International Journal of Communication 16(2022), 3065–3086 1932–8036/20220005

Testing Mechanisms and Effects of Opposition-Targeted Inoculation and Visual Strategies to Promote Health Policy

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Inoculation theory predicts messages forewarning people of opposing arguments can offset the effects of subsequent exposure to oppositional messages. Tests of inoculation rarely explicate the mechanisms of inoculation messages that specify oppositional targets or use visual evidentiary strategies. We test the effects of targeted inoculation and visual imagery on public support for restricting the marketing of sugary drinks to youth. A targeted inoculation message reduced the effects of anti-policy messages on policy support by evoking anger and counterarguing immediately after exposure to the inoculation message, but not after a one-week delay. Adding visual imagery provided no inoculation benefit.

Keywords: inoculation theory, anger, counterarguing, visual persuasion, health policy

The public communication environment is dynamic, with different advocacy and commercial forces competing to shape perceptions and opinions about social issues and policies to address them (Chong & Druckman, 2007; Fowler, Gollust, Dempsey, Lantz, & Ubel, 2011). In the context of health, policy advocates often compete with messages from commercial industries typically opposed to evidence-based governmental regulations that threaten commercial freedom and profits (Scully et al., 2017). A supportive public opinion environment increases the likelihood of policy proposals, passage, and implementation (Bou-Karroum et al., 2017).

Inoculation theory offers strategic communicators a strategy to offset the persuasive effects of commercial industries' anti-policy messaging. Inoculating people against anticipated opposing arguments

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Date submitted: 2021-10-13

through warning people of possible impending opposing claims (forewarning), and weakening the effects of those claims (e.g., preemptive refutation), can increase audience resistance to subsequent persuasive attempts (Banas & Rains, 2010; Compton, 2013). In recent years, researchers have tested inoculation strategies in garnering support for health, environmental, and science policies (Cook, Lewandowsky, & Ecker, 2017; Maertens, Anseel, & Van der Linden, 2020; Niederdeppe, Heley, & Barry, 2015).

Some inoculation studies use nonspecific messages about the source of oppositional messaging, using language like, "Some people will try to tell you . . ." and "Opponents of these policies may try to convince you that . . ." Public communication surrounding competitive public issues (e.g., policy positions) often refers to oppositional message targets when employing, intentionally or not, components of inoculation strategies. Targeted inoculation may appear in political debates (e.g., "[name of a political party/specific candidate] will try to tell you . . ."; see An & Pfau, 2004), and it may be adopted to oppose industry propaganda (e.g., "[name of the industry/company] will try to convince you . . ."; see Lim & Ki, 2007; Niederdeppe et al., 2015). We refer to this strategy as targeted inoculation. Although some suggest that targeted inoculation may result in derogation of the source of anticipated oppositional message, the mechanisms of targeted inoculation remain to be explicated (Compton, 2020a).

Although health campaigns often refer to oppositional message targets when employing inoculation strategies by emphasizing deceptive messaging from specific industries (Popova, 2016), this targeted inoculation approach remains understudied. Targeted inoculation strategies suggest distinct theoretical pathways through which effects can occur that complement traditional mechanisms of inoculation like threat and counterarguing (Banas & Rains, 2010). Specifically, identifying the source of the anticipated anti-policy arguments and highlighting the motives and dishonest behavior of that source (termed "source derogation") could evoke anger, which in turn may bolster protection from oppositional messaging attributed to that source (Kersh & Morone, 2002). In addition, although evidence for whether visual imagery enhances the effects of written/text-based messages is mixed (King, Jensen, Davis, & Carcioppolo, 2014), it is unclear how including visual evidence for the oppositional target's motives or behavior might also influence processing and effects of inoculation messages.

Addressing these research gaps, we use a longitudinal, randomized experiment to test whether targeted inoculation messages can increase public support for evidence-based health policies and reduce the influence of anti-policy messages that are delivered (a) immediately after inoculation message exposure or (b) one week later.

Inoculation Theory, Mechanisms, and Effects

Inoculation refers to exposing people to weakened forms of anticipated oppositional arguments to make people more resistant to future persuasion attempts (McGuire, 1961, 1964). The procedure is analogous to medical inoculation, where people are exposed to a virus in a weakened state to promote the proliferation of antibodies that protect healthy people from an infectious disease (McGuire, 1964). Inoculation in communication is often operationalized as message strategies that (1) signal to people the likelihood of encountering arguments that attack an attitude or issue position that one holds, or that a communicator might want people to hold (forewarning), and (2) refute a weakened form of anticipated

oppositional arguments (refutational preemption; Banas & Rains, 2010). However, forewarning is not required for inoculation, and messages may trigger perceived attitudinal threat without forewarning (Compton, 2021). Also, although the idea of inoculation was derived based on two-sided messaging (McGuire, 1961, 1964), identifying reasoning fallacies in forthcoming opposing arguments (Cook, Ellerton, & Kinkead, 2018) and debunking anticipated misinformation (Van der Linden, Leiserowitz, Rosenthal, & Maibach, 2017) can also have inoculation effects. Meta-analytic evidence has found that inoculation messages are, on average, more effective at creating resistance to subsequent oppositional messages than one-sided messages (e.g., messages without forewarning or refutational preemption) or no messages (Banas & Rains, 2010).

