation condition, no-self-affirmation/inoculation condition and no-self-affirmation/no-inoculation condition.

### Participants

This experimental study has been approved by the Ethical Review Board of Tilburg School of Humanities and Digital Sciences before it was distributed. A total of 161 Dutch participants participated in this experiment. They were gathered via convenience sampling and filled out an online questionnaire.

*Table 1.* Division of participants across the experimental conditions.

<b>Condition</b>	<b>Number of participants</b>
Self-affirmation/inoculation	42
Self-affirmation/no-inoculation	39
No-self-affirmation/inoculation	41
No-self-affirmation/no-inoculation	30

The division of the participants across the experimental conditions can be seen in Table 1. Three participants were younger than 18 years old without consent of their parents, six responses were not complete, and one participant did not agree with the informed consent. These participants were left out and the remaining 152 participants were included for further analyses. These participants (111 women, 41 men) were aged between 18 and 63 ( $M = 28.97$ ,  $SD = 12.02$ ). Most participants' education level was intermediate vocational education (48), followed by University (44) and higher education (42). Participants were randomly divided into one of four surveys, each of which corresponded with one of the four experimental conditions.

### Design

This study used a 2 (inoculation vs. no-inoculation) x 2 (self-affirmation vs. no-self-affirmation) between-subjects design. Inoculation and Self-Affirmation, the independent variables, were divided in four conditions: self-affirmation/inoculation (condition 1), self-

affirmation/no-inoculation (condition 2), no-self-affirmation/inoculation (condition 3) and no-self-affirmation/no-inoculation (condition 4). Participants in the no-self-affirmation/no-inoculation condition were only shown the misleading information. The inoculations and/or self-affirmations of the other conditions were shown before exposure to the misleading information. The mediators Resistance to the Inoculation and Resistance to the Misleading Information were added to the model to determine their possible influence on the effect of inoculation and/or self-affirmation on rejection of misleading information.

Rejection of the misleading information was measured with participant's pre- and post-attitudes towards a statement concerning the misleading information with a slider on a scale from 0 to 100. The statement was 'Scientists are able to artificially create mammals.' Participants could place the slider on the number that represented their agreement. A score of 100 meant that the participant thought scientists are definitely able to artificially create mammals, and a score of 0 meant that the participant thought that scientists are definitely not able to artificially create mammals. The effects of the inoculation and self-affirmation on rejection of the misleading information could be measured with these pre-and post-attitudes.

## **Materials**

Two fact-checking sites Snopes and Truth or Fiction try to expose fake news articles. They explained that two factors primarily influence how creators design successful misleading articles, namely a) quantity is put ahead of quality, and b) they count on the fact that most readers do not check the information in the article. Those two factors were used to design the misleading information used in this study.

This misleading information was based on an e-rumor that stated that a Russian scientist created a baby with programmed stem cells. It should have been the world's first baby grown in a lab (Snopes, 2015; Truth or Fiction, 2015). A fake news website created the hoax and the article was published on a website named World News Daily Report. According to Snopes (2015), many readers believed the story was real, even though the website included a disclaimer that stated that the article was fiction. Since the creation of a real human out of stem cells would have been worldwide news, it would be hardly impossible that people had missed this news. To make the misleading information more believable, the creation of a human was replaced with the creation of a mouse. Creating a mouse out of nothing is a break-through as well, but it would be more realistic that people had missed it and had not verified it beforehand. The misleading article was created by combining the information provided by the fact-checking sites Truth or Fiction and Snopes but applying it to a mouse instead of a baby. This information can be found

in the appendices. Since the survey was conducted in Dutch, the case was translated to Dutch. This translation can be found in the appendices as well. Participants received the article in a social media context, like they clicked on an article they came across on Facebook.

In the article, the name and description of the research center was long and substantiated with interesting words. This part puts quantity over quality; it was not sure whether this is an existing research center, but because many words were used, it was likely that participants took it for granted. Additionally, the name of the ‘scientist’ Alexei Nicolaïevitch Ivanov shows only results for orchestra and paintings on Google, he is not a real scientist. Furthermore, it was stated that he was an expert in ornithology, which is bird science, not anything in the field of biotechnology.

The described case was applicable for this study, because the use of stem cells for scientific purposes is a sensitive topic that raises discussions (Ho, Brossard, & Scheufele, 2008; NBAC, 1999). This was expected to lead to different attitudes among the participants. In addition, scientists are seen as very trustworthy people (Ipsos MORI, 2017), which may influence the authenticity of the misleading information. This case was misleading because the article was simply made-up, and some untrue claims could have been detected to be false.

The used message for inoculation was created for this study. Since social media play a crucial role in the distribution of misleading information (Allcott & Gentzkow, 2017) and with practical validity in mind, all materials were presented in a social media context. The message was shown in the form of a pop-up. Previous research showed that a detailed inoculation was slightly more effective than a general inoculation (Ecker et al., 2010). Therefore, the inoculation in this study contained detailed information.

The inoculation started with providing consensus information (‘Did you know that most people cannot differentiate between real news and fake news?’), followed by an explanation of the continued influence effect (‘A lot of information on internet, specifically on social media, is not true. However, people believe it and base their decisions on wrong information, even when the information turns out to be incorrect.’), illustrated with two examples to give detailed information. The first example is the same as in the specific warning of Ecker et al. (2010); people believe that Iraq had weapons of mass destruction while they have never been found. The second example is based on the example given in the introduction, vaccines that cause autism. The message ends with a concluding statement: ‘Do not believe everything you read on the internet!’. This statement could be the part that participants perceive as a threat and become

resistant to, because it tells them what to do. The inoculation used in this experiment can be found in the appendices.

### Measures

To measure resistance towards the inoculation and the misleading information, the same scales as the study of Dekker (2018) were used. Dillard and Shen's (2005) perceived threat to freedom scale and an adapted version of Fransen, Ter Hoeven and Verlegh's (2013) resistance scale were combined. These constructs were used to measure the mediators resistance to inoculation and resistance to the misleading information. The original scale of Fransen et al. (2013) consisted of 28 items, but only five of these items were relevant to this study and were measured on a seven-point Likert scale; 'I thought about things that are unrelated to the message', 'I thought favorably about the message', 'I ignored the information in the message that challenged my opinion', 'I thought critically about the information in the message', and 'I stood strong and refused to change my opinion after reading the message.' Dillard and Shen's (2005) scale consisted of four items measured on a seven-point Likert scale as well; 'The message tried to make a decision for me', 'The message threatened my freedom to choose', 'The message tried to pressure me', and 'The message tried to manipulate me'. The items were adjusted to remind participants what text they were evaluating, e.g. 'The message in the article tried to make a decision for me' versus 'The message in the pop-up tried to make a decision for me'. Similar to the study of Dekker (2018), the item 'I thought favorably about the message' of the scale of Fransen et al. (2013) was reverse recoded to be consistent with the other items. The threat to freedom scale had a good reliability ( $\alpha = .87$ ), whereas some items needed to be removed from the resistance scale to improve reliability, namely 'I thought about things that are unrelated to the message of the pop-up' and 'I thought favorably about the message of the article' ( $\alpha = .69$ ). Despite that this reliability score was .01 lower than the required .7, the small difference was accepted for further analyses.

