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# How to Counter Disinformation: What Works — Prebunking, Debunking, and Inoculation

**Pavlichenko Ketevan**

Salt Lake City, Utah.

## Abstract

*Recognizing disinformation as one of the foremost global risks that erode social resilience and trust in institutional mechanisms, this study provides a comparative analysis of two foundational countermeasures: preventive psychological inoculation and reactive debunking. The aim of the research is to systematically explicate the cognitive foundations, assess the empirical effectiveness, and identify the practical limitations of each approach in order to formulate evidence-based recommendations. The methodological basis encompasses a systematic review of academic publications and analytical reports followed by a comparison of theoretical models and experimental findings. The results indicate that, despite a moderate advantage of debunking in correcting discrete factual distortions, its efficacy declines sharply when trust in the source is lacking and under conditions of political polarization, where effects on behavioral attitudes are minimal. In contrast, prebunking, grounded in inoculation theory, strengthens long-term cognitive resilience to manipulative techniques and therefore represents a strategically preferable solution for the contemporary media environment. This implies the need to shift emphasis from reactive practices toward proactive, scalable, and cognitively oriented inoculation strategies. The findings will be of value to researchers in communications and cognitive psychology, developers of educational programs, strategic communications professionals, as well as technology platforms and governmental bodies responsible for information security.*

**Keywords:** *Disinformation, Preventive Inoculation, Prebunking, Debunking, Inoculation Theory, Cognitive Psychology, Information Literacy, Generative AI, Public Health.*

## INTRODUCTION

The modern information environment operates at speeds and scales previously inconceivable, and the democratization of content production tools has turned this advantage into a source of systemic, cross-border risk—disinformation. The phenomenon has long moved beyond narrow academic debates and has become a significant destabilizer of socio-political dynamics. Its priority is recognized at the highest international level: in the World Economic Forum's Global Risks Report 2025, disinformation and misinformation are, for the second consecutive year, listed among the principal short-term threats associated with intensifying social polarization, erosion of trust in governmental and scientific institutions, and the slowdown of interstate cooperation in addressing critical tasks [1]. Empirical verification of the problem's scale was vividly demonstrated in 2024: from false narratives about falsifications in elections to coordinated campaigns around natural disasters and geopolitical crises, which resulted in tangible social and economic costs [2, 3].

The escalation of the crisis is fueled by two technological drivers that are tightly coupled. First, social platforms have de facto become the primary news channel for a substantial share of the population, shaping an ecosystem optimized for viral dissemination of emotionally charged yet often unreliable content [4]. Second, the rapid progress of generative artificial intelligence has produced a manifold increase in the capability to create highly realistic, multimodal, and targeted disinformation. Technologies that, according to McKinsey reports, are being actively integrated into global business processes simultaneously and radically reduce the costs of producing plausible falsifications—from synthetic images to deepfake video—thereby creating a threat asymmetry [5, 6]. Taken together, this creates a threat multiplier: the institutional recognition of disinformation as a structural risk intersects with a technological explosion that democratizes and scales the means of its generation, as a result of which traditional countermeasures—above all manual fact-verification—prove strategically insufficient [7].

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In response to the identified challenge, the scholarly community and practitioners have articulated two basic lines of counteraction: reactive (debunking, or refutation) and proactive (prebunking, or preventive inoculation). The former relies on refuting false claims already in circulation, whereas the latter is oriented toward the prior development of psychological resistance in the target audience to future disinformation influences. Although each strategy has been studied in detail separately [8], a gap remains in the literature: there is no comprehensive comparative analysis of their cognitive mechanisms, empirical effectiveness, and—crucially—their applicability across differing situational regimes, including in public health and political mobilization.

**The purpose** of the article is to conduct a multifaceted comparative analysis of the cognitive foundations, empirically confirmed effectiveness, and practical limitations of prebunking and debunking strategies in order to develop evidence-based recommendations for countering disinformation.

**The scientific novelty** of the work lies in the proposed integrative connection of cognitive theories and empirical data, which makes it possible to identify the situational determinants of the effectiveness of each of the strategies under consideration.

**The author's hypothesis** is as follows: despite the fact that debunking can demonstrate slightly higher effectiveness in correcting individual factual errors, the strategically preferable approach is prebunking, based on inoculation theory, since it forms long-term cognitive resilience to manipulative techniques—a quality that is critically important in polarized information ecosystems.

