Routledge
Taylor & Francis Group

Environmental Communication

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/renc20

Combatting Climate Disinformation: Comparing the Effectiveness of Correction Placement and Type

Clara Christner, Pascal Merz, Berend Barkela, Hermann Jungkunst & Christian von Sikorski

To cite this article: Clara Christner, Pascal Merz, Berend Barkela, Hermann Jungkunst & Christian von Sikorski (2024) Combatting Climate Disinformation: Comparing the Effectiveness of Correction Placement and Type, Environmental Communication, 18:6, 729-742, DOI: 10.1080/17524032.2024.2316757

To link to this article: https://doi.org/10.1080/17524032.2024.2316757

ENVIRONMENTAL COMMUNICATION
2024, VOL. 18, NO. 6, 729–742
https://doi.org/10.1080/17524032.2024.2316757

Routledge
Taylor & Francis Group

RESEARCH ARTICLE

OPEN ACCESS Check for updates

Combatting Climate Disinformation: Comparing the Effectiveness of Correction Placement and Type

Clara Christner[a], Pascal Merz[a], Berend Barkela[a], Hermann Jungkunst[b] and Christian von Sikorski[a]

[a]Institute for Communication Psychology and Media Education, University of Kaiserslautern-Landau, Landau, Germany; [b]Institute for Environmental Sciences, University of Kaiserslautern-Landau, Landau, Germany

ABSTRACT

In this study, we investigated whether corrections can combat climate disinformation. Using a preregistered quota-based online experiment in Germany ($N = 1401$), we tested how the effectiveness of disinformation correction in reducing climate misperceptions was influenced by correction placement (prebunking or debunking) and correction type (focused on facts, logic, or the combination of both). We investigated how populist radical-right (PRR) attitudes moderate the effect of disinformation correction and whether correction alleviates the negative effects of disinformation on efficacy beliefs to mitigate climate change (EBMCC) through reduced misperceptions. All debunking conditions and the logic-focused prebunking condition significantly reduced climate misperceptions. Prebunking was only effective under the logic-focused correction condition. We found no moderating effect of PRR attitudes on climate misperceptions, suggesting that corrections similarly benefitted all participants. In addition, a significant indirect effect of corrections was observed on EBMCC via climate misperceptions.

ARTICLE HISTORY
Received 21 December 2022
Accepted 5 February 2024

KEYWORDS
Climate disinformation; corrections; PRR attitudes; efficacy beliefs; experiment

Responses to climate change are hampered by disinformation (e.g. Lewandowsky, 2021). Such climate disinformation is defined as false or misleading information that systematically questions the anthropogenic nature of climate change or confuses public debate to justify inaction to mitigate climate change (e.g. Treen et al., 2020). Although very similar to the overarching concept of misinformation, disinformation is actively created and disseminated, for example, by conservative think tanks or political parties (Lewandowsky, 2021). Climate disinformation is particularly prevalent on social media platforms that favor the creation and dissemination of disinformation by design (e.g. Treen et al., 2020). Misperceptions resulting from exposure to disinformation threaten societal discourses and undermine efforts to mitigate climate change. Hence, it is crucial to correct climate disinformation and respective misperceptions.

Previous research has shown that corrections are effective (e.g. Walter & Murphy, 2018). However, research on disinformation corrections still contains several research gaps. First, it remains unclear whether different correction placements (i.e. prebunking or debunking) and correction types (i.e. fact-focused, logic-focused) are more effective in combatting (climate) disinformation (see Ecker et al., 2022). Second, more research is needed to explore if corrections' effectiveness is

CONTACT Clara Christner clara.christner@rptu.de Institute for Communication Psychology and Media Education, University of Kaiserslautern-Landau, Fortstraße 7, Landau 76829, Germany
Supplemental data for this article can be accessed online at https://doi.org/10.1080/17524032.2024.2316757.

limited by prior attitudes (Ecker & Ang, 2019; Thorson, 2016). In particular, populist radical-right (PRR) attitudes may increase vulnerability to (climate) disinformation and resistance to correction (e.g. Forchtner et al., 2018; Huber, 2021). Third, effects of disinformation and their correction on relevant behavior or its prerequisites are unclear (Dias & Sippitt, 2020). This is highly relevant, especially in the context of climate disinformation. Although climate disinformation previously aimed to question or deny the anthropogenic nature of climate change, climate change discourses today have shifted away from "outright denial" toward "discourses of delay" (e.g. Coan et al., 2021; Lamb et al., 2020). They aim to justify inaction or inadequate efforts to mitigate (the effects of) climate change or to undermine support for specific policies meant to address climate change, for example by reducing efficacy beliefs to mitigate climate change (McAllister et al., 2021; Schmid-Petri et al., 2015). Finally, previous studies have a strong focus on the US, limiting the generalizability of findings across different countries.

We addressed these research gaps in a preregistered online survey experiment using a quota sample representative of the German population ($N = 1401$). Drawing from the debunking literature (e.g. Chan et al., 2017) and inoculation theory (McGuire, 1961), we varied all combinations of correction placement (prebunking, debunking) and type (fact-focused, logic-focused, and fact-logic-combined) to systematically compare their effectiveness. In addition, we employed two control conditions (unrelated information and disinformation-only). Second, we investigated whether the effectiveness of corrections was influenced by PRR attitudes. Third, we explored the effects of corrections on efficacy beliefs to mitigate climate change (EBMCC; e.g. Angill-Williams & Davis, 2022).

Correction placement and types

In general, two strategies for responding to disinformation can be distinguished: placing the correction before the disinformation (prebunking) or after the disinformation (debunking; e.g. Ecker et al., 2022; Tay et al., 2022). *Prebunking* aims to reduce the persuasiveness of disinformation before it is encoded by preemptively correcting and thus helping people recognize the disinformation (e.g. Ecker et al., 2022; van der Linden et al., 2017). While there are several approaches to prebunking (e.g. Brashier et al., 2021; Cook et al., 2017; Lewandowsky & van der Linden, 2021), the most common framework is the inoculation theory (Compton, 2012; McGuire, 1961). The basic idea of inoculation theory is to expose people to a weakened version of the persuasive message to build "attitudinal resistance against future unwanted persuasion attempts" (Roozenbeek et al., 2022, p. 4). Inoculation theory combines two key elements: a threat warning regarding the appearance of disinformation and the identification of the misleading technique or logical fallacy underlying the persuasive intent (e.g. van der Linden et al., 2017). *Debunking* aims to reduce the reliance on disinformation after it is encoded by retroactively correcting the disinformation and demonstrating why it is false (Ecker et al., 2022; Tay et al., 2022; Walter & Murphy, 2018). By providing people with corrective messages aimed at disproving inaccurate factual claims, the goal is to help them reduce misperceptions and update their beliefs (e.g. Dai et al., 2021). Debunking is often used synonymously with fact-checking. However, it only pertains to correcting false and misleading information (Roozenbeek et al., 2022).