Self-affirmation was manipulated with a method conducted by Kopelman and Rovenpor (2003) who revised the Study of Values by Allport, Vernon and Lindzey (1951). In Kopelman and Rovenpor's (2003) study, participants were asked to confirm which type of person was most applicable of them. Six types were presented, representing the six values of Allport et al. (1951). These values were religion, politics, social, art, business and science. The chosen value decided which statements the participant would see after that. Ten statements were presented, all with four possible answers. One of these answers represented the value the participant had labeled as most important. For example, the statement 'At an evening discussion with close

friends, are you more interested when the conversation concerns...’ had four possible answers, namely a) the meaning of life, b) developments in science, c) literature, or d) poverty and social amelioration. If the participant claimed to be a social type, he or she would be most likely to choose answer d. With this method, participants could affirm their most important value ten times. All statements and answers were translated to Dutch and can be found in the appendices, with an overview of which statements were presented to which type attached. One adjustment was made in statement 13: General Colin Powell was changed into the Dutch naval hero Michiel de Ruyter, because Colin Powell is not well-known in the Netherlands.

Two control variables were expected to affect the results, namely Facebook usage and background in medicine. It could have been hard for participants that did not use Facebook to imagine they were scrolling through a Facebook timeline. This may have affected the evaluation of the misleading information. Furthermore, participants with a background in medicine may have more knowledge of the subject of the misleading information to base their judgement on.

### **Procedure**

Participants of this study were asked to fill in an online questionnaire created with Qualtrics. The questionnaire started with the pretest of participants’ attitudes towards artificial creation of mammals. After answering this question, participants were asked to imagine that they were scrolling through their Facebook newsfeed. The corresponding screenshot was shown. After that, the participants needed to imagine that they clicked on the article. Depending on the participants’ condition, the self-affirmation, the inoculation or the article was shown. The participants in the self-affirmation conditions had to answer the questions about their values at the start and the inoculation conditions saw the inoculation before the article. All participants were asked to carefully read the (inoculation and the) article.

The participants in all conditions were asked to once more evaluate the same statement as presented in the posttest to test their post-attitude. The participants in the no-inoculation conditions were asked to answer the questions of the resistance scale only for the misleading information. The participants in the inoculation conditions were asked to fill in the resistance scale for the misleading information as well as for the inoculation. After answering these questions and questions about whether they used Facebook and whether they had a background in medicine, the participants were directed to the end of the survey where they were debriefed about the purpose of the study, thanked for their participation and provided with information for possible unanswered questions.

## Data analysis

The retrieved data was analyzed with three different statistical tests. A factorial analysis of variance (ANOVA) was conducted three times. The mean difference score of the posttest and pretest was used as dependent variable in all three ANOVAs. The ANOVA was once used to analyze whether main effects or an interaction effect of self-affirmation and inoculation occurred, once to test the possible effects of the control variables, and once to compare the conditions with and without an inoculation. Furthermore, an independent samples *t*-test showed whether the two inoculation conditions differed significantly. Analyses with PROCESS model 6 of Hayes (2012) were used to analyze possible mediation effects of resistance to the inoculation and resistance to the misleading information.

## Results

### Rejection of misleading information

For all conditions, the scores of the pretest, the posttest, and the difference between them were observed to determine whether inoculation and self-affirmation were effective in minimalizing the impact of misleading information.

*Table 2.* Overview results. Mean scores pretest, posttest and difference for all conditions. The mean scores represent how participants thought about the statement ‘Scientists are able to artificially create mammals.’ 100 = scientists are definitely able to artificially create mammals, 0 = scientists are definitely not able to artificially create mammals. Mean scores resistance to inoculation and resistance to misleading information. 0 = no resistance, 7 = high resistance. Resistance to inoculation was not applicable to condition 2 and condition 4, since they do not have an inoculation.

Condition	Rejection of misleading information			Resistance to inoculation mean	Resistance to misleading information mean
	Pretest mean	Posttest mean	Mean difference		
<b>1. Self-affirmation/ Inoculation</b>	51.50 <i>SD</i> = 29.86	50.69 <i>SD</i> = 26.33	-0.81 <i>SD</i> = 27.86	3.49 <i>SD</i> = 1.03	3.04 <i>SD</i> = 0.97
<b>2. Self-affirmation/ No-Inoculation</b>	51.59 <i>SD</i> = 29.57	67.97 <i>SD</i> = 25.68	+16.38 <i>SD</i> = 20.63	X	3.06 <i>SD</i> = 0.90
<b>3. No-self-affirmation/ Inoculation</b>	46.71 <i>SD</i> = 27.13	43.61 <i>SD</i> = 27.53	-3.10 <i>SD</i> = 17.38	3.68 <i>SD</i> = 0.86	3.23 <i>SD</i> = 0.95
<b>4. No-self-affirmation/ No-Inoculation</b>	49.83 <i>SD</i> = 28.00	64.13 <i>SD</i> = 26.00	+14.30 <i>SD</i> = 23.52	X	2.96 <i>SD</i> = 0.82

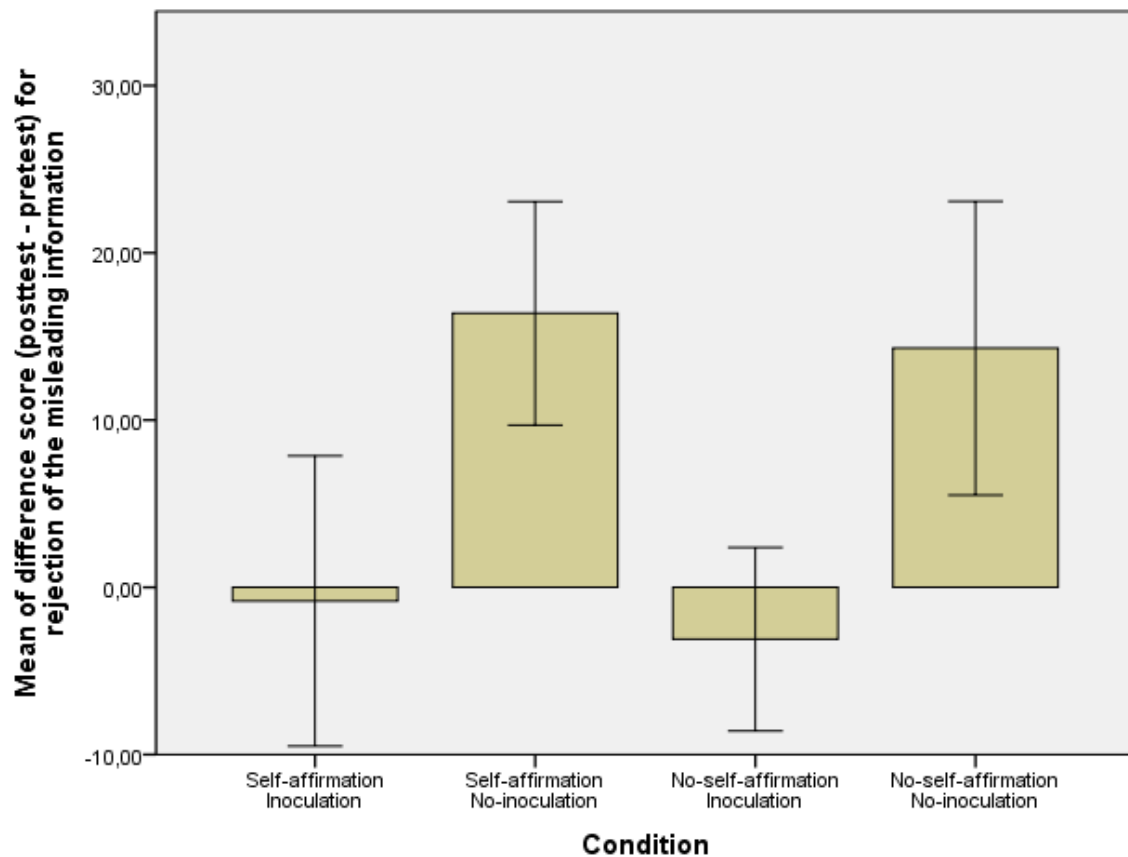


Figure 3. Mean difference scores between the post- and pretest for the conditions. The mean scores represent how participants thought about the statement ‘Scientists are able to artificially create mammals.’ 100 = scientists are definitely able to artificially create mammals, 0 = scientists are definitely not able to artificially create mammals