## MATERIALS AND METHODS

The study relies on a systematic literature review design, augmented by a comparative analysis of theoretical constructs and empirical results. This methodological linkage makes it possible not merely to consolidate disparate findings, but also to productively integrate interdisciplinary advances — from cognitive psychology and mass communication theory to political science — with the aim of constructing a coherent and verifiable research position. The research procedure is implemented in stages. First, the foundational theoretical premises that determine the logics of prebunking (psychological inoculation theory) and debunking (cognitive models of belief updating and the continued influence effect) are compared. These propositions are then aligned with the corpus of empirical data, which enables a quantitative assessment of practical effectiveness as well as the identification of key moderators and constraints of each approach.

The source base comprises selected scholarly and analytical publications, predominantly from recent years, which ensures the currency and thematic relevance of the conclusions. All materials are systematized into three groups. First, theoretical and review articles from peer-reviewed journals that set the conceptual boundaries: they explicate the principles of psychological inoculation, describe the cognitive mechanisms of the perception and correction of disinformation, and offer taxonomies of existing interventions, thereby forming the theoretical framework of the study. Second, empirical studies and meta-analytical reviews in high-impact journals (including Nature, PNAS, European Review of Social Psychology), which provide experimental evaluations of the effectiveness of prebunking and debunking strategies and serve as the empirical basis for their comparative analysis. Third, analytical reports by authoritative international institutions (e.g., the World Economic Forum) and leading consulting firms (McKinsey), which provide a macro-level perspective: they consider disinformation as a systemic global risk and connect the problem with accompanying technological trends, above all with the development of generative AI.

Such a configuration of sources affords a multidimensional perspective on the research problem: theoretical depth is combined with empirical testability and a clear understanding of the applied context, which makes it possible to develop an argued and methodologically rigorous position regarding the comparative effectiveness and boundaries of applicability of the prebunking and debunking approaches.

## RESULTS AND DISCUSSION

The effectiveness of any measures to counter disinformation is determined by the extent to which they correspond to the actual mechanisms of human cognition. Prebunking and debunking rely on different models of intervention in cognitive processes, which predetermine their asymmetric advantages and limitations.

The prebunking strategy traces back to inoculation theory proposed by social psychologist William McGuire in the 1960s [10]. The key here is the vaccination metaphor: just as a weakened pathogen triggers the formation of biological antibodies, so a reduced dose of disinformation can initiate the development of cognitive antibodies that increase resistance to subsequent informational influences [16]. The inoculation mechanism includes two essential elements.

At the first stage, the recipient is given a clear signal that their entrenched beliefs may become the target of attack. This warning serves a motivational function: the awareness of vulnerability activates protective attitudes and stimulates the independent generation of counterarguments [10, 14].

Preventive refutation is the second element, which consists in presenting weakened samples of arguments that are likely to be used against the recipient, with their advance neutralization. In contemporary inoculation practices, the focus is gradually shifting from refuting individual false claims (content-based inoculation) to exposing universal manipulative techniques (technique-based inoculation) —

emotionally charged rhetoric, false dichotomies, scapegoating, and appeals to conspiratorial narratives. This orientation provides substantially higher scalability and effectiveness: once acquired, the ability to recognize a technique transfers to an unlimited number of new disinformation messages [13, 21].

Thus, prebunking does not merely transmit information but purposefully engages the individual in forming their own cognitive defense, transforming them from a passive consumer into an active analyst of ongoing events.

The debunking strategy, for all its intuitive appeal, runs up against a set of persistent cognitive obstacles that sharply undermine its effectiveness. The key difficulty is the continued influence effect: even after accepting a correction, people continue to rely on the original misinformation when interpreting facts and drawing conclusions [12]. This phenomenon is sustained by several interrelated mechanisms.

First, mental models. To make sense of events, individuals construct coherent causal structures. Misinformation works because it provides a simple and vivid explanation of complex processes, filling critical gaps in such a structure. The simple message X is false removes one of the supporting elements, leaving a void in the model. Confronted with a choice between an incomplete but accurate model and a complete yet erroneous one, the mind often prefers the latter. Consequently, effective refutation is not reducible to labeling a claim as false; it is necessary to offer an alternative account comparable in coherence and explanatory power, capable of occupying the place of the false fragment in the mental model [11, 15].