Previous research has shown that both prebunking and debunking effectively counter disinformation. A meta-analysis showed that debunking corrections reduce, although not entirely mitigate, misperceptions (Walter & Tukachinsky, 2020), and studies have shown that debunking can curb the spread of disinformation on social media (e.g. MacFarlane et al., 2021). Similarly, studies have shown the effectiveness of prebunking interventions (e.g. Schmid-Petri & Bürger, 2022; Traberg et al., 2022; van der Linden et al., 2017).

However, thus far, comparative research is scarce and prebunking and debunking strategies are primarily studied separately (Dai et al., 2021). In a meta-analysis of correction strategies, Walter and Murphy (2018) found debunking to be more effective than prebunking. However, this meta-analysis mainly relied on studies that did not directly compare prebunking and debunking. Research that

directly compares the placement of corrections is mixed. Some studies found prebunking messages to be more effective (Bolsen & Druckman, 2015; Jolley & Douglas, 2017), while others found debunking messages to be more effective (Brashier et al., 2021; Dai et al., 2021). Still, other studies found no difference between prebunking and debunking (Tay et al., 2022) or showed no effect at all (Bolsen & Druckman, 2018).

In addition to placement, different correction types can be distinguished. The most common correction types are *fact-focused corrections*, which directly address inaccuracies in the disinformation and provide recipients with accurate information that rebut the disinformation (e.g. Brashier et al., 2021; Ecker et al., 2022). Increasingly, researchers have investigated the effectiveness of *logic-focused corrections*, which directly address the logical fallacy of disinformation. Logic-focused corrections explain or unmask the rhetorical techniques used to mislead recipients, such as citing fake experts and oversimplification (e.g. Cook et al., 2018; Roozenbeek et al., 2022; Vraga et al., 2020). When individuals are aware of such techniques, they better resist persuasive attempts (Friestad & Wright, 1994), and misperceptions can be reduced (e.g. Schmid & Betsch, 2019). Furthermore, logic-focused corrections are advantageous since they can be generalized across different topics and thus have the potential to counter a range of disinformation (e.g. Vraga et al., 2020). Finally, fact- and logic-focused elements can be *combined* in a single correction (e.g. Ecker et al., 2022; Schmid & Betsch, 2019; van der Linden, 2022).

Similar to correction placement, research so far has shown that both fact-focused (e.g. Amazeen et al., 2018; Barrera et al., 2020) and logic-focused corrections (e.g. van der Linden et al., 2017; Vraga et al., 2019) can effectively counter disinformation. However, there is a lack of research regarding which correction type is the most effective or whether a combination is better. Initial comparative findings are mixed (Dai et al., 2021; Ecker et al., 2022; van der Linden, 2022). Schmid and Betsch (2019) found no difference between correction strategies, nor did they find additional benefits of using combined corrections. To the best of our knowledge, only one study to date has investigated correction placement and type in conjunction with each other: For corrections of climate disinformation on Instagram with humorous messages, Vraga et al. (2020) found fact-focused debunking to be more effective than fact-focused prebunking. For logic-focused corrections, prebunking and debunking were equally effective. However, the combination of fact- and logic-focused elements was not considered.

Following previous research, we assumed that corrections are generally effective:

> H1: Individuals exposed to climate disinformation with a correction possess lower levels of climate misperception than individuals who are not exposed to a correction.

Moreover, we strove for a direct comparison between different correction placements and types. Since previous findings on the superiority of specific correction placement and types are mixed, we additionally formulated the following research question:

> RQ1: How does (a) correction type (fact-focused, logic-focused, combined), (b) correction placement (prebunking, debunking), and (c) the interaction of type and placement affect climate misperceptions?

PRR attitudes

Previous research has highlighted the need to consider individual's preexisting attitudes when attempting to understand the impact of corrections (Ecker & Ang, 2019; Hameleers, 2022; Hameleers & van der Meer, 2020; Thorson, 2016). In the context of (climate) disinformation, right-wing ideology and populism are especially relevant (Huber, 2021; Lewandowsky, 2021). *PRR attitudes*, might condition the effectiveness of corrections since it can be assumed that while climate disinformation is consistent, corrections are inconsistent with PRR attitudes. However, the influence of PRR attitudes on the effectiveness of corrections has thus far only been assumed.

Research has highlighted the pervasive association between radical right-wing populism and climate skepticism (Huber, 2021; Lockwood, 2018) but also a general affinity between (radical right-wing) populism and disinformation (e.g. Waisbord, 2018). The core elements of radical-right-wing

populism are populism, nativism, and authoritarianism (Mudde, 2007). Populism is defined as a thin-centered ideology "that considers society to be ultimately separated into two homogenous and antagonistic groups, 'the pure people' versus the 'corrupt elite', and which argues that politics should be an expression of the volonté générale (general will) of the people" (Mudde, 2004, p. 543). In right-wing populism, the thin-centered populist ideology is accompanied by two thick ideologies, namely nativism, defined as an illiberal form of nationalism in which the native state is threatened by non-native elements (i.e. persons or ideas) and authoritarianism, which refers to a preference for maintaining law and order and social conformity at the detriment of individual autonomy (Mudde, 2007).

The relationship between radical right-wing populism and climate skepticism can first be explained by the followers of right-wing populist parties, who often represent people who work in sectors endangered by climate change policies and therefore reject them (structural approach; Lockwood, 2018). Second, elites are the central actors in climate change action, which right-wing populists mistrust. Therefore, right-wing populists oppose climate action (ideational argument; Lockwood, 2018; see also Huber, 2021). Third, Fraune and Knodt (2018) highlight the post-truth or anti-science worldview that underlies populism and favors the rejection of climate science.

Studies have shown that disinformation is especially difficult to correct and can continue to influence and persuade individuals' attitudes (Seifert, 2002; Walter & Tukachinsky, 2020), when it is closely related to ideology (Lewandowsky et al., 2012; Thorson, 2016). Following the theory of motivated reasoning and the theory of cognitive dissonance (Taber & Lodge, 2006; see also van der Linden, 2022), the reduced effectiveness of corrections can be explained by an individuals' tendency to evaluate information in a biased manner to maintain consistency with preexisting beliefs (see e.g. Ecker & Ang, 2019; Hameleers & van der Meer, 2020). Incongruent information might be rejected, whereas supportive information might be accepted, irrespective of its veracity (Hameleers & van der Meer, 2020; Thorson, 2016). Several studies have provided evidence for a higher likelihood of rejection of counter-arguing corrections (e.g. Nyhan & Reifler, 2010; Nyhan et al., 2013, 2014). Some have even warned of a possible worldview backfire effect, meaning that corrections to ideological disinformation could actually reinforce false beliefs in some individuals, ironically strengthening the misconceptions they are intended to correct (e.g. Lewandowsky et al., 2012). However, today, the possible danger of a backfire effect is rather low (for a discussion, see Ecker et al., 2022, p. 18). Yet, other studies have shown that corrections can also correct attitude-consistent disinformation (e.g. Hameleers, 2022) and are equally effective across the political spectrum, neutralizing the polarizing influence of misinformation (Cook et al., 2017).