Table 2 shows the mean difference scores for the posttest and the pretest. When the scores on the posttest were lower than the scores on the pretest, the impact of misleading information was considered decreased, and the manipulations thus effective. This was expected for the first and third condition, which indeed showed a negative mean difference. Both conditions had an inoculation, yet the first condition ( $M_{diff} = -0.81$ ,  $SD = 27.86$ ) did contain self-affirmation and the third condition ( $M_{diff} = -3.10$ ,  $SD = 17.38$ ) did not contain self-affirmation. The data show that both the conditions without an inoculation had higher scores on the posttest than on the pretest, as can be seen in Table 2 and Figure 3.

The figure shows unexpected results. The mean difference was expected to be more negative for the self-affirmation/inoculation condition than for the no-self-affirmation/inoculation condition, because it was expected that people became more resistant to the inoculation when no self-affirmation was present and yet rejected the misleading information less. Furthermore, Figure 3 shows a higher mean difference for the self-

affirmation/no-inoculation condition than for the no-self-affirmation/no-inoculation (control) condition. This finding meets the expectation. However, the mean difference of the control condition was expected to be significantly lower (but still positive) than the mean difference of the self-affirmation/no-inoculation, because this condition affirms people and makes them more open to a persuasive message. Based on Figure 3, the difference does not seem to be significant, but a statistical analysis needs to confirm this. It was expected that the self-affirmation was applied to the misleading information with the absence of an inoculation. The rejection was likely to be lower in comparison to the no-self-affirmation/no-inoculation condition.

To test whether inoculation and self-affirmation affect rejection of the misleading information, a two-way ANOVA was performed with the difference score between the posttest and pretest as dependent variable and self-affirmation and inoculation as independent variables. The higher the difference scores, the more the misleading information was rejected. The sample was not normally distributed. Therefore, the bootstrapped 95% confidence intervals will be reported further on. The factorial ANOVA showed a significant main effect of inoculation,  $F(1, 148) = 5.50, p = .020, 95\%CI [1.52, 17.83], \eta_{\text{partial}}^2 = .036$ . Rejection of the misleading information was higher (because the posttest score was lower) ( $M = 48.41, SD = 2.77$ ) for participants with an inoculation than for participants without an inoculation ( $M = 58.09, SD = 3.06$ ). No main effect for self-affirmation was found ( $F(1, 148) = 1.10, p = .294, 95\%CI [-12.50, 3.81]$ ). The difference was not significant, although the pattern shows that the overall rejection of the misleading information was higher for participants without self-affirmation ( $M = 51.07, SD = 3.03$ ) than for participants with self-affirmation ( $M = 55.42, SD = 2.80$ ). There was also no interaction effect of self-affirmation and inoculation,  $F(1, 148) = 0.27, p = .603$ .

Thus, hypothesis 3 was not supported because the self-affirmation/inoculation condition did not lead to significantly higher rejection of the misleading information than the no-self-affirmation/inoculation condition. Both conditions consisted of an inoculation, but only the first contained self-affirmation. Furthermore, hypothesis 4 was partly supported. The self-affirmation/no-inoculation condition resulted, as expected, in significant lower levels of rejection of the misleading information than the conditions with an inoculation (with and

without self-affirmation) but did not significantly differ from the no-self-affirmation/no-inoculation control condition since no main effect of self-affirmation was found<sup>1</sup>.

### **Resistance to the inoculation**

To test Hypothesis 2a, whether the self-affirmation/inoculation condition yields lower levels of resistance to the inoculation than the no-self-affirmation inoculation, an independent samples *t*-test with the condition as grouping variable was conducted. The mean scores of resistance to the inoculation can be found in Table 2. Results showed no significant difference between the two groups (i.e., self-affirmation/inoculation condition and no-self-affirmation/inoculation condition) for resistance to the inoculation,  $M_{diff} = -0.188$ ,  $t(81) = 0.91$ ,  $p = .392$ , 95%CI [-0.61, 0.21]. Therefore, Hypothesis 2a was not supported. Although the difference was not significant, the pattern showed that, on average, the condition with self-affirmation ( $M = 3.49$ ,  $SD = 1.03$ ) resulted in lower levels of resistance to the inoculation than the condition without self-affirmation ( $M = 3.68$ ,  $SD = 0.86$ ).

### **Resistance to the misleading information**

To test Hypothesis 2b, whether the self-affirmation/no-inoculation condition yields lower levels of resistance to the misleading information than the self-affirmation/inoculation condition, a factorial ANOVA with resistance to the misleading information as dependent variable and self-affirmation and inoculation as independent variables was conducted. The mean scores of resistance to the misleading information can be found in Table 2. Results showed no main effect of inoculation ( $F(1, 148) = 0.95$ ,  $p = .332$ , 95%CI [-0.43, 0.13]), no main effect of self-affirmation ( $F(1, 148) = 0.10$ ,  $p = .758$ , 95%CI [-0.26, 0.34]), and no interaction effect ( $F(1, 148) = 0.70$ ,  $p = .405$ ). Hypothesis 2b was thus not supported. On average, the no-self-affirmation/inoculation condition showed the highest resistance to the misleading information ( $M = 3.23$ ,  $SD = 0.95$ ).

### **Mediation analyses**

To test Hypotheses 1a, 1b and 1c, whether higher levels of rejection of the misleading information can be explained by lower levels of resistance to the inoculation and/or higher levels of resistance to the misleading information, a mediation analysis with PROCESS model

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<sup>1</sup> The findings cannot be explained by the control variables. Facebook use did not influence the results, ( $F(1, 149) = 0.52$ ,  $p = .471$ ), nor did a background in medicine ( $F(1, 149) = 0.11$ ,  $p = .746$ ).

6 of Hayes (2012) was conducted with the difference score between the posttest and the pretest as dependent variable, the resistance to the inoculation as first mediator, the resistance to the misleading information as second mediator and condition as independent variable. Model 6 was used because the model consists of two mediators. This analysis will show whether any mediation effect occurs.