Second, the dual-process architecture of memory. Retrieval can rely on fast, low-effort automatic processes based on familiarity, or on slow strategic processes that require attention and reinstate context — source, conditions, reliability. Repeated misinformation quickly becomes familiar and is therefore easily activated by automatic pathways. A correction is often encoded as a negation tag, access to which requires strategic search. Under conditions of attentional overload and time pressure, automatic mechanisms dominate, with the result that the false assertion itself is recalled rather than its correction [11].

Third, the illusory truth effect: repeated exposure increases the subjective credibility of a statement by easing the processing of familiar material. A paradoxical yet empirically observed scenario is that a poorly constructed correction — one that repeats the myth again and again in order to debunk it — unintentionally reinforces the myth by increasing its familiarity and, as a consequence, long-term confidence in its plausibility [11].

As a result, the confrontation between prebunking and debunking revolves around competition for limited cognitive resources. Debunking demands substantial effort: restructuring an already formed mental model and suppressing automatically triggered heuristics. In contrast, prebunking functions as an investment in the prior formation of mental antibodies — robust rules for recognizing manipulations that enable rapid, low-load identification of misleading message structures at the moment of contact. This mechanism aligns better with the real conditions of the digital environment, where attention is dispersed and processing speed is critical [11] (see Table 1).

**Table 1.** Comparative characteristics of the cognitive mechanisms of Prebunking and Debunking (compiled by the author based on [10, 15, 19, 24]).

| Criterion | Prebunking (Inoculation Theory) | Debunking (Information correction) |
|---|---|---|
| Timing of intervention | Preventive (before exposure to disinformation) | Reactive (after exposure to disinformation) |
| Primary objective | Building resistance to future attacks | Correcting already formed false beliefs |
| Key cognitive process | Threat activation and anticipatory counter-arguing | Updating the mental model and inhibition of automatic memory |
| Role of the individual | Active builder of cognitive defense | Predominantly a passive recipient of correction |
| Cognitive load | High at the moment of inoculation, low at the moment of encountering disinformation | Low at the moment of reception, high at the moment of correction and belief updating |
| Primary vulnerability | Waning of the effect over time (decay effect) | Continued influence effect (continued influence effect) |

Theoretical divergences between the approaches are corroborated by empirical evidence that enables assessment of their applied effectiveness and identification of key contextual determinants of outcomes. Comparative studies directly juxtapose prebunking and debunking and show that both strategies can substantially reduce trust in misinformation, although meaningful nuances emerge between them. A large-scale study conducted under the auspices of the Joint Research Centre of the European Commission (JRC), published in Nature, recorded a slight advantage of debunking in refuting specific false narratives [8]. Compared to prebunking, debunking is statistically significantly more effective in decreasing agreement with a false claim and reducing the willingness to share it on social media (average marginal effect — minus 3,09 percentage points) [8]. At the same time, no differences were identified between the methods in lowering credibility assessments of false information. These results indicate that for the targeted correction of a specific fact, debunking may serve as a more

effective tool; however, as will be shown below, this tactical advantage is offset by strategic vulnerabilities that emerge under more complex and real-world-proximate conditions (see Fig. 1).