Traditional theorizing about inoculation suggests that two psychological mechanisms underlie the success of inoculation messages: perceived threat and counterarguing (Compton, 2013). Perceived threat, traditionally, refers to the perception that one's attitude or issue position is in danger of a future attack. Counterarguing refers to the process of refuting oppositional claims (Ivanov et al., 2013; Pfau & Burgoon, 1998). Counterarguing can be a cognitive process where the counterarguments generated feature reasoning and factual statements. It may also be an affective process where counterarguments include opinions and feeling-oriented words (Wigley & Pfau, 2010). Also, although counterarguing is often studied as an intrapersonal process, it can also occur in interpersonal settings where people talk about the issue after receiving the inoculation message, and such postinoculation conversation can boost resistance against oppositional messaging (Ivanov et al., 2012). Traditional inoculation theorizing contends, for inoculation to occur, inoculation messages must advocate for an issue position that is consistent with a person's preexisting attitude toward that issue, just like vaccines are typically used on people who have not yet been infected with a virus (Compton, 2013). Recent theory and research, however, suggest that inoculation effects may not be limited to people who hold prior attitudes consistent with the message's advocated position (e.g., Compton, 2020b; Miller et al., 2013; Niederdeppe, Gollust, & Barry, 2014; Niederdeppe et al., 2015).

Targeted Inoculation and Source Derogation

In the context of health policies, anti-policy advocacy messages are usually from campaigns funded by commercial industries (Nixon, Mejia, Cheyne, & Dorfman, 2015). This is true for policies designed to regulate the sale and marketing of sugar-sweetened beverages (SSBs) to fight childhood obesity, including restricting the marketing of sugary drinks to children, limiting availability at schools, and adding nutrition labels to SSB packages (Muth et al., 2019). The sugary drink industry has strongly opposed these proposed policies by emphasizing that policies reflect government overreach, restrict individual dietary choice, and are unnecessary considering the industry's own self-regulation (Barry, Niederdeppe, & Gollust, 2013; Mejia et al., 2014). It has financed anti-policy campaigns with expenditures that far outweigh the volume of resources available to public health advocates (Kamerow, 2010).

People who believe that the sugary drink industry uses deceptive marketing practices to promote unhealthy products to children are more likely to support more stringent regulation (Niederdeppe et al., 2014). This has led researchers to employ targeted inoculation that identifies the sugary drink industry as a source of anti-policy messaging and emphasizes its motives (i.e., profit) and behavior (e.g., deceptive marketing to vulnerable kids; Niederdeppe et al., 2015). We theorized about this case of inoculation

proposing three mechanisms of targeted inoculation effects: perceived threat to freedom, anger, and counterarguing.

These mechanisms echoed studies about psychological reactance in inoculation. One line of research that has linked inoculation to reactance forewarned people that messages might make them feel that their freedom to perform risky behaviors (e.g., binge drinking) is threatened, and argued that people should not feel threatened given that these health messages are fact-based. In this way, inoculation reduced resistance to health promotion messages (Richards & Banas, 2015; Richards, Banas, & Magid, 2016). Another line of research looked at the effects of forewarning people of the manipulative nature and lack of integrity in commercial industries' messaging to trigger perceived threat to freedom and counterarguing against industry marketing (Niederdeppe et al., 2015). Other work has found that recognizing the deceptive nature of advertising on news websites increased both perceived threat to freedom and psychological reactance (anger and counterarguments). Reactance, in turn, decreased respondents' willingness to like or share content (Amazeen, 2020).

In targeted inoculation, by stating that a specific source of impending opposition messages will attempt to persuade receivers, targeted inoculation offers an alternative conceptualization of inoculation-induced threat as a perceived threat to freedom (i.e., freedom to make up one's own mind; see Miller et al., 2013). This is useful because meta-analysis showed that perceived threat to beliefs/attitudes (i.e., that one's existing beliefs and attitudes might change because of persuasion), as traditionally conceptualized in inoculation research, was not a significant predictor of resistance to the influence of impending persuasive messages (Banas & Rains, 2010). Although more threat may not result in more resistance, perceived threat might set a threshold for inoculation, in which readers may need to have a sufficient level of perceived threat before resistance occurs. Moreover, if people's preexisting beliefs and attitudes are inconsistent with the position of the impending message, they are unlikely to perceive a threat to their beliefs. This definition of threat confines the applicability of inoculation only to people who agreed with the position of an inoculation message (i.e., "prophylactic" inoculation, see Compton, 2020b). Recent evidence, however, suggests that inoculation treatments can also have "therapeutic" effects on audiences with attitudes that are inconsistent with the advocated position of the message (Compton, 2020b). Thus, by conceptualizing threat as perceived threat to freedom in targeted inoculation, one might expect such a threat to evoke resistance to subsequent persuasion from opposing sources regardless of receivers' original issue positions.