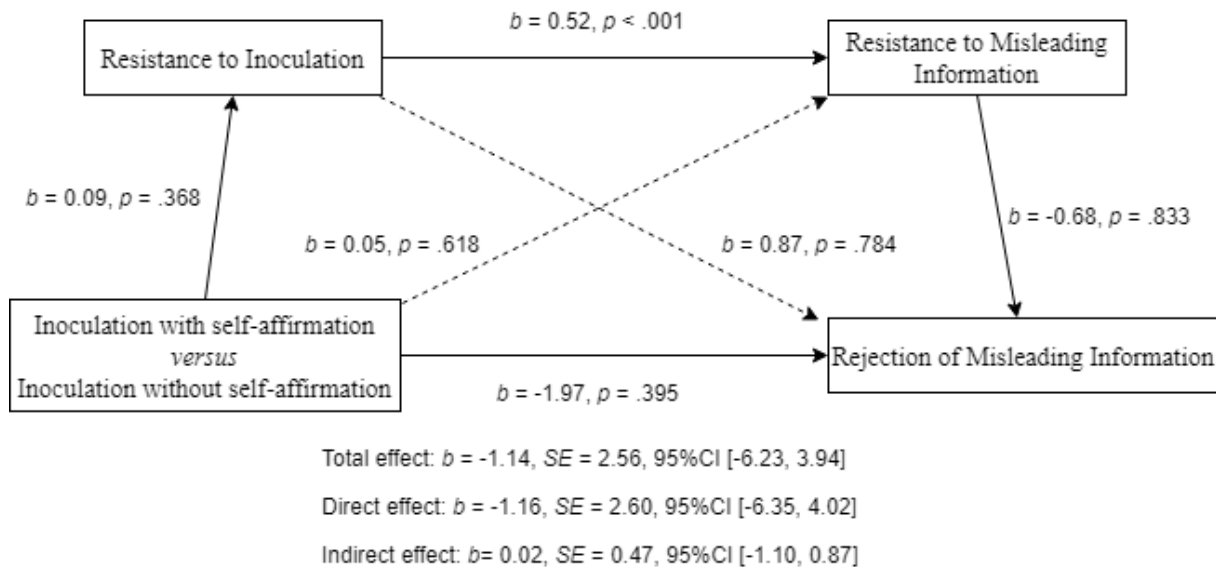


Figure 4. Total, direct and indirect effects of resistance to inoculation and resistance to misleading information for the inoculation conditions.

The results presented in Figure 4 show no total, direct or indirect effects of inoculation on rejection of misleading information via resistance to the inoculation and resistance to the misleading information. Thus, Hypothesis 1a, 1b and 1c were not supported. Resistance to the inoculation and resistance to the misleading information do not mediate rejection of misleading information. However, one correlation was found,  $b = 0.52, p < .001$ . Higher levels of resistance to the misleading information correlate with higher levels of resistance to the inoculation. This finding is contrary to the hypothesis, which expected a negative relation.

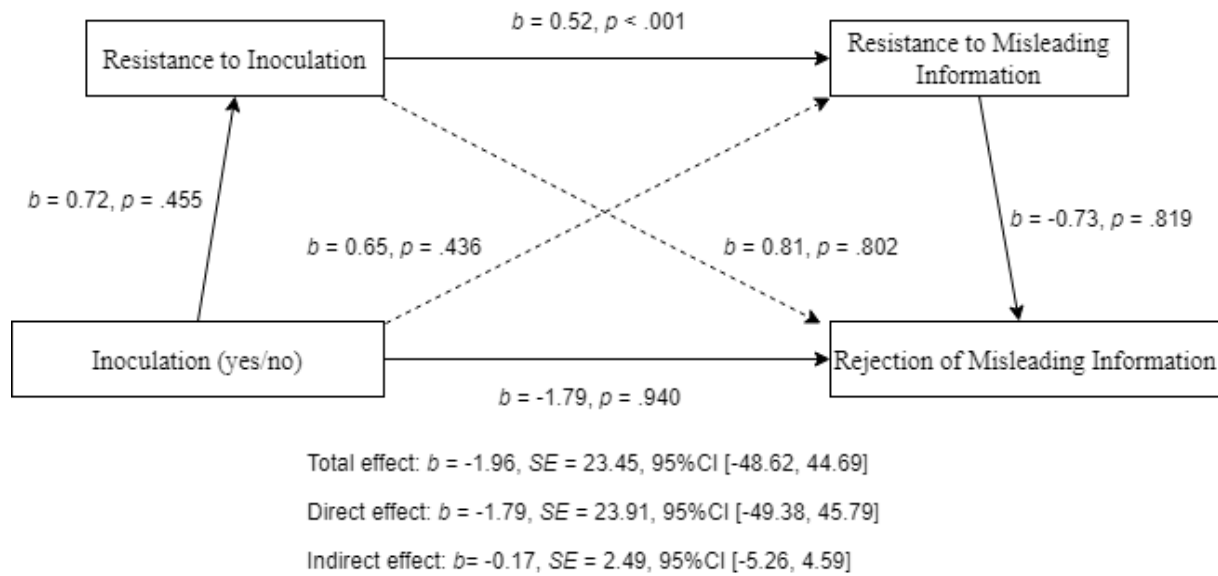


Figure 5. Total, direct and indirect effects of resistance to the inoculation and resistance to the misleading information for inoculation.

Figure 5 shows no total, direct or indirect effects of inoculation on rejection of the misleading information via resistance to the inoculation and resistance to the misleading information for inoculation. The same inoculation effect was found,  $b = 0.52, p < .001$ ; higher levels of resistance to the misleading information correlate with higher levels of resistance to the inoculation.

### Resistance scales

The analyses for resistance to inoculation and resistance to misleading information showed no relations. The scale that measured resistance originally consisted of two separate scales that were combined. The scale of Dillard and Shen (2005) was used to measure the perceived threat to freedom. In other words, it assessed the resistance to both the inoculation and the misleading information. The scale of Fransen et al. (2013) measured the participants' attitude towards the inoculation and misleading information with an adapted resistance scale. The perceived threat to freedom scale evaluated what was in the message and the attitude scale evaluated how this affected the participants. Separate analyses of these scales only showed one additional marginally positive relation of condition and the attitude towards the inoculation ( $b = 0.21, p = .094, 95\%CI [-0.04, 0.45]$ ) and the same positive relationship between attitude towards the inoculation and attitude toward the misleading information as found earlier ( $b = 0.42, p < .001, 95\%CI [0.25, 0.60]$ ). The condition with self-affirmation yields lower levels of negative attitude towards the inoculation ( $M = 3.29, SD = 1.14$ ) than the condition without self-

affirmation ( $M = 3.71$ ,  $SD = 1.06$ ). No relation was found between attitude towards the inoculation and rejection of misleading information ( $b = 2.11$ ,  $p = .433$ , 95%CI [-3.22, 7.44]), nor between attitude towards the misleading information and rejection of misleading information ( $b = -2.81$ ,  $p = .352$ , 95%CI [-8.79, 3.17]), nor between condition and attitude towards the misleading information ( $b = 0.02$ ,  $p = .827$ , 95%CI [-0.17, 0.22]). Additionally, the positive relationship between the perceived threat to freedom towards the inoculation and perceived threat to freedom toward the misleading information was found again ( $b = 0.47$ ,  $p < .001$ , 95%CI [0.28, 0.65]). No relationship was found between condition and perceived threat to freedom towards the inoculation ( $b = 3.72$ ,  $p = .884$ , 95%CI [-0.32, 0.28]), nor between perceived threat to freedom towards the inoculation and rejection of misleading information ( $b = -0.55$ ,  $p = .802$ , 95%CI [-4.92, 3.82]), nor between perceived threat to freedom towards the misleading information and rejection of misleading information ( $b = 0.99$ ,  $p = .665$ , 95%CI [-3.55, 5.54]), nor between condition and perceived threat to freedom towards misleading information ( $b = 0.09$ ,  $p = .478$ , 95%CI [-0.16, 0.34]). Yet, self-affirmation has a marginal positive effect on attitude towards the inoculation. However, both attitude scores were at the middle of a 7-point Likert scale.