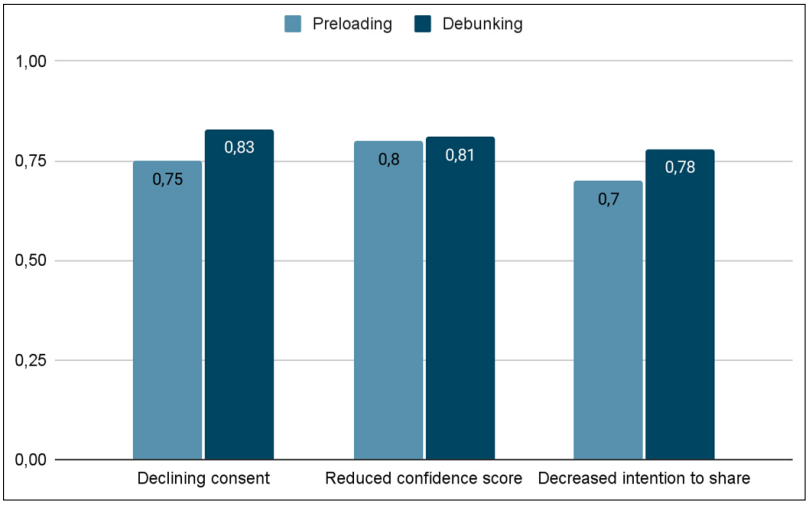


**Fig. 1.** Preloading and debunking (compiled by the author based on [8, 23]).

The context of health-related misinformation (including narratives about vaccination and the COVID-19 pandemic) is fundamentally important for analysis, since it is dominated by the parameter of trust in the communicator [18]. The referenced JRC study recorded a key regularity: the effectiveness of debunking is directly modified by the audience's level of trust in the source of refutation [17]. When the correction originated from a recognized state institution, it proved more effective for segments that initially trusted that institution. By contrast, among groups with low trust in the authorities the same message became counterproductive: it not only failed to weaken but sometimes strengthened adherence to misinformation, displaying a boomerang effect. This vulnerability is one of the central Achilles heels of debunking. In contrast, prebunking, by focusing on the recognition of manipulative techniques rather than on the authority of the source, is substantially less sensitive to trust deficits and retains effectiveness even in polarized, skeptical audiences (see Fig. 2).

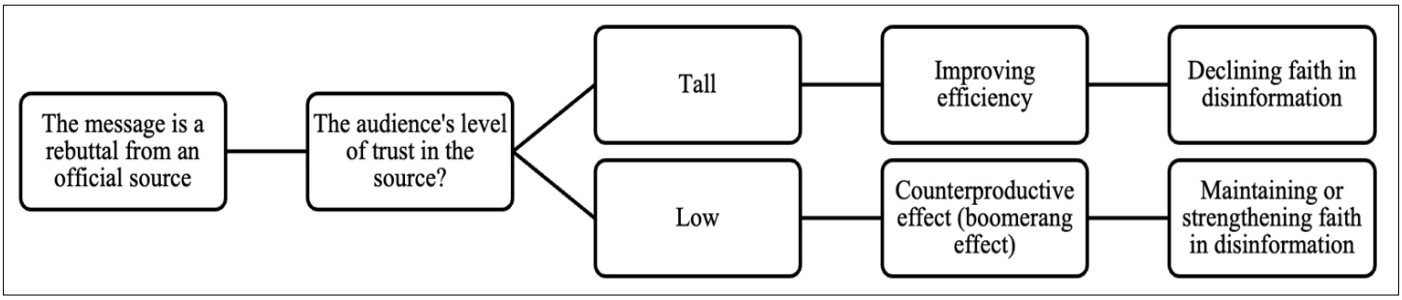


**Fig. 2.** Diagram of the influence of trust in the source on the effectiveness of Debunking (compiled by the author based on [7, 20, 25]).

The greatest vulnerability of debunking practices manifests precisely in the political domain. Here, messages are evaluated not by criteria of empirical correctness, but through the lenses of partisan self-identification and ideological commitment. A body of studies based on U.S. electoral campaigns demonstrates that: even when supporters of a particular politician are presented with incontrovertible evidence of the falsity of his statements — and even when they explicitly acknowledge the correctness of the correction — their electoral attitudes and their image of the politician change little, if at all. An effect of ironic coexistence arises: an individual can simultaneously recognize the falsity of statement X and continue to support its source as if the statement remained true [9]. Consequently, under conditions of heightened political charge, debunking proves to be a tool of limited tactical power: it operates at the level of factual verification, whereas real decisions are anchored in value orientations and the logic of group loyalty. By contrast, prebunking, which cultivates skills for recognizing universal propaganda techniques irrespective of actors, is potentially capable of bypassing these party shields, although its capacity to overcome deep-seated ideological commitments requires further empirical testing.

Thus, the accumulated evidence compels a reconsideration of the very definition of effectiveness. If it is understood as the successful correction of a single factual error in a controlled setting, debunking will appear to be the more advantageous strategy. However, when effectiveness is construed as the cultivation of long-term cognitive resistance capable of transforming behavior within real, polarized information ecosystems, the strategic advantage shifts to prebunking.

Below, Table 2 describes the effectiveness of the strategies across various applied contexts [9].