Based on this state of research we assumed that individuals with stronger PRR attitudes are more likely to have congruent attitudes toward climate disinformation and that incongruent attitudes towards corrections can impair the effects of corrections:

> H2: Corrections have a weaker effect for participants with higher levels of PRR attitudes than for individuals with lower levels of PRR attitudes.

Furthermore, previous research allows only limited conclusions about which forms of placement and type of correction might be more or less effective for individuals with more pronounced PRR attitudes. Thus, in addition to our hypothesis, we also explored the question:

> RQ2: How do PRR attitudes moderate the effects of (a) correction type, (b) correction placement, and (c) the interaction of correction type and placement on climate misperceptions?

Efficacy beliefs to mitigate climate change (EBMCC)

As discussed so far, studies have shown that corrections can effectively counteract disinformation by reducing false knowledge or misperceptions (e.g. Chan et al., 2017; Lewandowsky & van der Linden, 2021; Walter & Murphy, 2018). However, only limited research has investigated the effects of disinformation and their corrections on relevant behavior or its prerequisites (Dias & Sippit, 2020;

York et al., 2020). Since climate disinformation strategically targets inaction or inadequate efforts to mitigate (the effects of) climate change as part of "discourses of delay" (e.g. Coan et al., 2021; Lamb et al., 2020), it is directed against the fundamental belief that individual and collective action to mitigate climate change is both possible (self and collective efficacy) and effective (response efficacy), hence EBMCC (Angill-Williams & Davis, 2022; Crosman et al., 2019). Following Bandura's self-efficacy theory (Bandura, 1997), efficacy beliefs depend on available information. Hence, if EBMCC depend on available information, disinformation might negatively affect EBMCC and corrections should have a remedial potential.

However, so far, research on climate disinformation and EBMCC is scarce and research so far indicated that climate messages can positively but also negatively affect efficacy beliefs (Hart & Feldman, 2016) and the framing of climate change influences the likelihood of action to address it (Mayer & Smith, 2019). Climate disinformation lowers the acknowledgement of climate change (Ranney & Clark, 2016) and support of mitigation policies (e.g. Treen et al., 2020). Furthermore, exposure to climate change conspiracy theories reduces people's intention to reduce their carbon footprint (Douglas & Sutton, 2015; Jolley & Douglas, 2014; van der Linden, 2015). Similar to disinformation, false claims about COVID-19 can influence the perceived efficacy of countermeasures (Chung & Jones-Jang, 2022; Dada et al., 2021).

Due to limited research and high uncertainty surrounding the potential direct and indirect effects on efficacy beliefs, particularly distinct effects of different correction conditions, we explored the effectiveness of climate disinformation and their correction on EBMCC asking the following research question:

> RQ3: Do corrections – varying in (a) correction type, (b) correction placement, and (c) the interaction of correction type and placement – affect EBMCC indirectly via climate misperceptions?

Methods

Participants

To test the hypotheses and investigate the research questions, we conducted a preregistered[1] online survey experiment in Germany.[2] We recruited participants via a commercial panel (Bilendi) between 8 and 16 September 2022, using quotas based on age, gender, and education. In total, $N = 1401$ participants completed our study. Participants were, on average, 46.64 years ($SD = 14.99$) old, and 50.17% were female; 30.91% had low, 31.38% had medium, and 37.62% had high levels of education (for more information regarding data quality and quotas, see online appendix Tables A1 and A2).

Experimental design

All participants were told that they would participate in a study on climate change discourses on social media. After a short demographic questionnaire, they were randomly distributed among 6 correction conditions (3x type: fact-focused, logic-focused, fact/logic-combined; 2x placement: prebunking, debunking) and 2 groups without correction (disinformation only, control), resulting in a between-subject design with 8 groups: (1) fact-focused prebunking ($n = 176$), (2) logic-focused prebunking ($n = 176$), (3) combined prebunking ($n = 176$), (4) fact-focused debunking ($n = 176$), (5) logic-focused debunking ($n = 172$), (6) combined debunking ($n = 175$), (7) disinformation only (no correction, $n = 176$), and (8) control (unrelated information, $n = 174$).

Depending on the condition, participants were either shown two stimuli (disinformation preceded or followed by correction for the six correction conditions) or one stimulus (disinformation-only group, control group) in the format of a social media post (see online appendix Tables B1 and B2). To ensure adequacy and factuality of disinformation and correction, we

interdisciplinary collaborated with the environmental sciences and intensively discussed the state-of-the-art evidence on climate science and mitigation strategies.

As climate disinformation we decided for a post claiming that CO_2 was a plant food and therefore even more CO_2 emissions were good for world nutrition.[3] We chose this disinformation for several reasons. First, by questioning the reduction of greenhouse gas emissions, it undermines the essential measure of climate change mitigation (IPCC, 2023) and therefore is an adequate strategic climate disinformation. Second, it was propagated in the election program of the German right-wing populist party Alternative for Germany, and corrected by several fact-checking organizations (see e.g. Paal, 2021), hence it is representative for existing disinformation and correction. Third, it was already investigated in previous studies (e.g. Vraga et al., 2020), allowing for comparisons and integration of the state of research.

All corrections[4] were titled "Human-made CO_2 emissions can harm plants and their growth," established that "the positive effect of CO_2 on plant growth is more than offset by the negative effects of global warming" and ended with the efficacy appeal "by reducing CO_2, climate change can be limited." To manipulate *correction type*, a sub-headline and a paragraph were added to this general warning and rectification. The *fact-focused correction* was headed "These are the facts" and a subsequent paragraph directly addressed the inaccuracies in the disinformation and provided correct facts (e.g. Ecker et al., 2022). The *logic-focused correction* was headed "Be careful of logical fallacies" and the paragraph unmasked and explained the rhetorical technique of disinformation used to mislead audiences (e.g. Cook et al., 2018; Ecker et al., 2022). In the *combined correction* both fact- and logic-focused correction were shown. To manipulate *correction placement,* the correction post appeared either directly before the disinformation post (*prebunking*) or directly after the disinformation post (*debunking*) (e.g. Vraga et al., 2020). In the control group, participants were exposed to an unrelated post about homework in schools.

After viewing the social media post(s), participants rated their climate misperception and efficacy beliefs to mitigate climate change (EBMCC), answered questions about their political attitudes, and completed a manipulation check. Finally, the participants were fully debriefed.

Measures

Climate misperceptions were assessed by asking participants to indicate their agreement with a statement that directly targeted climate disinformation and correction: "CO_2 is plant food so CO_2 emissions are good for plants" (Vraga et al., 2020) on a scale from 1 = *does not apply at all* to 7 = *completely applies* ($M = 4.08$, $SD = 1.78$).

Efficacy beliefs to mitigate climate change (EBMCC) were measured using six items translated and adapted from Bieniek-Tobasco et al. (2020) assessing self-efficacy (e.g. "As an individual, I can take specific steps to reduce CO_2 emissions"), collective efficacy (e.g. "As citizens, we can take specific steps to reduce CO_2 emissions"), and response efficacy (e.g. "The steps that I take as an individual to reduce CO_2 emissions can have a significant impact in reducing the effects of global warming") (1 = *completely disagree* to 7 = *completely agree*). The six items were aggregated into a scale ($M = 5.06$, $SD = 1.28$, $\alpha = 0.92$).