### Discussion

The aim of this study was to contribute to the field of research that focusses on the limitation of the continued influence effect of misleading information (Ecker et al., 2011b). This study tried to minimize this effect by using an inoculation aimed at forewarning people that misleading information is coming. The hypothesis of Dekker (2018), which states that eliminating the continued influence effect has not yet succeeded because resistance to the inoculation might occur, is further developed in this paper. Dekker's (2018) hypothesis was extended by using another indirect persuasion strategy, namely self-affirmation. It was expected that the combination of self-affirmation and inoculation would result in the highest rejection of the misleading information. Self-affirmed people are said to be more open to persuasive messages, which should make people more responsive to the inoculation in this study.

The first research question asked to what extent it was possible to inoculate people against the effects of misleading information. The second research question examined the role of resistance to the inoculation in the successfulness of an inoculation. The last research question investigated the role of self-affirmation in decreasing resistance to the inoculation. The self-affirmation/inoculation condition was expected to show that self-affirmation leads to less resistance to the inoculation and, as a result, the highest rejection of the misleading information.

### **Self-affirmation and inoculation**

According to Hypothesis 2a, the self-affirmation/inoculation condition was expected to result in lower levels of resistance to the inoculation than the no-self-affirmation/inoculation condition. Support for this hypothesis would provide evidence that self-affirmation can reduce resistance to the inoculation. Hypothesis 2b stated that the self-affirmation/no-inoculation condition results in lower levels of rejection of the misleading information than the self-affirmation/inoculation condition. The self-affirmation was expected to make participants more responsive to a persuasive message, but the absence of an inoculation was proposed to make participants more open to the misleading information instead (Zuwerink Jacks & O'Brien, 2004). Hypothesis 3 examined the effectiveness of self-affirmation by stating that the self-affirmation/inoculation condition results in higher levels of rejection of the misleading information than the no-self-affirmation-inoculation. Since self-affirmed people are said to be more open to persuasive messages (Zuwerink Jacks & O'Brien, 2004), this analysis was expected to show that self-affirmation is an effective tool for decreasing resistance to the inoculation. The fourth and last hypothesis tested whether the self-affirmation/no-inoculation condition resulted in lower levels of rejection of the misleading information than the inoculation- and control condition. In other words, the participants in the self-affirmation/no-inoculation condition were more likely to believe the misleading information more than the inoculation- and control condition. However, results showed no support for either Hypothesis 2a, Hypothesis 2b nor Hypothesis 3. Even though the self-affirmation/inoculation resulted in higher rejection of the misleading information than the two conditions without an inoculation, the no-self-affirmation/inoculation condition showed the highest rejection of misleading information. Moreover, the absolute scores of resistance to the inoculation are 3.49 and 3.68. The second number corresponds with the no-self-affirmation/inoculation condition and shows that this resistance to the inoculation is higher than the resistance to the inoculation in the self-affirmation/inoculation condition. Furthermore, the absolute numbers show that self-affirmation did decrease resistance to the inoculation a little, but the overall resistance to the inoculation is relatively low. Moreover, Hypothesis 4 is partly supported. It was expected that the two conditions with an inoculation showed higher levels of rejection of the misleading information, because of the warning in the inoculation that misleading information is coming. The inoculation was expected to prepare the participants for the upcoming persuasive message, i.e., the misleading information, just like a vaccine prepares the body for a virus (McGuire & Papageorgis, 1962). This part of the hypothesis was supported. Additionally, the self-

affirmation/no-inoculation condition was expected to result in lower levels of rejection of the misleading information than the no-self-affirmation/no-inoculation control condition. In the self-affirmation/no-inoculation condition, the self-affirmed people were made more responsive for the upcoming persuasive message (i.e., the misleading information in this case) (Zuwerink Jacks & O'Brien, 2004). The control condition was expected to show higher levels of rejection of the misleading information than the participants in the self-affirmation/no-inoculation condition, because the participants in the control condition were not manipulated to be extra responsive to the persuasion, as the participants in the other condition were. This part of Hypothesis 4 is not supported. The self-affirmation/no-inoculation condition even rejected the misleading information less than the control condition.

### **Resistance to the inoculation and misleading information**

Furthermore, it was expected that two mediators would explain the rejection of misleading information. Hypothesis 1a considered lower levels of resistance to the misleading information as explanation for higher levels of rejection of the misleading information, Hypothesis 1b considered higher levels of resistance to the misleading information as explanation, and Hypothesis 1c considered a combination of both mediators as explanation. All three hypotheses were not supported. Resistance to the inoculation or resistance to the misleading information did not correlate with the rejection of misleading information. Nonetheless, the absolute numbers of resistance to the inoculation were 3.49 and 3.68. Both scores were around the middle of the 7-point Likert scale and thus was the resistance to the inoculation relatively not very high. Moreover, one positive correlation was found; higher levels of resistance to the misleading information correlate with higher levels of resistance to the inoculation. This finding was contrary to the expectations, since it was expected that higher levels of misleading information could be explained by lower levels of resistance to the inoculation (Lewandowsky et al., 2012), i.e., that the correlation between these two variables was negative. A possible explanation for this finding will be discussed later in this paper (see limitations and future research).

In sum, the inoculation used in this study was effective in increasing the rejection of misleading information, yet self-affirmation was not. It is possible to inoculate people against the effects of misleading information, but self-affirmation is not effective in decreasing resistance to the inoculation. However, the resistance to the inoculation was relatively low, so self-affirmation did not have much resistance to deal with in the first place.

### **Theoretical implications**

This study contributes to the field of research that focusses on the continued influence effect. Since the distribution of misleading information becomes easier via social media, the remedy for its effects should be applicable to a social media context. The current study is the first study that investigated the effectiveness of an inoculation in a social media context. Furthermore, the used inoculation is applicable in a real-life setting, therefore externally valid. The inoculation can immediately be applied on social media. Implementation decreases the effects of misleading information. This study, specifically the examination of the experiment in a social media context, can serve as the base of future research.

Furthermore, this study contributes to studies regarding the inoculation theory of resistance for misleading information by extending the few papers that already exist (e.g., Ecker et al., 2010; Van der Linden et al., 2017). Where earlier research primarily focused on how the inoculation should be designed, this study focused more on the context rather than the content of the inoculation. The context of the inoculation used in this study differed from the contexts used in previous studies in a) the social media context that the study was executed in, and b) the pop-up that was used as an inoculation. A pop-up was shown to be effective in studies regarding gambling addictions (e.g., Auer, Malischnig, & Griffiths, 2014), yet not for misleading information. This study proves that an inoculation in a pop-up is effective in decreasing the effects of misleading information. Thus, this research contributes to the inoculation theory of resistance by proving that an inoculation is also effective in a social media context and when it is used as a pop-up.