Second, criticizing the source of the opposing message (i.e., source derogation) through questioning the integrity of its behaviors is central to a targeted inoculation strategy. Early research in social psychology found that messages that discredit anticipated sources of messaging can increase people's resistance to subsequent attempts by that source to persuade (Anderson, 1967). Studies on source derogation have demonstrated its effectiveness in reducing the impact of arguments from the discounted source (Thalhofer & Kirscht, 1968) and boosting the influence of refutational messages (Anderson, 1967). Moreover, consumers perceive commercial sources such as advertising as less trustworthy compared to noncommercial sources like other consumers (Batinic & Appel, 2013), which may suggest that commercial sources may be more readily discounted by message recipients. Thus, specifying a powerful industry as the source of an impending opposing message should help explain targeted inoculation effects.

Source derogation in targeted inoculation may lead to anger. The cognitive functional model (Nabi, 1999) and the anger activism model (Turner, 2007) both suggest anger can be triggered by an audience's cognitive appraisal of the situations depicted in messages. Behaviors that are perceived to violate societal norms and pose risks to others' well-being will evoke anger (Oatley, 1992). For example, anger can be elicited when the commercial industry is portrayed as sacrificing the interests of consumers for profits (Dillard & Nabi, 2006). Subsequently, anger will lead to persuasive outcomes such as attitude change (Nabi, 1999; Turner, 2007). Recently, for example, Skurka (2019) found messages emphasizing the sugary drink industry's marketing their products to children evoked anger toward the sugary drink industry and its actions, which in turn predicted greater support for policies regulating the sugary drink industry. Also, research has found people are averse to persuasion from a source perceived not to have the receiver's best interests in mind (Miller et al., 2013). Taken together, these studies suggest focusing on industry marketing practices could be beneficial because such an approach highlights nefarious motives and behaviors of the industry.

Therefore, we contend that a targeted inoculation approach may be able to trigger anger toward both the anti-policy message and its source by depicting the sugary drink industry and its messages as overlooking the health concerns of its consumers (source derogation) and failing to assume responsibility for consumers' health (Kersh & Morone, 2002). It can be expected that anger toward the anticipated opposing message and its source may be essential mechanisms in targeted inoculation, along with perceived threat to freedom and counterarguing. We propose the following hypotheses comparing the effects of the targeted inoculation message to the control message and the non-inoculation pro-policy message, respectively:

H1: Respondents who read a targeted inoculation message will (a) experience more threat to freedom; (b) be angrier toward the sugary drink industry; (c) be angrier toward the anti-policy message; and (d) counterargue the anti-policy message more than respondents who read the control message.

H2: Respondents who read a targeted inoculation message will (a) experience more threat to freedom; (b) be angrier toward the sugary drink industry; (c) be angrier toward the anti-policy message; and (d) counterargue the anti-policy message more than respondents who read the non-inoculation pro-policy message.

For policy outcomes of targeted inoculation, because competitive frames often work in opposing directions (Chong & Druckman, 2007), we expect that both targeted inoculation messages and a sugary drink industry anti-policy message will affect policy-related outcomes immediately after exposure.

H3: Respondents who read a targeted inoculation message will (a) have stronger anti-industry beliefs and (b) be more supportive of anti-SSB policies immediately after exposure compared to respondents who read the control message.

H4: Respondents who read an industry anti-policy message will have (a) weaker anti-industry beliefs and (b) be less supportive of anti-SSB policies immediately after exposure than those who do not read the anti-policy message.

Moreover, as the targeted inoculation message should generate psychological processes that are hypothesized to promote resistance to subsequent opposing messages (Banas & Rains, 2010), the inoculation strategy should undermine the effects of the anti-policy message on anti-industry beliefs and policy support.

H5: The effects of exposure to an industry anti-policy message on (a) anti-industry beliefs; and (b) policy support will be weaker among respondents who read the targeted inoculation message than those who read the control message.

H6: The effects of exposure to the industry anti-policy message on (a) anti-industry beliefs; and (b) policy support will be weaker among respondents who read the targeted inoculation message than those who read the non-inoculation pro-policy message.

We further expect that the effects of targeted inoculation on anti-industry beliefs and policy support should be explained by the mechanisms theorized above (i.e., perceived threat to freedom, anger, and counterarguing) per inoculation theory and source derogation in targeted inoculation.

H7: Indicators of targeted inoculation message-related psychological processes (i.e., perceived threat to freedom, anger, and counterarguing) will mediate the effects of targeted inoculation on (a) anti-industry beliefs and (b) policy support.

Given the large volume of anti-policy messaging through campaigns of the sugary drink industry (Mejia et al., 2014), it is also important to examine the potential of the inoculation message to evoke resistance to persuasion over time (Compton, 2013). Findings are mixed, however, about the length of time for which inoculation effects endure. Originally, McGuire (1964) argued some receivers may need time to develop counterarguments toward forthcoming opposing messages after inoculation message exposure. Thus, sustained inoculation effects have been hypothesized as likely and some studies support this idea of increased resistance over time (Freedman & Sears, 1965; Petty & Cacioppo, 1986). By comparison, other studies have shown that the impact of inoculation messages declines quickly (Pfau, 1997; Pryor & Steinfatt, 1978), in line with expectations of most strategic message effects, while some studies found inoculation effects remained stable for weeks (Pfau et al., 2006), months (Maertens, Roozenbeek, Basol, & Van der Linden, 2021), or more than a year (Pfau & Bockern, 1994). Given inconsistent findings about over-time effects of inoculation, we pose the following question:

RQ1: Are there targeted inoculation message effects on study outcomes one week after exposure?