Populist radical-right (PRR) attitudes were measured by assessing the three constructs of populism, nativism, and authoritarianism (Maier et al., 2023; Mudde, 2007). Populist attitudes were measured with three dimensions: anti-elite attitudes, demand for popular sovereignty, and belief in the homogeneous virtuousness of the people (Schulz et al., 2018) on a scale from 1 = *completely disagree* to 7 = *completely agree* ($M = 4.73$, $SD = 0.95$, $\alpha = 0.83$). Nativist attitudes were measured using four items of the anti-immigrant attitudes scale by Akkerman et al. (2017) (e.g. "Immigrants increase crime in our country") on a scale from 1 = *does not apply at all* to 7 = *completely applies* ($M = 3.88$, $SD = 1.59$, $\alpha = 0.91$). Authoritarian attitudes were measured using an adapted version of the child-rearing values measure by Feldman and Stenner (1997). For four trait pairs, participants rated

which traits would be more desirable for a child to have, such as respect for elders vs. independence ($M = 3.03$, $SD = 0.76$, $\alpha = 0.62$), on a five-point semantic differential scale. To create the PRR attitudes scale, all 17 items were z-standardized due to their different scales and aggregated into one scale ($\alpha = 0.85$).

As *control variables* we considered age, gender, education and prior attitudes toward climate change. Prior attitudes toward climate change were measured by asking participants to rate their agreement with three statements about (1) the existence of climate change, (2) the human impact on climate change, and (3) climate change being a problem (Corner et al., 2012) on a scale from 1 = *completely disagree* to 7 = *completely agree* ($M = 5.54$, $SD = 1.39$, $\alpha = 0.90$).

Manipulation check

In total, eight t-tests were conducted to ensure that the manipulations worked as intended. The results revealed that the manipulations were successful and worked as intended (see online appendix Table C1). For example, to confirm that participants recognized the different correction types, we checked whether participants recognized the subline referring to the facts/warning against logical fallacies (i.e. "I saw a post with the subheading 'These are the facts'/'Beware of logical fallacies'") and the factual/logical elements.

Results

To determine whether the correction conditions reduced climate misperceptions (H1), we first compared all correction conditions with the disinformation-only condition. A regression analysis showed that climate misperceptions were significantly lower when people saw the fact-focused debunking ($B = -0.69$, $SE = 0.19$, $p < .001$), the logic-focused debunking ($B = -0.50$, $SE = 0.19$, $p < .01$), the combined debunking ($B = -0.73$, $SE = 0.19$, $p < .001$), or the logic-focused prebunking ($B = -0.45$, $SE = 0.19$, $p < .05$) correction compared to the disinformation-only post. However, climate misperceptions were not significantly different when people saw the fact-focused ($B = -0.28$, $SE = 0.19$, $p = .130$) or combined prebunking ($B = -0.32$, $SE = 0.19$, $p = .090$) compared to the disinformation-only post (see Figure 1 for means by condition and online appendix Table D1 for full regression model).

To examine the effects of correction placement and type on misperceptions (RQ1) a two-factor ANOVA (excluding the disinformation-only condition) was performed. Simple main effects analyses showed that the correction placement did have a significant effect on misperceptions ($F(1,1045) = 7.246$, $p = .007$), with debunking outperforming prebunking. There was no significant main effect of correction type ($F(2,1045) = 0.231$, $p = .928$) and no significant interaction between the factors of correction placement and correction type ($F(2,1045) = 1.175$, $p = .309$).

To test how PRR attitudes affect the effects of corrections on climate misperceptions, we ran a moderation model (Model 1) in PROCESS version 4.1.1 (Hayes, 2018). First, we combined all correction conditions and tested whether PRR attitudes moderate the effect of corrections (vs. the disinformation-only condition) on climate misperceptions (H2). We found no significant interaction between PRR attitudes and the combined corrections ($B = -0.02$, $SE = 0.25$, $p = .921$; see online appendix Table D2). Second, we explored whether PRR attitudes moderate the effect of the different correction conditions on climate misperceptions (RQ2). We found no significant interaction between PRR attitudes and the different correction conditions (see Table 1), although PRR attitudes showed a significant unconditional effect on climate misperceptions ($B = 1.16$, $SE = 0.09$, $p < .001$).

Finally, to examine whether corrections indirectly affected EBMCC via climate misperceptions (RQ3), we ran a mediation model (Hayes, 2018, Model 4 using 5000 bootstrap iterations), again comparing the correction conditions to the disinformation-only condition (Table 2). The results showed a significant effect of climate misperceptions on EBMCC ($B = -0.15$, $SE = 0.02$, $p < .001$). Looking at the indirect pathways, we find significant effects for all debunking corrections on

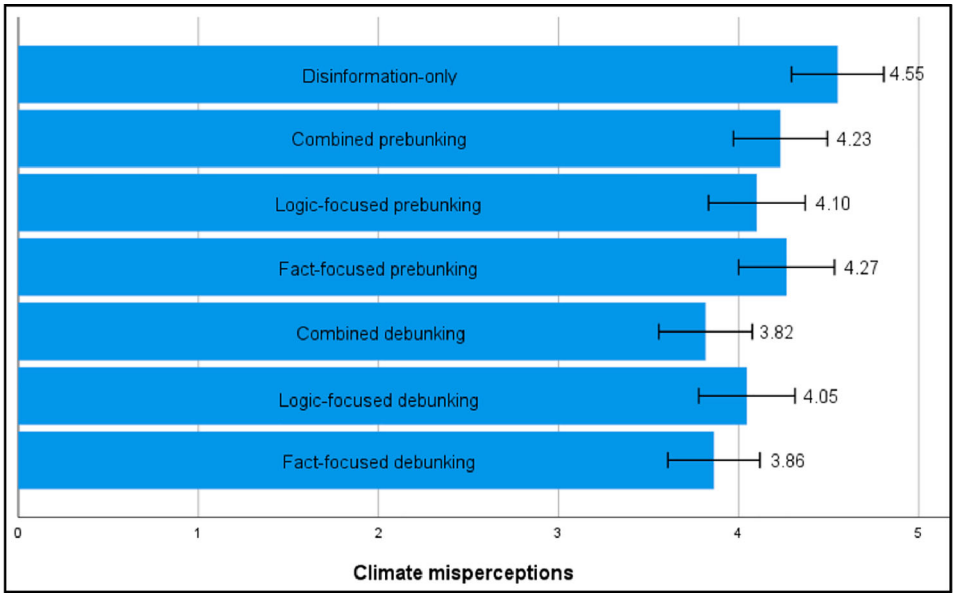

Figure 1. Effects of correction type and placement on climate misperceptions.