Lastly, this study also contributes to a relatively new field of research: research concerning resistance to inoculation. This study specifically contributes to this field by examining another indirect persuasion strategy (i.e., self-affirmation) to reduce resistance to the inoculation than the one used in the study of Dekker (2018), who used narrative persuasion. Resistance to an inoculation was only examined by one unpublished Master's thesis and three Master's theses in progress (including this one). Results showed relatively low levels of resistance to the inoculation. Yet, all studies contribute to this field of research by confirming that the resistance to the inoculation is not high (scores are around the middle of the scale).

### **Limitations and future research**

**Resistance and self-affirmation.** It is possible that the positive correlation between resistance to inoculation and resistance to the misleading information can be explained by the activation of persuasion knowledge. If participants perceived the inoculation as persuasive, it

is highly likely that their persuasion knowledge was activated (Campbell & Kirmani, 2000). The persuasion knowledge was probably not deactivated in the short time between the inoculation and misleading information, which may have provided a spill-over effect of the application of persuasion knowledge on the misleading information. It is possible that the participants became skeptic about the misleading information and perceived it as a persuasive attempt. When persuasion motives become accessible, people may activate their persuasion knowledge and may become resistant (Campbell & Kirmani, 2000). However, this does not explain why self-affirmation did not have any effect. Self-affirmation needed to prevent activation of persuasion knowledge for the inoculation in the first place. Perhaps the use of self-affirmation on itself should be questioned.

The positive effects of an inoculation may be suppressed by self-affirmation. Data show that the self-affirmation/inoculation condition is effective in increasing the rejection of misleading information, but only a little. On the contrary, the no-self-affirmation/inoculation shows higher rejection. Perhaps the self-affirmation suppressed the positive effects of the inoculation, yielding minimal rejection scores. This idea is supported by the data of the two other conditions. The self-affirmation/no-inoculation condition showed lower levels of rejection of the misleading information than the no-self-affirmation/no-inoculation condition. Results of the study of Klein and Harris (2009) may contribute to the explanation of the counterproductive effects of self-affirmation. They found that self-affirmation may enable the processing of persuasive messages, even though the effects could debilitate among people that exhibit high levels of the behavior that the message tries to reduce. The case used by Klein and Harris (2009) tried to reduce alcohol consumption. It turned out that the effects of self-affirmation were reduced among people with high alcohol consumption. In the case of the present study, the self-affirmation effects may be reduced because the participants normally show low levels of rejection of misleading information. However, this is a possible explanation for why the self-affirmation was not effective, not why it shows counterproductive results.

The counterproductive effect may be explained with the ego-depletion hypothesis examined by Wheeler, Briñol and Hermann (2007) and Fennis, Janssen, and Vohs (2009). These researchers posit that self-regulatory resources can be depleted. In other words, that the resources that regulate self-control can be depleted. Depletion of these resources results in compliance with the initial request. For instance, asking people about their book collection before asking them to donate money to a charity may deplete their self-regulatory resources that much, that it fosters compliance and thus donating money. Additionally, Fennis et al.

(2009) found that depletion of such resources prompts heuristic decision making. In other words, it prompts decision making like they normally do, without thinking about it. The self-affirmation task in this study required a lot of effort, because it consisted of eleven questions. Most of these questions contained a lot of text as well. This effortful task may have depleted the self-regulatory resources and may have prompted the relapse on familiar behavior; believing the information in the article and thus not rejecting the misleading information.

Future research can elaborate on whether self-affirmation suppresses the positive effects of an inoculation. This can possibly be done with different self-affirmation tasks with different degrees of required effort. The following research question can be used: “To what extent does self-affirmation suppress the positive effects of an inoculation in decreasing the effects of misleading information?”

A practical implication of this study is that the self-affirmation task conducted by Kopelman and Rovenpor (2003) used in this study was, besides effortful, not externally valid. It is not possible to prepare people for misleading information that is coming in a real-life setting in the way that was done in this research. In the self-affirmation task, participants were asked to choose one type of person out of seven possible types that suited them best. This task was followed up by ten statements, which corresponded with the type of person. Each statement had four possible answers and one of these answers corresponded with the type of person again. With this task, participants could affirm their most important value at least ten times. This self-affirmation task was expected to reduce resistance to the inoculation. The resistance to the inoculation turned out to be at the middle of the scale. Future research can focus on eliminating the resistance to the inoculation by aiming at a score of 0 on a 7-point scale. Other indirect persuasion strategies than narrative persuasion and self-affirmation could be used, such as reverse psychology (Knowles & Linn, 2004). Up to now, inoculations focused on warning people that misleading information is coming and that they should not believe this information. Maybe the resistance needs to be decreased the other way around: tell people not to do something and they will do it (i.e., reverse psychology) (Knowles & Linn, 2004). Future research could possibly use inoculations in a pop-up but use statements similar to a British army recruitment that used reverse psychology successfully (Freedman, 2016). In their campaign, they used commercials that said, for example, ‘Do not join the army. Do not learn something new. Do not learn something that matters. Do not find out what you are capable of.’ (British Army, 2016). Research regarding misleading information could use statements like ‘Believe everything you read on Facebook. Believe everything you see on Instagram. Believe everything

you read on the internet.’ The corresponding research question can be: “To what extent does reverse psychology play a role in the successfulness of an inoculation in decreasing the effects of misleading information?”

**Sample distribution.** The sample of this study was gathered via convenience sampling via the researcher’s network. The sample consisted of 111 female participants and only 50 male participants. Therefore, results of this study are not generalizable to the whole population. The excessive part of female participants may have influenced the study results since women have been shown to be more vulnerable to self-affirmation than men in intellectual performance (Martens, Johns, Greenberg, & Schimel, 2006). Participants may perceive filling out a survey as a task where they need to prove themselves and are under pressure, which may have influenced women’s vulnerability to self-affirmation. To accomplish generalizability and to tackle the practical limitation of this study, future research could for example gather their participants via a professional panel where people can fill out surveys in exchange for money, such as Mechanical Turk.

**Case.** In the pretest and posttest of this study, the statement ‘Scientists are able to artificially create mammals’ was used to measure participants’ rejection of misleading information. The scores of the pretest and posttest are stuck around 50 on a 100-point scale and can probably be interpreted as ‘I do not know’. This means that the misleading information did not convince the participants that the statement was false. A possibility is that this particular case was not suitable for this experiment. The artificial creation of a mouse may either be non-appealing to participants or too distant. Perhaps people are not sure whether artificial creation is possible, and maybe they do not care because they do not find the subject appealing. Participant’s personal reactions as ‘I guess it should be possible with the modern technology, but I do not know’ were common. However, the case was realistic and comparable to articles found on social media. There was no certainty whether people would open the article in real life, yet it was highly likely that they have come across similar articles. A case like the one about the accident with the minibus used in Ecker et al. (2010) could seal the deal instead. Cases like these do not have to cope with preexisting attitudes or knowledge, and answers can be based purely on the information provided by the article.

Additionally, just a few days before the survey was distributed, a news article appeared where it was announced that a scientist successfully created a genetically modified baby (NOS, 2018). This could have influenced participants’ attitude towards the misleading information.

Even participants that did not have any knowledge regarding this field, may expect that scientist should be able to artificially create a mammal if they can manipulate DNA of human babies. Although these are just speculations, it is highly likely that it has influenced the study results in some way.