**Table 2.** Effectiveness of strategies across applied contexts (compiled by the author based on [9, 15]).

| Context | Debunking (Advantages and risks) | Prebunking (Advantages and risks) |
|---|---|---|
| Neutral, factual information | Advantage: High effectiveness in correcting a specific fact. Risk: Requires resources for each individual case. | Advantage: Less relevant for single facts. Risk: Inexpedient. |
| Public health | Advantage: Effective when trust in the source is high (physicians, scientists). Risk: Counterproductive when trust is low (boomerang effect). | Advantage: Trains recognition of tactics (pseudoscientific arguments), does not depend on trust in a specific source. Risk: Requires proactive deployment. |
| Political sphere | Advantage: Can correct facts. Risk: Extremely low impact on political behavior and preferences due to partisan identity. | Advantage: Potentially bypasses partisan defenses by focusing on universal manipulation techniques. Risk: The effect may be insufficient to overcome strong ideological commitment. |

The theoretical advantages of prebunking take shape in concrete methodological and technical formats that make it possible to scale inoculation against disinformation to broad audiences. One of the most compelling cases is gamification. Game environments such as Bad News, created by a research group at the University of Cambridge, function as interactive simulators in which the user adopts the role of a producer of falsified news [16]. While progressing through scenarios, participants operationalize six basic manipulative techniques, from impersonation and emotionally charged rhetoric to the fabrication of conspiratorial narratives. This active learning mode substantially outperforms passive information uptake, as it develops procedural skills for recognizing manipulations rather than only declarative knowledge. The results of large-scale cross-national studies show that participation in Bad News statistically significantly reduces the perceived credibility of manipulative content without degrading the evaluation of legitimate news [16]. The effect is consistently replicated across diverse cultural and linguistic contexts, which confirms the strong potential of gamification as a universal and easily replicable tool for mass psychological inoculation (Fig. 3).

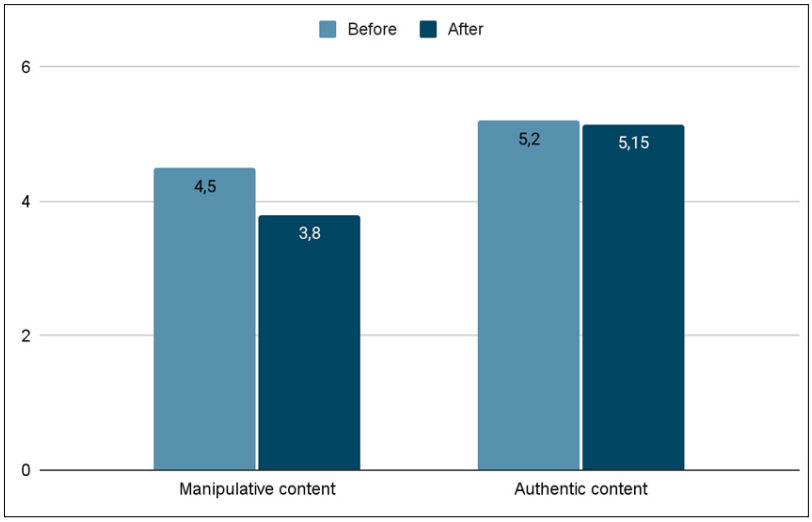


**Fig. 3.** Dynamics of decrease in confidence in fake news after inoculation game (compiled by the author based on [16]).

Generative AI models, while being a crucial accelerator of disinformation dissemination, simultaneously provide the technological basis for its containment. Research groups are actively investigating the potential of large language models (LLM) as the core of a new generation of inoculation solutions. Particularly promising is the embedding of LLM into browser extensions and social platform plugins that diagnose the content being viewed in real time and deliver to the user gentle behavioral signals (nudges) about the presence of propagandistic or manipulative techniques [22]. Such a design shifts efforts from episodic educational interventions (such as games) to a continuous protection embedded in the media environment that accompanies the user's everyday online practice. In essence, this is a paradigm shift: from targeted instruction of the individual to the construction of an intelligent information ecology that supports more well-founded decision making.

The diagram (Fig. 4), constructed from the data of the WEF report, clearly depicts the profile of short-term global risks for 2025: disinformation and misinformation emerge among the most significant threats, underscoring the critical need to develop effective countermeasures.