EBMCC via climate misperceptions (fact-focused: *ab* = 0.10, Boot-SE = 0.03, BootCI [0.044, 0.169], logic-focused: *ab* = 0.07, Boot-SE = 0.03, BootCI [0.020, 0.139], and combined: *ab* = 0.11, Boot-SE = 0.03, BootCI [0.049, 0.177]). Within the prebunking conditions, only the logic-focused correction was significant (*ab* = 0.07, Boot-SE = 0.03, BootCI [0.012, 0.129]). We found no significant indirect effect for the fact-focused (*ab* = 0.04, Boot-SE = 0.03, BootCI [−0.011, 0.101]) or combined prebunking condition (*ab* = 0.05, Boot-SE = 0.03, BootCI [−0.006, 0.106]). In other words, correction conditions that significantly reduced climate misperceptions (i.e. all debunking corrections and logic-focused prebunking) also indirectly increased EBMCC. To check the robustness of the results, we additionally included PRR attitudes, attitudes toward climate change, as well as age, gender, and education as covariates. With covariates, climate misperceptions no longer remained a significant

Table 1. Linear regression models: effect of correction conditions (vs. no correction) (IV) on climate misperception (DV) moderated by PRR attitudes (Mo) (*N* = 1227).

	Climate misperception					
	Model 1			Model 2		
	B	*SE*	*p*	*B*	*SE*	*p*
Constant	4.59	.12	<.001	4.60	.12	<.001
Fact-focused debunking	−.67	.18	<.001	−.66	.18	<.001
Logic-focused debunking	−.58	.18	.001	−.58	.18	.001
Combined debunking	−.77	.18	<.001	−.77	.18	<.001
Fact-focused prebunking	−.45	.18	.010	−.48	.18	.007
Logic-focused prebunking	−.51	.18	.004	−.51	.18	.004
Combined prebunking	−.31	.18	.072	−.32	.18	.070
PRR attitudes[a]	1.16	.09	<.001	1.19	.23	<.001
Fact-focused debunking*PRR				.08	.32	.799
Logic-focused debunking*PRR				−.20	.34	.563
Combined debunking*PRR				−.11	.33	.736
Fact-focused prebunking*PRR				.23	.33	.479
Logic-focused prebunking*PRR				−.10	.32	.764
Combined prebunking*PRR				−.12	.34	.731
R^2	.135			.143		

Note: [a]z-standardized PRR attitudes scale.

Table 2. Mediation model: effect of correction conditions (IV) on EBMCC (DV) through climate misperceptions (M) ($N = 1227$).

	DV: Climate misperceptions			DV: EBMCC		
	B	*SE*	*p*	*B*	*SE*	*p*
Constant	4.55	.13	<.001	5.65	.13	<.001
Fact-focused debunking	−.69	.19	<.001	−.10	.13	.460
Logic-focused debunking	−.50	.19	.007	−.12	.13	.385
Combined debunking	−.73	.19	<.001	.18	.13	.173
Fact-focused prebunking	−.28	.19	.129	−.10	.13	.452
Logic-focused prebunking	−.45	.19	.017	.01	.13	.942
Combined prebunking	−.32	.19	.089	.02	.13	.873
Climate misperceptions				−.15	.02	<.001
R^2	.018			.048		

Note: *B* = unstandardized effect size.

predictor of EBMCC (see online appendix Table D3), and none of the indirect effects of the correction conditions on EBMCC via climate misperceptions remained significant (see online appendix Table D4). However, the results also showed that despite the significant influence of attitudes toward climate change and education, the corrections (except for the combined prebunking condition) still significantly reduced climate misperceptions.

Discussion

This study examined disinformation and corrections in the context of climate change, an issue characterized by a significant distribution of disinformation (e.g. Lewandowsky, 2021; Treen et al., 2020). We make an important contribution to the literature concerned with corrections of climate disinformation by considering (1) a comparison of different placement and types, (2) highly relevant prior attitudes, and (3) effects beyond the reduction of misperceptions.

First, although previous research has investigated the effectiveness of different correction placements and types (Chan et al., 2017; Lewandowsky & van der Linden, 2021; Walter et al., 2020), thus far, only a few studies have simultaneously compared different combinations of these correction features (Schmid & Betsch, 2019; Vraga et al., 2020). We addressed this gap by systematically investigating the effectiveness of fact-focused, logic-focused, and combined corrections that occur either before (prebunking) or after (debunking) the disinformation. Overall, our results showed that corrections decreased climate misperceptions, but the effects differed across placement and type. In line with previous research (Brashier et al., 2021; Dai et al., 2021; Vraga et al., 2020), debunking outperformed prebunking. In the debunking condition, all three types of corrections (fact-focused, logic-focused, and combined) effectively reduced climate misperceptions. For the corrections that appeared before the climate disinformation (prebunking), only the logic-focused correction significantly reduced climate misperceptions, supporting the assumptions of inoculation theory (Compton, 2012; McGuire, 1961). Logic-focused corrections also effectively reduced misperceptions if shown after climate disinformation (debunking) (see Vraga et al., 2020). Therefore, in situations where it is unclear whether people have already been exposed to specific disinformation, logic-focused corrections are especially useful–independent of their placement. Furthermore, logic-focused corrections may have the advantage of empowering people to uncover other disinformation using similar misleading techniques (Cook et al., 2017; Schmid & Betsch, 2019). Thus, revealing misleading techniques, a central premise of inoculation theory (Compton, 2012; McGuire, 1961), can be a widely applicable approach to counter disinformation. However, our study provides no evidence that a combination of fact- and logic-focused corrections is superior to a single strategy, supporting previous findings (Schmid & Betsch, 2019). While combined debunking significantly reduced misperceptions, we found no significant effect of combined prebunking. We can only speculate what the reason for this is, but in addition to the length of the arguments, this is another indication that the effectiveness of certain approaches depends on the placement. Facts are

particularly effective, but our study shows that this is only the case when they are presented after disinformation.

Second, studies have shown that prior attitudes can reduce the effectiveness of corrections (e.g. Ecker & Ang, 2019). Previous research highlighted the role of right-wing populism (Huber, 2021; Lockwood, 2018). Thus, we examined the extent to which PRR attitudes lead people to reject corrections. In our moderation models we found no indication of a worldview backfire effect (see e.g. Ecker et al., 2022), meaning that PRR attitudes did not explain higher misperceptions after exposure to attitude-inconsistent corrections. Rather, corrections significantly reduced climate misperceptions for all participants, independent of PRR attitudes. However, climate misperceptions are generally higher among people with high PRR attitudes.

Third, to examine the effects of corrections beyond the reduction of misperceptions (e.g. Dias & Sippitt, 2020), we investigated the indirect effects of corrections of climate disinformation on EBMCC. In our mediation analyses–except for the fact-focused prebunking and combined prebunking conditions–corrections indirectly affected EBMCC through climate misperceptions. Hence, in line with previous research (York et al., 2020), corrections through verbal persuasion (Bandura, 1997) can alleviate the negative effects of climate disinformation on EBMCC. While corrections still reduced climate misperceptions when controlling for age, gender, education, and attitudes toward climate change, corrections no longer indirectly predicted EBMCC. In particular, attitudes toward climate change predicted both climate misperceptions and EBMCC, indicating that indirect effects of corrections may be masked by attitudes toward the issue. Thus, future research should investigate the role of prior attitudes more closely, as they might not only confound the effects of corrections on misperceptions but also on subsequent behavior or its prerequisites.