Visual Message Features in Targeted Inoculation

Reviews of visual persuasion find imagery, in general, often has a positive influence on messages designed to persuade and inform (Ancker, Senathirajah, Kukafka, & Starren, 2006; King, 2015), but it remains unclear if visual evidence supporting preemptive refutation about an impending anti-policy message from the SSB company can enhance targeted inoculation effects.

While some inoculation research with attack messages (Compton & Pfau, 2004) or inoculation messages (Burgoon, Pfau, & Birk, 1995) in the form of advertising featured visual content, visuals were not specified as a part of these manipulations. It is therefore difficult to understand the specific role of visuals in these studies. Other research used images and texts across message conditions (Ivanov, Pfau, & Parker, 2009), or only used videos to deliver inoculation without comparing them to text-based stimuli (Pfau, Van Bocken, & Kang, 1992), making it impossible to isolate the effects of visuals from textual information. Pfau, Holbert, Zubric, Pasha, and Lin (2000) examined the modality of an inoculation message by comparing video and print treatments. Findings showed videos were more likely to offer resistance through evoking positive perceptions about the source of inoculation and negative perceptions about the anticipated oppositional message. Nabi (2003) found emotionally evocative visuals about medical experimentation with animals conferred greater resistance to an attack message. Conversely, Pfau and colleagues (2008) concluded that inoculation attempts featuring images of troops deployed in combat did not influence emotional responses but elicited more threat and counterarguing. These studies offer conflicting findings.

Theorizing on the influence of visual imagery has recently focused on modifiable features (King, 2015), with the intention to assist communicators with message design. Exemplification (Zillmann, 2006) suggests that individual events (exemplars) can be extrapolated to larger event sets by providing the recipient of an exemplar with vivid anecdotal evidence of an event set. Exemplars tend to be more persuasive, emotionally evocative, and influential than base-rate information (usually as written statistics; see Bigsby, Bigman, & Gonzalez, 2019). In terms of visualizing exemplification, the theory suggests three possible display strategies: no visual image, base-rate visual imagery (e.g., graphs/charts), and visual exemplars (e.g., photographs or illustrations). Although exemplification theory posits visual exemplars would be most persuasive, there is also considerable evidence that graphs and charts (i.e., how base-rate information is usually visualized) can effectively communicate scientific information (Ancker et al., 2006), and only one study to our knowledge has compared visual exemplars to visual base-rate information (Reinhardt, Weber, & Rossmann, 2017).

Given past research on visuals and inoculation theory providing mixed results, and exemplification theory offering clear visual message strategies to consider (no imagery, base-rate imagery, and visual exemplars) within the policy-focused targeted inoculation messages in the present study, we pose a research question that explores the effects of visual exemplification within targeted inoculation messages.

RQ2: Does the inclusion of (a) visual exemplars or (b) base-rate visual information enhance the effects of targeted inoculation messages?

Method

Participants

We conducted a randomized, two-wave longitudinal experiment. We recruited adults from Amazon's Mechanical Turk (MTurk) via TurkPrime. Restrictions for participation included people who had completed at least 50 human intelligence tasks (HITs), had a 96% or better HIT completion rate, and were in the United States. In total, 540 participants satisfactorily completed the study at time 1, and 454 of those

participants completed the follow-up one week later (time 2, retention = 84%). Participants were removed from the combined dataset if they rushed through reading two or more message screens (i.e., less than five seconds before clicking through), appeared to be duplicate responses based on worker IDs, or were above or below 3 SDs of the total time to complete the study.

Respondent demographics were similar between study waves. At time 1, the average age was 37.61 (*SD* = 10.84, range: 19–76), 79.6% were White, 52.8% were female, 54.8% received a bachelor's degree or above, and 43.5% consumed sugary drinks one to two times per week or more often. At time 2, the average age was 37.96 (*SD* = 10.79, range: 19–76), 81.3% were White, 53.5% were female, 56.4% received a bachelor's degree or above, and 43.4% consumed sugary drinks one to two times per week or more often.

Experimental Design

We randomized respondents into one of 10 conditions, using a 5 (message type) × 2 (timing of anti-policy message) design. All participants first viewed a "magnitude of the problem" message defining sugary drinks and stating that they are a major cause of the childhood obesity problem in the United States (control message). Respondents then saw messages corresponding to their study condition and answered questions related to these messages. The non-inoculation pro-policy message emphasized several policy options to restrict the sugary drink industry to reduce childhood obesity. The targeted inoculation message adopted a two-sided refutational approach, warning respondents that the sugary drink industry would try to persuade them, preemptively refuting characterizations of industry's anti-policy arguments, and then arguing for the same policy options emphasized in the plain pro-policy message using verbatim language whenever possible. There were three versions of the targeted inoculation message: presented alone (without visuals), accompanied by base-rate visual information, or accompanied by visual exemplars. Respondents also saw an anti-policy message, either at time 1 (immediately after the control, plain pro-policy, or targeted inoculation message) or time 2 (in isolation, approximately one week after the first wave). The anti-policy message argued against government regulations to restrict the sugary drink industry and was based on discrete arguments used by industry representatives in public debates and advocacy websites. Messages were similar in length. Summary tables of the hypotheses and experimental design can be found in Appendix A at the following link (https://osf.io/b392w/?view_only=c401e83f40ff4d869237bf9bb65bb43d).