The statement 'Scientist are able to artificially create mammals' can also be the malefactor in this situation. Even though the statement seemed to be suitable for the experiment beforehand, the statement is broad and hard to counterargue. Due to peoples' lack of knowledge on artificial creation, only experts in this scientific field might disagree with the information. Nevertheless, maybe it is simply not possible to measure the continued influence effect with this statement, or with a statement at all. Future research can use the questions used in the study of Ecker et al. (2010) to analyze the continued influence effect. This study used nine inference questions, nine fact-recall questions and two manipulation-check questions. This would also tackle one of the practical limitations of this study, because no manipulation checks were included. Because of this, it could not be checked whether participants read the information thoroughly.

Another possibility is that the subject did not negatively influence the results, but the fact that it was only one experiment and one case did. If a participant is not attracted to the subject, they could pay less attention to an article in comparison to a subject that they find appealing. Future research could use multiple cases in an experiment to try to hold the participant's attention and to be able to compare data. However, independent of the case or article of future studies, a pretest can be used to check the effectivity of the information and the statement and people's attitudes towards the subject(s).

The pretest can also detect other aspects of the experiment that might affect results. For example, the scales that were used in this study to measure resistance showed a reliability score of .69, while this should be minimal 0.7. This was an unexpected score, because the scales were proven to be reliable in earlier studies. Nevertheless, the statements of the scales were translated from English to Dutch, which may be the cause of the low reliability. A pretest might have detected this beforehand and changes could have been made to the statements to increase reliability. Perhaps participants were not consistent in their answers because the survey was quite long and some participants had to answer the same questions twice, once for the inoculation and once for the misleading information.

**Elimination of continued influence effect.** The average resistance to the misleading information for the conditions with an inoculation are 3.04 and 3.23, which are relatively low

on a 7-point Likert scale. The absolute numbers of the posttest show scores between 40 and 50, which is below or in the middle of a 100-point scale. The ideal score on the posttest is 0, which means that the misleading information is completely rejected. Therefore, even though inoculations are effective in rejection of misleading information, participants are still not convinced that scientists are unable to artificially create mammals. They are stuck in the middle and evaluate the authenticity of the statement lower after the inoculation on a minimal level. As previously mentioned, the case and statements could have influenced these scores as well. Yet, the inoculations used in this study are not able to eliminate the effects of misleading information but are effective in decreasing the effects.

The elimination of the continued influence effect or a total rejection of misleading information may be, in this case, too ambitious. The ideal score on the posttest of 0 is unlikely to be reached with only one experiment. Future research can work to a more achievable goal, for example 35. The posttest scores of the inoculation conditions in this study were 43.61 and 50.69, so 35 would already be a challenging aspiration. In such a study, an inoculation is expected to protect people against misleading information in a way that the authenticity of the misleading information will be evaluated as 35% true. As suggested before, the questions that Ecker et al. (2010) used to check the continued influence effect can be used as well in future research. If that is the case, the questions combined can produce a score. For example, every right answer is afforded with zero points and every wrong answer receives five points. A total of 100 points can be achieved with the 20 questions. The maximum score that the participants might achieve is, in that case, 35 (i.e., seven wrong answers). A possible research question for an investigation like that can be the same as used in this study, only with a different measure for the dependent variable: “To what extent is it possible to inoculate people against misleading information?”

**Inoculations.** Facebook has adjusted their algorithm, hired fact-checkers and started working with so-called ‘trust-indicators’ to detect and mark fake news articles (Kreijveld, 2018). It takes up to three days before fake news is labeled as such, which is too long in a social media context (Kreijveld, 2018). This study found that it is possible to inoculate people against the effects of misleading information and is the first in examining these inoculation effects in a social media context (i.e., Facebook). The materials used in the experiment looked like screenshots from Facebook, which implied that the participants came across the message on Facebook. Future research could focus on developing this inoculation in different social media contexts as well. This study used a pop-up as inoculation, yet a disclosure could achieve the

same effects. A warning that you might come across misleading information can be presented at the top of a news article, just like a sponsorship disclosure in a blog (e.g., Van Reijmersdal et al., 2016). A small text message may be effective in increasing the rejection of misleading information and applicable in a social media context. The use of a disclosure might be a contribution to the recognition of fake news. The text that was used in the inoculation in this study might be shown at the top of an article, or at a later stage it might say ‘Believe everything you read on Facebook. Believe everything you see on Instagram. Believe everything you read on the internet’, but that depends on the research concerning reverse psychology. The inoculation in a disclosure might make people reject misleading information beforehand. Additionally, trust-indicators might evoke resistance, because it might be perceived as a threat to freedom. The presence of an inoculation might make these trust-indicators unnecessary.

Future research can focus on optimizing a disclosure as inoculation and may start with the research question: “To what extent does a disclosure play a role in the successfulness of an inoculation in decreasing the effects of misleading information?”

This study used a pop-up for the inoculation. Since this was externally valid, applicable in a social media context, and turned out to be effective, future research could focus on the optimization of a pop-up as inoculation. For example, with forced exposure (Fransen et al., 2015) of the pop-up with a timed option to close it. The experimental design can be similar to the one use in this study, only expanded with clickable screenshots.

### **To conclude**

This study tried to contribute to a new field of research concerning resistance to inoculation. Since only one Master’s thesis had examined this, minimal existing literature could be used to substantiate any choices. This made this experiment exciting and challenging at the same time. The effectiveness of inoculation was examined in this research as well but was taken a step further by applying it to a social media context. The external validity of the inoculation was a goal which was achieved. Lots of opportunities exist to further explore the possibilities of inoculation to decrease effects of misleading information. Only few are presented in this paper, but many more are available.

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## Appendices

### Appendix A – Self-affirmation

*Table 3.* Division of the statements across the values. The numbers represent the statements. The bottom shows that all values have ten corresponding statements.

Theoretical	Economical	Social	Political	Aesthetic	Religious
1	1	1	1	-	-
2	-	-	2	2	2
3	3	3	-	3	-
-	4	-	4	4	4
5	5	5	-	-	5
-	-	6	6	6	6
7	7	-	7	-	7
-	8	8	8	8	-
9	-	9	-	9	9
10	10	-	10	10	-
11	-	11	11	-	11
-	12	12	-	12	12
13	13	13	13	-	-
-	-	14	14	14	14
15	15	-	-	15	15
10	10	10	10	10	10

Dutch statements and multiple-choice answers:

1. Een goede regering zou zich voornamelijk moeten richten op:
  - a. Meer zorg voor armen, zieken en ouderen.
  - b. De ontwikkeling van productieprocessen en handel.
  - c. Het introduceren van de hoogst ethische principes in haar beleid en diplomatiek.
  - d. Het realiseren van een positie van respect en aanzien onder landen.
2. Een persoon die de hele week op kantoor werkt kan op zondag volgens jou het best:
  - a. Zichzelf iets leren door het lezen van serieuze boeken.
  - b. Proberen te winnen in een sportwedstrijd.
  - c. Een optreden van een orkest bezoeken.
  - d. Naar een goede preek luisteren.
3. Als ik het onderwijsbeleid van scholen kon beïnvloeden, zou ik me richten op:
  - a. Het promoten van de studie van muziek en beeldende kunst.
  - b. Het stimuleren van de studie van sociale problemen.
  - c. Het bieden van extra laboratorium voorzieningen.
  - d. Het verhogen van de praktische relevantie van vakken.