Finally, we contributed to the generalizability of previous findings that had a strong focus on the US. For the case of Germany, our results support previous research (e.g. Ecker et al., 2010; Vraga et al., 2020): Overall, correction can be effective in countering disinformation, although the effect is rather small, and a single correction cannot completely eliminate misperceptions. Furthermore, effects of corrections are affected by their placement and type as well as attitudes towards the issue.

Limitations

This study is not without limitations. First, we tested a single exposure and exposed participants to disinformation and correction, one after another. Consequently, we did not determine the extent to which the time between disinformation and correction might influence the effectiveness of corrections. Furthermore, we examined the effects directly after exposure to corrections, we cannot make any statement about how long the effects last or whether the duration of the effects depends on the type or placement. So far, results are mixed, suggesting long-lasting effects of debunking (e.g. Carnahan et al., 2021), as well as diminishing effects over time (e.g. Paynter et al., 2019). Future research should investigate the influence of time on different correction placement and type. Second, we tested disinformation about plant growth and CO_2 emissions and explained the logical fallacy of oversimplification, as done previously by Vraga et al. (2020). Therefore, our results help to generalize previous findings, but future research should also investigate other disinformation strategies and delay discourses. Third, in our experimental design both the materials and their reception were controlled by us, providing internal validity. However, the resulting lack of external validity could be addressed in future studies by investigating the reception of disinformation and corrections in natural reception environments.

Conclusion

In the light of our findings and existing research, we conclude that it is worthwhile to correct disinformation. Most reliably, fact- and logic-focused corrections after exposure to disinformation reduce misperceptions. Furthermore, logic-focused corrections are effective, independent of their

placement. In addition, effective correction apparently also reduces negative effects of disinformation on efficacy beliefs. Since our study indicates effective correction for individuals with high PRR attitudes on the one hand, but uncertain results with regard to attitudes towards the issue on the other, future research should especially focus on interactions of corrections and prior attitudes.

Notes

1. https://osf.io/yn7xv/?view_only=518dde62cc234e9990b366d95bcffb9f.
2. The procedure of the study was approved by the local ethical review board.
3. A fictitious page called "Klimawahrheiten" (translated: Climate Truths) was used as the source of the disinformation, which was created in the style of a real climate denial Facebook group.
4. The source of all corrections was the Germanophone fact-checking organization Correctiv.

Data availability

The dataset is available from the corresponding author on reasonable request.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by research grant from the strategy fund of the University of Koblenz-Landau and by a research grant from the research focus "Media, Democracy, and Citizens" of the University of Koblenz-Landau.

References

Akkerman, A., Zaslove, A., & Spruyt, B. (2017). 'We the people' or 'We the peoples'? A comparison of support for the populist radical right and populist radical left in the Netherlands. *Swiss Political Science Review*, *23*(4), 377–403. https://doi.org/10.1111/spsr.12275

Amazeen, M. A., Thorson, E., Muddiman, A., & Graves, L. (2018). Correcting political and consumer misperceptions: The effectiveness and effects of rating scale versus contextual correction formats. *Journalism & Mass Communication Quarterly*, *95*(1), 28–48. https://doi.org/10.1177/1077699016678186

Angill-Williams, A., & Davis, C. J. (2022). Increasing climate efficacy is not a surefire means to promoting climate commitment. *Thinking & Reasoning*, *28*(3), 375–395. https://doi.org/10.1080/13546783.2021.1979651

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman.

Barrera, O., Guriev, S., Henry, E., & Zhuravskaya, E. (2020). Facts, alternative facts, and fact checking in times of post-truth politics. *Journal of Public Economics*, *182*, 104123. https://doi.org/10.1016/j.jpubeco.2019.104123

Bieniek-Tobasco, A., Rimal, R. N., McCormick, S., & Harrington, C. B. (2020). The power of being transported: Efficacy beliefs, risk perceptions, and political affiliation in the context of climate change. *Science Communication*, *42*(6), 776–802. https://doi.org/10.1177/1075547020951794

Bolsen, T., & Druckman, J. N. (2015). Counteracting the politicization of science. *Journal of Communication*, *65*(5), 745–769. https://doi.org/10.1111/jcom.12171

Bolsen, T., & Druckman, J. N. (2018). Do partisanship and politicization undermine the impact of a scientific consensus message about climate change? *Group Processes & Intergroup Relations*, *21*(3), 389–402. https://doi.org/10.1177/1368430217737855

Brashier, N. M., Pennycook, G., Berinsky, A. J., & Rand, D. G. (2021). Timing matters when correcting fake news. *Proceedings of the National Academy of Sciences of the United States of America*, *118*(5), e2020043118. https://doi.org/10.1073/pnas.2020043118

Carnahan, D., Bergan, D. E., & Lee, S. (2021). Do corrective effects last? Results from a longitudinal experiment on beliefs toward immigration in the U.S. *Political Behavior*, *43*(3), 1227–1246. https://doi.org/10.1007/s11109-020-09591-9

Chan, M. S., Jones, C. R., Hall Jamieson, K., & Albarracín, D. (2017). Debunking: A meta-analysis of the psychological efficacy of messages countering misinformation. *Psychological Science*, *28*(11), 1531–1546. https://doi.org/10.1177/0956797617714579

Chung, M., & Jones-Jang, S. M. (2022). Red media, blue media, Trump briefings, and COVID-19: Examining how information sources predict risk preventive behaviors via threat and efficacy. *Health Communication*, *37*(14), 1707–1714. https://doi.org/10.1080/10410236.2021.1914386

Coan, T. G., Boussalis, C., Cook, J., & Nanko, M. O. (2021). Computer-assisted classification of contrarian claims about climate change. *Scientific Reports*, *11*(1), 22320. https://doi.org/10.1038/s41598-021-01714-4

Compton, J. (2012). Inoculation Theory. In *The SAGE Handbook of persuasion: Developments in theory and practice* (pp. 220–236). Sage. https://doi.org/10.4135/9781452218410

Cook, J., Ellerton, P., & Kinkead, D. (2018). Deconstructing climate misinformation to identify reasoning errors. *Environmental Research Letters*, *13*(2), 024018. https://doi.org/10.1088/1748-9326/aaa49f

Cook, J., Lewandowsky, S., & Ecker, U. K. H. (2017). Neutralizing misinformation through inoculation: Exposing misleading argumentation techniques reduces their influence. *PLoS One*, *12*(5), e0175799. https://doi.org/10.1371/journal.pone.0175799

Corner, A., Whitmarsh, L., & Xenias, D. (2012). Uncertainty, scepticism and attitudes towards climate change: Biased assimilation and attitude polarisation. *Climatic Change*, *114*(3), 463–478. https://doi.org/10.1007/s10584-012-0424-6

Crosman, K. M., Bostrom, A., & Hayes, A. L. (2019). Efficacy foundations for risk communication: How people think about reducing the risks of climate change. *Risk Analysis*, *39*(10), 2329–2347. https://doi.org/10.1111/risa.13334

Dada, S., Ashworth, H. C., Bewa, M. J., & Dhatt, R. (2021). Words matter: Political and gender analysis of speeches made by heads of government during the COVID-19 pandemic. *BMJ Global Health*, *6*(1), e003910. https://doi.org/10.1136/bmjgh-2020-003910

Dai, Y., Yu, W., & Shen, F. (2021). The effects of message order and debiasing information in misinformation correction. *International Journal of Communication*, *15*, 1039–1059.