Stimuli

Appendix B provides all written messages used in the study. Appendix C shows the images selected for the main study. We modeled the written stimuli after those used in another study of inoculation and health policy messages (Niederdeppe et al., 2015), though we featured different arguments and policies. Information about the selection of the visual stimuli can be found in Appendix D. The full wording of measures can be found in Appendix E.

Measures

Perceived Threat to Freedom

We measured perceived threat to freedom using items adapted from Dillard and Shen (2005), where 1 = strongly disagree and 7 = strongly agree. The perceived threat to freedom index was created by averaging the four items above (ω = .88, 95% CI [.86, .90], *M* = 4.11, *SD* = 1.51).

Anger Toward the Sugary Drink Industry

We measured anger toward the sugary drink industry at time 1 by asking respondents how angry they were at sugary drink companies, where 1 = not at all and 7 = a great deal (*M* = 4.20, *SD* = 2.00). The measure used is phrased in line with previous work studying anger in communication (Turner, 2007).

Anger Toward the Anti-Policy Message

After reading the anti-policy message (at either time 1 or time 2), respondents were asked the degree to which they were angry at "the people who put together the information," where 1 = not at all and 7 = a great deal (t1 *M* = 2.64, *SD* = 1.82; t2 *M* = 2.38, *SD* = 1.82).

Counterarguing the Anti-Policy Message

After reading the anti-policy message (at either time 1 or time 2), participants responded to four items, adapted from Miller and colleagues (2013), where 1 = strongly disagree and 7 = strongly agree (t1 ω = .90, 95% CI [.88, .92], *M* = 3.75, *SD* = 1.50; t2 ω = .92, 95% CI [.89, .94], *M* = 3.38, *SD* = 1.53).

Anti-Industry Beliefs

We measured anti-industry beliefs at time 1 and time 2 with five items used previously by Niederdeppe and colleagues (2015), where 1 = strongly disagree and 7 = strongly agree. We reverse coded two items and then averaged the five items into a scale (t1 ω = .77, 95% CI [.73, .80], *M* = 4.78, *SD* = 1.17; t2 ω = .83, 95% CI [.80, .85], *M* = 4.56, *SD* = 1.22).

Policy Support

We measured policy support at time 1 and time 2 with eight items adapted from another study of policy support (Niederdeppe et al., 2015). We asked respondents the extent to which they supported/opposed (1 = strongly oppose and 7 = strongly support) specific policies. We averaged the eight items to form a scale (t1 ω = .88, 95% CI [.86, .89], *M* = 4.89, *SD* = 1.35; t2 ω = .88, 95% CI [.86, .90], *M* = 4.87, *SD* = 1.31).

Results

Targeted Inoculation-Related Psychological Processes

We performed ordinary least squares (OLS) regressions with message conditions indicator coded to test study hypotheses and research questions. We combined the targeted inoculation condition and the targeted inoculation with visuals conditions for all analyses except those addressing RQ2 (on the role of visual images) as targeted inoculation with visuals and without visuals did not show differential effects.

Perceived threat to freedom was greater in the targeted inoculation condition than in both the control condition and the plain pro-policy condition, supporting H1a and H2a (Table 1). Anger at the sugary drink industry was greater among respondents in the targeted inoculation condition than respondents who read the control message or the plain pro-policy message, supporting H1b and H2b. Anger at the anti-policy message was greater at time 1 among respondents in the targeted inoculation condition than in the control group and the plain pro-policy condition, supporting H1c and H2c. Similarly, counterarguing of the anti-policy message was greater at time 1 among respondents in the targeted inoculation condition than respondents who read the control message or the plain pro-policy message, supporting H1d and H2d. There were no differences in counterarguing or anger at the anti-policy message by condition at time 2, however (addressing RQ1, see Table 1).

Table 1. Effects of Inoculation on Perceived Threat to Freedom, Anger, and Counterarguing.

	Perceived threat to freedom (N = 540)		Anger toward the beverage industry (N = 540)		Anger toward the anti-policy message, t1 (n = 274)		Counterargue the anti-policy message, t1 (n = 274)		Anger toward the anti-policy message, t2 (n = 230)		Counterargue the anti-policy message, t2 (n = 230)	
Message	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*
Control as reference												
Control	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Pro-policy	.14	.50	.10	.71	.05	.88	−.04	.87	−.12	.76	.13	.72
Inoculation	.59***	<.001	.76***	<.001	.83**	.001	.54*	.02	.02	.96	−.04	.87
Pro-policy as reference												
Pro-policy	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Control	−.14	.50	−.10	.71	−.05	.88	.04	.87	.12	.76	−.13	.72
Inoculation	.45*	.01	.65**	.004	.78**	.004	.59**	.006	.14	.65	−.17	.55
Model R^2	.03***		.03***		.05***		.03**		.001		.002	

Note. Values are unstandardized regression coefficients. *p < .05; **p < .01; ***p < .001

Anti-Industry Beliefs and Policy Support

There were no differences in anti-industry beliefs between the targeted inoculation condition and control group at either time period, but respondents in the targeted inoculation condition had higher levels of policy support than the control group at time 1 (Table 2). Results thus offer no support for H3a but supported H3b. Respondents (recently) exposed to the anti-policy message had lower anti-industry beliefs at time 1 and time 2, supporting H4a. There were no differences in policy support by exposure to the anti-policy message at either time, rejecting H4b (see Table 2).