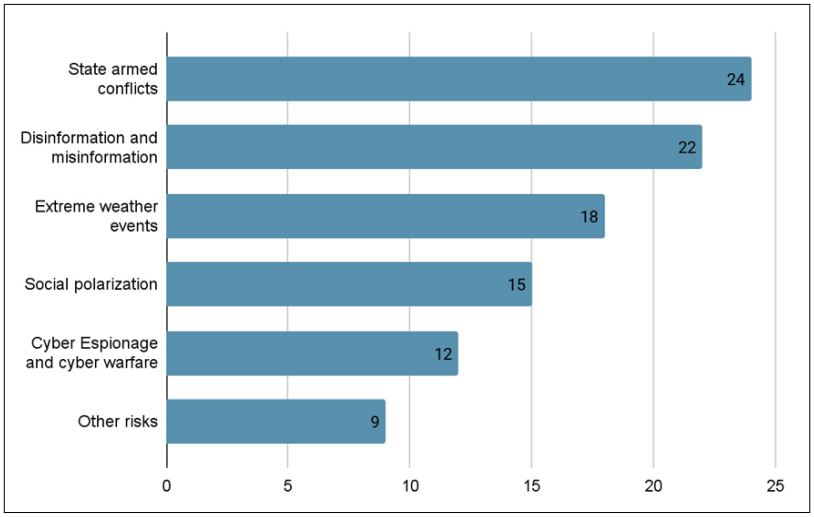


**Fig.4.** Key short-term global risks for 2025 (according to the WEF version)(compiled by the author based on [1]).

Despite a compelling empirical base for the effectiveness of prebunking, a number of fundamental uncertainties and limitations remain that shape the agenda for further research. A synthesis of current studies makes it possible to delineate three principal lines [21]:

- Durability of effects: the action of psychological inoculation is subject to natural decay. At present there is insufficient empirical evidence describing the shape of the decay curve and the optimal revaccination intervals required to maintain stable cognitive immunity.

- Gap between laboratory and practice: a substantial share of results has been obtained under highly controlled conditions. Field trials are required to assess how inoculation interventions translate into actual user behavior within the dynamic and competitive ecosystem of social platforms, in particular — their decisions about sharing specific materials.

- Collective resilience: the strategic goal of countering disinformation is not individual protection but a societal resistant contour. This implies a shift from the conceptual apparatus of cognitive psychology to an epidemiological perspective. Future work should model information epidemics in order to determine the population share and the intensity of vaccination sufficient to reduce the virality (reproduction coefficient) of disinformation and to achieve the effect of herd immunity.

These problems set an important methodological framework: if foundational psychological research has convincingly confirmed the feasibility of inoculation, the next step — the science of implementation. It requires interdisciplinary integration of psychology, epidemiology, data science, and computational modeling. The focus of research questions shifts from Does it work? to How to design, scale, and sustain it at the societal level?

## CONCLUSION

The conducted comparison of prebunking and debunking strategies makes it possible to formulate several fundamental conclusions. Reactive refutation (debunking) remains necessary but, by itself, is an insufficient means of countering disinformation. Its effectiveness is tightly constrained by basic cognitive regularities, including the continued influence effect, and it approaches zero in contexts dominated by strong group identity and low institutional trust—above all in politics.

By contrast, preventive inoculation (prebunking) exhibits a more calibrated and forward-looking logic of intervention. By acting in advance and targeting universal manipulation techniques rather than isolated factual claims, this approach builds long-term cognitive resistance in individuals that is less susceptible to contextual variables. This confirms the author's hypothesis: debunking can win a tactical skirmish over an individual fact, whereas prebunking provides a strategy for victory in the protracted war for society's cognitive resilience.

The practical significance of the findings spans several key domains.

For educational institutions: the results necessitate shifting the emphasis in media literacy programs from predominantly teaching fact-checking to cultivating resistance to manipulative techniques based on inoculation theory.

For technology platforms: rather than relying exclusively on reactive content moderation, platforms should systematically embed scalable prebunking tools into user interfaces, from inoculation games to AI prompts.

For government bodies and civil society organizations: it is necessary to design and implement national information campaigns as programs of mass psychological vaccination, especially in the domains of public health and the integrity of electoral processes.

In an era in which disinformation has evolved from a byproduct of informational freedom into an instrument of hybrid warfare and a driver of global instability, the shift from reactive to proactive, cognitively grounded, and scalable strategies becomes not merely preferable but a

critically necessary condition for preserving public trust and democratic institutions.

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