Dias, N., & Sippitt, A. (2020). Researching fact checking: Present limitations and future opportunities. *The Political Quarterly*, *91*(3), 605–613. https://doi.org/10.1111/1467-923X.12892

Douglas, K. M., & Sutton, R. M. (2015). Climate change: Why the conspiracy theories are dangerous. *Bulletin of the Atomic Scientists*, *71*(2), 98–106. https://doi.org/10.1177/0096340215571908

Ecker, U. K. H., & Ang, L. C. (2019). Political attitudes and the processing of misinformation corrections. *Political Psychology*, *40*(2), 241–260. https://doi.org/10.1111/pops.12494

Ecker, U. K. H., Lewandowsky, S., Cook, J., Schmid, P., Fazio, L. K., Brashier, N., Kendeou, P., Vraga, E. K., & Amazeen, M. A. (2022). The psychological drivers of misinformation belief and its resistance to correction. *Nature Reviews Psychology*, *1*(1), 13–29. https://doi.org/10.1038/s44159-021-00006-y

Ecker, U. K. H., Lewandowsky, S., & Tang, D. T. W. (2010). Explicit warnings reduce but do not eliminate the continued influence of misinformation. *Memory & Cognition*, *38*(8), 1087–1100. https://doi.org/10.3758/MC.38.8.1087

Feldman, S., & Stenner, K. (1997). Perceived threat and authoritarianism. *Political Psychology*, *18*(4), 741–770. https://doi.org/10.1111/0162-895X.00077

Forchtner, B., Kroneder, A., & Wetzel, D. (2018). Being skeptical? Exploring far-right climate-change communication in Germany. *Environmental Communication*, *12*(5), 589–604. https://doi.org/10.1080/17524032.2018.1470546

Fraune, C., & Knodt, M. (2018). Sustainable energy transformations in an age of populism, post-truth politics, and local resistance. *Energy Research & Social Science*, *43*, 1–7. https://doi.org/10.1016/j.erss.2018.05.029

Friestad, M., & Wright, P. (1994). The persuasion knowledge model: How people cope with persuasion attempts. *Journal of Consumer Research*, *21*(1), 1–31. https://doi.org/10.1086/209380

Hameleers, M. (2022). *Populist disinformation in fragmented information settings: Understanding the nature and persuasiveness of populist and post-factual communication*. Routledge.

Hameleers, M., & van der Meer, T. G. L. A. (2020). Misinformation and polarization in a high-choice media environment: How effective are political fact-checkers? *Communication Research*, *47*(2), 227–250. https://doi.org/10.1177/0093650218819671

Hart, P. S., & Feldman, L. (2016). The influence of climate change efficacy messages and efficacy beliefs on intended political participation. *PLoS One*, *11*(8), e0157658. https://doi.org/10.1371/journal.pone.0157658

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. The Guilford Press.

Huber, R. A. (2021). Populism and climate change: A match made in heaven? In R. Heinisch, C. Holtz-Bacha, & O. Mazzoleni (Hrsg.), *Political populism* (pp. 555–568). Nomos.

IPCC. (2023). *Climate change 2023: Synthesis report*. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, Ii and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Lee, H., & Romero, J. (Eds.)].

Jolley, D., & Douglas, K. M. (2014). The social consequences of conspiracism: Exposure to conspiracy theories decreases intentions to engage in politics and to reduce one's carbon footprint. *British Journal of Psychology*, *105*(1), 35–56. https://doi.org/10.1111/bjop.12018

Jolley, D., & Douglas, K. M. (2017). Prevention is better than cure: Addressing anti-vaccine conspiracy theories. *Journal of Applied Social Psychology*, *47*(8), 459–469. https://doi.org/10.1111/jasp.12453

Lamb, W. F., Mattioli, G., Levi, S., Roberts, J. T., Capstick, S., Creutzig, F., Minx, J. C., Müller-Hansen, F., Culhane, T., & Steinberger, J. K. (2020). Discourses of climate delay. *Global Sustainability*, *3*, e17, 1–5. https://doi.org/10.1017/sus.2019.23

Lewandowsky, S. (2021). Climate change disinformation and how to combat it. *Annual Review of Public Health*, *42*(1), 1–21. https://doi.org/10.1146/annurev-publhealth-090419-102409

Lewandowsky, S., Ecker, U. K. H., Seifert, C. M., Schwarz, N., & Cook, J. (2012). Misinformation and its correction: Continued influence and successful debiasing. *Psychological Science in the Public Interest*, *13*(3), 106–131. https://doi.org/10.1177/1529100612451018

Lewandowsky, S., & van der Linden, S. (2021). Countering misinformation and fake news through inoculation and prebunking. *European Review of Social Psychology*, *32*(2), 348–384. https://doi.org/10.1080/10463283.2021.1876983

Lockwood, M. (2018). Right-wing populism and the climate change agenda: Exploring the linkages. *Environmental Politics*, *27*(4), 712–732. https://doi.org/10.1080/09644016.2018.1458411

MacFarlane, D., Tay, L. Q., Hurlstone, M. J., & Ecker, U. K. H. (2021). Refuting spurious COVID-19 treatment claims reduces demand and misinformation sharing. *Journal of Applied Research in Memory and Cognition*, *10*(2), 248–258. https://doi.org/10.1037/h0101793

Maier, M., Gil-López, T., Bromme, L., Zinkernagel, A., Welzenbach-Vogel, I. C., Christner, C., Adam, S., Schmitt, M., & Tillman, E. R. (2023). The interplay between explicit and implicit right-wing populism in Germany and Switzerland. *Political Psychology*. https://doi.org/10.1111/pops.12895

Mayer, A., & Smith, E. K. (2019). Unstoppable climate change? The influence of fatalistic beliefs about climate change on behavioural change and willingness to pay cross-nationally. *Climate Policy*, *19*(4), 511–523. https://doi.org/10.1080/14693062.2018.1532872

McAllister, L., Daly, M., Chandler, P., McNatt, M., Benham, A., & Boykoff, M. (2021). Balance as bias, resolute on the retreat? Updates & analyses of newspaper coverage in the United States, United Kingdom, New Zealand, Australia and Canada over the past 15 years. *Environmental Research Letters*, *16*(9), 094008. https://doi.org/10.1088/1748-9326/ac14eb

McGuire, W. J. (1961). The effectiveness of supportive and refutational defenses in immunizing and restoring beliefs against persuasion. *Sociometry*, *24*(2), 184–197. https://doi.org/10.2307/2786067

Mudde, C. (2004). The populist Zeitgeist. *Government and Opposition*, *39*(4), 541–563. https://doi.org/10.1111/j.1477-7053.2004.00135.x

Mudde, C. (2007). *Populist radical right parties in Europe*. Cambridge University Press.