Table 2. Effects of Inoculation on Anti-Industry Beliefs and Policy Support.

	Anti-industry beliefs, t1 (N = 540)		Policy support, t1 (N = 540)		Anti-industry beliefs, t2 (n = 454)		Policy support, t2 (n = 454)	
Message	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*
Control as reference								
Control	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Pro-policy	.10	.52	.42*	.03	.21	.24	.24	.21
Inoculation	.20	.14	.33*	.04	.20	.19	.19	.25
Anti-policy at t1	−.39***	<.001	.02	.84	–	–	–	–
Anti-policy at t2	–	–	–	–	−.43***	<.001	−.18	.14
Pro-policy as reference								
Pro-policy	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Control	−.10	.52	−.42*	.03	−.21	.24	−.24	.21
Inoculation	.10	.40	−.09	.55	−.01	.94	−.05	.73
Anti-policy at t1	−.39***	<.001	.02	.84	–	–	–	–
Anti-policy at t2	–	–	–	–	−.43***	<.001	−.18	.14
Model R^2	.03***		.01		.04**		.01	

Note. Values are unstandardized regression coefficients. *p < .05; **p < .01; ***p < .001

We added interaction terms between the inoculation condition and the anti-policy condition to the OLS regression models to test whether targeted inoculation reduced the impact of the anti-policy message (Table 3). These models also included interactions between the pro-policy message and the anti-policy message (when the control group was the reference group) or the control message and the anti-policy message (when the pro-policy message was the reference group) because these are necessary to interpret the inoculation*anti-policy coefficient. There was a statistically significant interaction between the targeted inoculation message and the industry's anti-policy message in predicting anti-industry beliefs, such that the targeted inoculation message reduced the impact of the anti-policy message on anti-industry beliefs compared to both the control message and the plain pro-policy message at time 1, supporting H5a and H6a

(see Table 3). However, no such influence was observed at time 2, whether compared to the control message or the plain pro-policy message. The targeted inoculation message did not reduce the influence of the anti-policy message on policy support at either time relative to the control message or the plain pro-policy message, rejecting H5b and H6b.

Table 3. Interaction Effects on Anti-Industry Beliefs and Policy Support.

	Anti-industry beliefs, t1 (*N* = 540)		Policy support, t1 (*N* = 540)		Anti-industry beliefs, t2 (*n* = 454)		Policy support, t2 (*n* = 454)	
Message	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*
Control as reference								
Control	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Pro-policy	.07	.72	.88**	.003	−.17	.39	−.12	.66
Inoculation	−.22	.20	.53*	.02	.33	.06	.05	.85
Anti-policy message at t1	−.88***	<.001	.44	.12	–	–	–	–
Anti-policy message at t2	–	–	–	–	−.45	.10	−.50	.09
Pro-policy*anti-policy at t1	.03	.92	−.90*	.02	–	–	–	–
Pro-policy*anti-policy at t2	–	–	–	–	.80*	.02	.72	.06
Inoculation*anti-policy at t1	.81**	.002	−.39	.21	–	–	–	–
Inoculation*anti-policy at t2	–	–	–	–	−.24	.43	.28	.40
Pro-policy as reference								
Pro-policy	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Control	−.07	.72	−.88**	.003	.17	.39	.12	.66
Inoculation	−.29	.07	−.34	.12	.50**	.002	.16	.40
Anti-policy message at t1	−.85***	<.001	−.46	.08	–	–	–	–
Anti-policy message at t2	–	–	–	–	.35	.13	.23	.36
Control*anti-policy at t1	−.03	.92	.90*	.02	–	–	–	–
Control*anti-policy at t2	–	–	–	–	−.80*	.02	−.72	.06
Inoculation*anti-policy at t1	.79**	.001	.51	.09	–	–	–	–
Inoculation*anti-policy at t2	–	–	–	–	−1.04***	<.001	−.44	.14

Model R^2	.06***	.02	.06***	.02

Note. Values are unstandardized regression coefficients. *p < .05; **p < .01; ***p < .001

Mediation Pathways

We used the PROCESS macro (Hayes, 2018) to test hypothesized mediation pathways between message conditions and study outcomes (anti-industry beliefs and policy support) with anger toward the sugary drink industry, anger toward the anti-policy message, threat to freedom, and counterarguing as mediators (H7). PROCESS macro tested each mediating path controlling for all other mediators in the model (Hayes, 2018). We stratified the sample by the timing of receipt of the anti-policy message (time 1 versus time 2).