4. Ik sluit het liefst vriendschappen met mensen die:
  - a. Efficiënt en industrieel zijn en die praktisch kunnen denken.
  - b. Serieus geïnteresseerd zijn in het overdenken van hun houding tegenover het leven als geheel.
  - c. Beschikken over leiderschaps- en organisatie kwaliteiten.
  - d. Artistieke en emotionele gevoeligheid tonen.
5. Als ik in een kleine plaats woonde en meer dan genoeg inkomen had, zou ik het geld het liefst:
  - a. Productief inzetten om de economie en industrie te stimuleren.
  - b. Gebruiken om de activiteiten van lokale religieuze groepen te ontwikkelen.
  - c. Besteden aan de ontwikkeling van lokaal wetenschappelijk onderzoek.
  - d. Doneren aan een goed doel voor het welzijn van kinderen.
6. Als je naar een theater gaat, geniet je dan het meest van:
  - a. Toneelstukken over het leven van beroemde personen.
  - b. Ballet, opera, of soortgelijke artistieke optredens.
  - c. Toneelstukken die gaan over menselijk lijden en liefde.
  - d. Drama's die de dilemma's en paradoxen van het leven behandelen.
7. Aangenomen dat je over voldoende kwaliteiten beschikt en dat het salaris van alle beroepen hetzelfde is, welk beroep zou je dan het liefst uitoefenen?
  - a. Wiskundige.
  - b. Salesmanager.
  - c. Iets in de kerk (priester, pastoor, etc....).
  - d. Politicus.
8. Als je voldoende vrije tijd en geld had, zou je dan het liefst:
  - a. Een collectie van beelden en schilderijen verzamelen.
  - b. Een centrum voor de verzorging en training van invaliden oprichten.
  - c. Jezelf richten op politiek of een plek in het kabinet.
  - d. Een winstgevend eigen bedrijf oprichten en de opbrengsten zelf houden.
9. Ik discussieer het liefst met vrienden over:
  - a. De zin van het leven.
  - b. Wetenschappelijke ontwikkelingen.
  - c. Literatuur.
  - d. Armoede en het verbeteren van sociaal welzijn.

10. Wat zou je het liefst willen doen tijdens je volgende zomervakantie (aangenomen dat je over de juiste kwaliteiten bezit en je het je kan veroorloven):
- Een wetenschappelijk artikel schrijven en publiceren.
  - Verblijven in een afgelegen gebied waar je mooie landschappen kan bekijken.
  - Meedoen aan een lokaal tennis- of ander sporttoernooi.
  - Ervaring opdoen in een nieuwe bedrijfstak.
11. Ontdekkingen zoals die van Columbus zijn belangrijk omdat:
- Ze laten zien dat mensen alle krachten van de natuur kunnen overwinnen.
  - Ze bijdragen aan onze kennis van geografie, meteorologie, oceanologie, etc.
  - Ze menselijke interesses en internationale gevoelens over de hele wereld verenigen.
  - Ze elk op hun eigen manier bijdragen aan het ultieme begrip van het universum.
12. Iemand zou zijn gedrag en trouw moeten baseren op:
- Zijn of haar religieuze geloof.
  - Schoonheidsidealen.
  - Zijn of haar bedrijf en medewerkers.
  - Naastenliefde.
13. Welke van deze personen spreekt jou het meeste aan?
- Moeder Theresa.
  - Michiel de Ruyter.
  - Bill gates.
  - Marie Curie.
14. Als levenspartner zie ik het liefst iemand die:
- Succesvol is in zijn of haar beroep en aanzien heeft.
  - Het fijn vindt om anderen te helpen.
  - Voornamelijk spiritueel is ingesteld in zijn of haar houding tegenover het leven.
  - Artistieke kwaliteiten in huis heeft.
15. Ik zie Leonardo da Vinci's schilderij "Het laatste avondmaal" voornamelijk als:
- Een uitdrukking van de hoogst mogelijke spirituele ambities en emoties.
  - Een van de meest onbetaalbare en onvervangbare schilderijen ooit gemaakt.
  - In relatie tot Leonardo's veelzijdigheid en zijn plaats in de geschiedenis.
  - De essentie van harmonie en design.

## Appendix B - Case

**Truth or Fiction.** A group of scientists of the famous State Research Center of Virology and Biotechnology VECTOR (Государственный научный центр вирусологии и биотехнологии Вектор), based in Koltsovo, Russia, announced this morning that they had successfully given life to the first human baby grown entirely in vitro and created from reprogrammed stem cells.

After working for 2 years on a controversial project, reminiscent of that of the young doctor who created a grotesque but sentient creature through an unorthodox scientific experiment in Mary Shelley's famous novel, *Frankenstein*, Dr. Ivanov and his team gave life to an artificially created young boy in their biotechnology lab, located in southern Russia.

The baby, who is simply named Adam, was "born" on June 12, in a laboratory of the research center. He weighs only 400 grams and is barely seven inches (18 cm) tall, but the experts believe that his chances of survival are very good.

**Snopes.** A group of scientists of the famous State Research Center of Virology and Biotechnology VECTOR (Государственный научный центр вирусологии и биотехнологии Вектор), based in Koltsovo, Russia, announced this morning that they had successfully given life to the first human baby grown entirely in vitro and created from reprogrammed stem cells.

"This is a very exciting advance and it's also very tantalizing in terms of the wider fields of medicine and science," says the famous geneticist, Dr. Alexei Nicolaïevitch Ivanov, who directs the project. "The ability to create an entire human being from simple cells, in a lab, is definitely one of the 'holy grails' in medicine. This is a major breakthrough! For the first time, we literally created intelligent life from scratch!"

## Misleading information article

### *Wetenschappers creëren muis in lab*

Een groep wetenschappers van het beroemde staatsonderzoekscentrum voor virologie en biotechniek VECTOR, gevestigd in Koltsovo, Rusland, meldde vanmorgen dat ze met succes de eerste levende muis hebben gecreëerd, in een lab met behulp van hergeprogrammeerde stamcellen.

Na 2 jaar gewerkt te hebben aan het controversiële project gaven Dr. Ivanov en zijn team het leven aan een kunstmatig gecreëerd muisje in hun lab voor biotechnologie, gevestigd in het zuiden van Rusland. Het muisje, Mickey genoemd, is "geboren" op 12 juni, in een van

de laboratoria van het onderzoekscentrum. De experts denken dat de overlevingskansen groot zijn.

“Dit is een grote doorbraak die veel betekent voor de geneeskunde en de wetenschap in het algemeen,” aldus de expert in ornithologie Dr. Alexei Nicolaïevitch Ivanov, die het project leidt. “Onze onderzoeksgroep is erin geslaagd om nieuw leven te creëren door stamcellen de functie van geslachtscellen te laten overnemen. De volgende stappen zijn het zorgvuldig monitoren van de groei en ontwikkeling van Mickey en het ontwikkelen van de techniek voor toepassing bij grotere zoogdieren. Met name voor zoogdieren die met uitsterven worden bedreigd, kan deze techniek het voortbestaan van de soort in de toekomst mogelijk veiligstellen.”

### Appendix C - Stimuli



Figure 6. The Facebook timeline.



Figure 7. The inoculation.



Figure 8. Article.