Nyhan, B., & Reifler, J. (2010). When corrections fail: The persistence of political misperceptions. *Political Behavior*, *32*(2), 303–330. https://doi.org/10.1007/s11109-010-9112-2

Nyhan, B., Reifler, J., Richey, S., & Freed, G. L. (2014). Effective messages in vaccine promotion: A randomized trial. *Pediatrics*, *133*(4), e835–e842. https://doi.org/10.1542/peds.2013-2365

Nyhan, B., Reifler, J., & Ubel, P. A. (2013). The hazards of correcting myths about health care reform. *Medical Care*, *51*(2), 127–132. https://doi.org/10.1097/MLR.0b013e318279486b

Paal, G. (2021, Juni 10). *Die AfD sagt: Mehr CO2 fördert das Pflanzenwachstum. Stimmt das?* SWR Online. https://www.swr.de/wissen/1000-antworten/foerdert-mehr-co2-das-pflanzenwachstum-100.html

Paynter, J., Luskin-Saxby, S., Keen, D., Fordyce, K., Frost, G., Imms, C., Miller, S., Trembath, D., Tucker, M., & Ecker, U. (2019). Evaluation of a template for countering misinformation—Real-world Autism treatment myth debunking. *PLoS One*, *14*(1), e0210746. https://doi.org/10.1371/journal.pone.0210746

Ranney, M. A., & Clark, D. (2016). Climate change conceptual change: Scientific information can transform attitudes. *Topics in Cognitive Science*, *8*(1), 49–75. https://doi.org/10.1111/tops.12187

Roozenbeek, J., van der Linden, S., Goldberg, B., Rathje, S., & Lewandowsky, S. (2022). Psychological inoculation improves resilience against misinformation on social media. *Science Advances*, *8*(34), eabo6254. https://doi.org/10.1126/sciadv.abo6254

Schmid, P., & Betsch, C. (2019). Effective strategies for rebutting science denialism in public discussions. *Nature Human Behaviour*, *3*(9), 931–939. https://doi.org/10.1038/s41562-019-0632-4

Schmid-Petri, H., Adam, S., Schmucki, I., & Häussler, T. (2015). A changing climate of skepticism: The factors shaping climate change coverage in the US press. *Public Understanding of Science (Bristol, England)*, *26*, 498–513. https://doi.org/10.1177/0963662515612276

Schmid-Petri, H., & Bürger, M. (2022). The effect of misinformation and inoculation: Replication of an experiment on the effect of false experts in the context of climate change communication. *Public Understanding of Science*, *31*(2), 152–167. https://doi.org/10.1177/09636625211024550

Schulz, A., Müller, P., Schemer, C., Wirz, D. S., Wettstein, M., & Wirth, W. (2018). Measuring populist attitudes on three dimensions. *International Journal of Public Opinion Research*, *30*(2), 316–326. https://doi.org/10.1093/ijpor/edw037

Seifert, C. M. (2002). The continued influence of misinformation in memory: What makes a correction effective? In *Psychology of learning and motivation* (Bd. 41, S. 265–292). Academic Press. https://doi.org/10.1016/S0079-7421(02)80009-3

Taber, C. S., & Lodge, M. (2006). Motivated skepticism in the evaluation of political beliefs. *American Journal of Political Science*, *50*(3), 755–769. https://doi.org/10.1111/j.1540-5907.2006.00214.x

Tay, L. Q., Hurlstone, M. J., Kurz, T., & Ecker, U. K. H. (2022). A comparison of prebunking and debunking interventions for implied versus explicit misinformation. *British Journal of Psychology*, *113*(3), 591–607. https://doi.org/10.1111/bjop.12551

Thorson, E. (2016). Belief echoes: The persistent effects of corrected misinformation. *Political Communication*, *33*(3), 460–480. https://doi.org/10.1080/10584609.2015.1102187

Traberg, C. S., Roozenbeek, J., & van der Linden, S. (2022). Psychological inoculation against misinformation: Current evidence and future directions. *The ANNALS of the American Academy of Political and Social Science*, *700*(1), 136–151. https://doi.org/10.1177/00027162221087936

Treen, K. M. d., Williams, H. T. P., & O'Neill, S. J. (2020). Online misinformation about climate change. *WIREs Climate Change*, *11*(5), e665. https://doi.org/10.1002/wcc.665

van der Linden, S. (2015). The conspiracy-effect: Exposure to conspiracy theories (about global warming) decreases pro-social behavior and science acceptance. *Personality and Individual Differences*, *87*, 171–173. https://doi.org/10.1016/j.paid.2015.07.045

van der Linden, S. (2022). Misinformation: Susceptibility, spread, and interventions to immunize the public. *Nature Medicine*, *28*(3), 460–467. https://doi.org/10.1038/s41591-022-01713-6

van der Linden, S., Leiserowitz, A., Rosenthal, S., & Maibach, E. (2017). Inoculating the public against misinformation about climate change. *Global Challenges*, *1*(2), 1600008. https://doi.org/10.1002/gch2.201600008

Vraga, E. K., Kim, S. C., & Cook, J. (2019). Testing logic-based and humor-based corrections for science, health, and political misinformation on social media. *Journal of Broadcasting & Electronic Media*, *63*(3), 393–414. https://doi.org/10.1080/08838151.2019.1653102

Vraga, E. K., Kim, S. C., Cook, J., & Bode, L. (2020). Testing the effectiveness of correction placement and type on Instagram. *The International Journal of Press/Politics*, *25*(4), 632–652. https://doi.org/10.1177/1940161220919082

Waisbord, S. (2018). The elective affinity between post-truth communication and populist politics. *Communication Research and Practice*, *4*(1), 17–34. https://doi.org/10.1080/22041451.2018.1428928

Walter, N., Cohen, J., Holbert, R. L., & Morag, Y. (2020). Fact-checking: A meta-analysis of what works and for whom. *Political Communication*, *37*(3), 350–375. https://doi.org/10.1080/10584609.2019.1668894

Walter, N., & Murphy, S. T. (2018). How to unring the bell: A meta-analytic approach to correction of misinformation. *Communication Monographs*, *85*(3), 423–441. https://doi.org/10.1080/03637751.2018.1467564

Walter, N., & Tukachinsky, R. (2020). A meta-analytic examination of the continued influence of misinformation in the face of correction: How powerful is it, why does it happen, and how to stop it? *Communication Research*, *47*(2), 155–177. https://doi.org/10.1177/0093650219854600

York, C., Ponder, J. D., Humphries, Z., Goodall, C., Beam, M., & Winters, C. (2020). Effects of fact-checking political misinformation on perceptual accuracy and epistemic political efficacy. *Journalism & Mass Communication Quarterly*, *97*(4), 958–980. https://doi.org/10.1177/1077699019890119