Mediation models suggest the importance of both targeted inoculation-related cognitive and emotional mediators in shaping policy outcomes (Table 4). Compared to the control message or the pro-policy message, the indirect effects of the targeted inoculation message with perceived threat to freedom as the mediator were not statistically significant at either time period. However, the data are consistent with positive indirect effects of the targeted inoculation message (compared to both the control and pro-policy message group), through both counterarguing and anger toward the sugary drink industry, on anti-industry beliefs and policy support at time 1. Finally, the model offered evidence of a positive indirect effect of the targeted inoculation message (compared to both the control and pro-policy message group), through anger toward the anti-policy message, on anti-industry beliefs but not policy support at time 1. Thus, H7 was partially supported. None of these indirect pathways were apparent at time 2 (addressing RQ1, see Table 4).

Table 4. Indirect Effects of Inoculation on Anti-Industry Beliefs and Policy Support Through Mediators.

	Anti-industry Beliefs, t1 (n = 274)		Policy Support, t1 (n = 274)		Anti-industry Beliefs, t2 (n = 230)		Policy Support, t2 (n = 230)	
	b	95% CI	*b*	95% CI	*b*	95% CI	*b*	95% CI
Mediator: Perceived Threat								
Control = Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Pro-policy	.00	−.03, .03	.00	−.04, .03	.00	−.03, .05	.00	−.04, .05
Inoculation	−.01	−.08, .05	−.01	−.08, .06	.01	−.04, .07	.01	−.04, .08
Pro-policy = Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Control	.00	−.03, .03	.00	−.03, .04	.00	−.05, .03	.00	−.05, .04
Inoculation	−.01	−.07, .04	−.01	−.07, .06	.01	−.04, .06	.01	−.04, .07
Mediator: Counterarguing								
Control = Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Pro-policy	−.01	−.18, .15	−.01	−.08, .07	.07	−.29, .43	.01	−.08, .12
Inoculation	**.17**	**.03, .34**	**.07**	**.001, .18**	−.02	−.30, .26	.00	−.08, .07

Pro-policy = Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Control	.01	−.15, .18	.01	−.07, .08	−.07	−.43, .29	−.01	−.12, .08
Inoculation	**.19**	**.05, .34**	**.08**	**.01, .18**	−.09	−.38, .19	−.02	−.11, .05
Mediator: Anger - industry								
Control = Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Pro-policy	−.05	−.17, .09	−.11	−.39, .19	.04	−.04, .16	.15	−.14, .45
Inoculation	**.15**	**.04, .27**	**.34**	**.11, .59**	.05	−.01, .16	.19	−.03, .43
Pro-policy = Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Control	.05	−.09, .17	.11	−.19, .39	−.04	−.16, .04	−.15	−.45, .14
Inoculation	**.19**	**.08, .33**	**.45**	**.20, .71**	.01	−.06, .10	.04	−.20, .29
Mediator: Anger - message								
Control = Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Pro-policy	.01	−.07, .08	.00	−.04, .04	.00	−.06, .05	−.01	−.10, .06
Inoculation	**.09**	**.01, .18**	.02	−.06, .11	.00	−.04, .05	.00	−.06, .07
Pro-policy = Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Control	−.01	−.08, .07	.00	−.04, .04	.00	−.05, .06	.01	−.06, .10
Inoculation	**.08**	**.01, .18**	.02	−.05, .11	.00	−.04, .06	.01	−.04, .09

Note. Values are unstandardized regression coefficients and their 95% confidence intervals. Significant indirect effects are bolded.

Effects of Visual Exemplars and Base-Rate Visual Imagery

We tested RQ2 using OLS regression to compare each targeted inoculation condition with visual images (visual exemplars and base-rate information) to the no-image targeted inoculation condition on targeted inoculation-related psychological processes. In short, none of the visual image conditions were significantly different from the no-image targeted inoculation condition (*p*-values ranged from .14 to .99).

Discussion

This study tested the mechanisms and effects of targeted inoculation as a message strategy to offset the influence of messages against policies to reduce SSB consumption. Results offer support for several theoretical predictions related to the influence of targeted inoculation messages on relevant beliefs and policy support through anger and counterarguing. Resistance to oppositional messages was apparent only immediately after exposure to the inoculation message but not at delayed measurement. There was no evidence that adding visual imagery enhanced targeted inoculation appeals.

First, while tests of inoculation have not focused on explicating the effects and mechanisms of targeted inoculation, commercial industries (e.g., sugary drink companies) are often the largest funders of anti-policy campaigns that employ deceptive messaging strategies (Nixon et al., 2015), and public communicators also routinely employ strategies that emphasize specific oppositional threat. The usage of such strategies in the real world and their potential impact underscores the importance of applying and extending inoculation theory to examine the unique process of targeted inoculation. We adapted traditional theorizing of inoculation for targeted inoculation by adding anger at both the source and message as mechanisms central to receivers' resistance to impending opposition messages in accordance with source derogation (Anderson, 1967).

Findings show that respondents became angry at the sugary drink industry and its anti-policy messages when an inoculation message preemptively refuted the industry's arguments and discredited SSB companies as a source. While the role of anger has been overlooked in many inoculation studies (Banas & Rains, 2010), some research found that inoculation messages that include affect-laden words or images (Ivanov et al., 2009), feature information about the obstruction of one's goals (Wigley & Pfau, 2010), or highlight the deceptive nature of oppositional messages (Amazeen, 2020) can generate anger and other emotions. In the present study, anger toward the sugary drink industry and its messaging might be evoked by respondents' cognitive appraisal of the issue, as the targeted inoculation message depicted the sugary drink industry as engaging in deceptive marketing strategies in pursuit of profits at the expense of consumer health (i.e., source derogation), which obstructed the goals of receivers to remain healthy. The targeted inoculation message also triggered perceived threat to freedom, echoing recent calls to conceptualize threat in targeted inoculation as threat to freedom (Miller et al., 2013; Niederdeppe et al., 2015), and increased counterarguing, a result that is consistent with previous inoculation theorizing (Ivanov et al., 2013; Miller et al., 2013). Thus, the processes triggered by targeted inoculation messages not only echo those described in previous inoculation studies, but also complement this work by identifying anger as additional responses to inoculation messages that specify a target.

Second, the mediation analyses suggest that the indirect pathways of targeted inoculation on policy-related outcomes operate through anger and counterarguing but not perceived threat to freedom. The targeted inoculation message influenced anger, counterarguing, and perceived threat to freedom, but only anger and counterarguing were significant predictors of policy-related outcomes. Meta-analytic findings from reviews of inoculation theory found that perceived threat to existing beliefs have been less consistently predictive of resistance than counterarguing (see Banas & Rains, 2010). Although this traditional threat measurement emphasized threat to attitudes, it was often measured as apprehensive threat using adjectives such as scary, intimidating, dangerous, and more (Banas & Richards, 2017). We observed a similar result for perceived threat to freedom in targeted inoculation, which did not predict policy-relevant outcomes in the current study. On the one hand, it is possible that perceived threat to freedom and apprehensive threat only set thresholds for inoculation effects to occur, so more perceived threat does not lead to more resistance. On the other hand, there are alternative threat measures that may better predict resistance to attitude change. For example, motivational threat that focused on people's motivations to defend their attitudes has been found to be a better predictor of resistance to attitude change than traditional threat measures (Banas & Richards, 2017). All told, findings suggest that anger and counterarguing play central

roles in targeted inoculation, a pattern of results consistent with theoretical predictions from cognitive appraisal (Nabi, 1999) and source derogation (Anderson, 1967; Thalhofer & Kirscht, 1968).

Third, including either base-rate visual information or visual exemplars about SSBs and the sugary drink industry practices did not enhance the effects of textual, targeted inoculation messages. Past studies have offered evidence that visual exemplars can enhance persuasive impact and that graphs, charts, and maps that display base-rate visuals could also be effective in communicating health information (e.g., Ancker et al., 2006; Niederdeppe, Roh, & Dreisbach, 2016). However, our study suggests that visuals that were selected based on a rigorous pretest for perceived visual informativeness did not enhance the effects of targeted inoculation on perceived threat to freedom, anger, or counterarguing. The lack of effects might be related to our decision to match the images in terms of their congruence with the arguments in the inoculation message—that they did not offer unique new information. Additional research is needed to determine what visual features seem more likely to drive strategically advantageous effects.

Fourth, targeted inoculation triggered resistance-related psychological processes toward the anticipated opposing message only when people encountered the anti-policy message immediately after the targeted inoculation exposure, but not at delayed measurement. Also, the targeted inoculation message successfully reduced the impact of the anti-policy message on anti-industry beliefs at time 1 but not at time 2. Thus, our findings are consistent with many other inoculation studies that have shown that inoculation effects decay quickly over time (Pfau, 1997; Pryor & Steinfatt, 1978). This result could have occurred if perceptions of threat, anger, and counterarguments were primed by the targeted inoculation message, elevating their intentions to resist the impending opposing message in the short term (Insko, 1967). Such a primed state of message resistance may not hold over time in a public information environment in which corporations and government institutions regularly convey messages about personal responsibility and agency. Therefore, a single targeted inoculation exposure may not protect people from persuasion attacks over time, a situation that poses a huge challenge for health policy advocates.

This study has limitations. We measured some psychological processes (e.g., anger and counterarguing) directly after message exposure, which might prime people to think about these processes and have intensified respondents' reactions more so than they would have been experienced in natural settings. Also, we measured perceived threat to freedom but not traditional attitudinal threat or motivational threat. Future research should include alternative measures of threat to compare their functions in inoculation. Finally, we did not measure whether respondents have obesity or diabetes or if they have obese or diabetic family members. Given that consuming sugary drinks can increase the risks of obesity and diabetes, it is possible that having these health conditions may moderate the effects of message inoculation against the sugary drink industry.

Conclusion

Our findings suggest that targeted inoculation messages can improve resistance to anti-health policy messaging in the short term. Anger seems to offer additional explanatory power in predicting the success of targeted inoculation in shaping anti-industry beliefs and pro-health policy support. We did not find any evidence supporting the inclusion of visual imagery to targeted inoculation messages. These

findings can inform public health professionals, campaign strategists, and advocacy groups about utilizing the inoculation approach in health campaigns, opinion pieces, and advocacy messages to build defense against industry anti-policy messaging.

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