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Bridging gaps in image meme research: A multidisciplinary paradigm for scaling up qualitative analyses

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Abstract

This paper outlines a multidisciplinary framework (*Digital Rhetorical Ecosystem or DRE3*) for scaling up qualitative analyses of image memes. First, we make a case for applying rhetorical theory to examine image memes as quasi-arguments that promote claims on a variety of political and social issues. Next, we argue for integrating rhetorical analysis of image memes into an ecological framework to trace interaction and evolution of memetic claims as they coalesce into evidence ecosystems that inform public narratives. Finally, we apply a computational framework to address the particular problem of claim identification in memes at large scales. Our integrated framework answers the recent call in information studies to highlight the social, political, and cultural attributes of information phenomena, and bridges the divide between small-scale qualitative analyses and large-scale computational analyses of image memes. We present this theoretical framework to guide the development of research questions, processes, and computational architecture to study the widespread and powerful influence of image memes in shaping consequential public beliefs and sentiments.

1 | INTRODUCTION

In the aftermath of the February 3, 2023 train derailment disaster in East Palestine, Ohio, outrage exploded as inadequate official narratives clashed with first-hand testimonies and frantic sensemaking in online spaces. The trending hashtag #OhioChernobyl equated the toxic conditions created by the derailment with the 1986 nuclear disaster in the Soviet Union. Allusions to Chernobyl also implied "that national and local media were ignoring the disaster" (Thompson, 2023, para. 19). Mistrust of the rail company and of government entities dominated public opinion, both in the affected Ohio communities as well as nationally. Social media influencers ran amok with speculations about the extent of the damage and about the federal government's efforts to cover up details of the disaster. While official messages were insufficient and confusing, online sensemaking filled in gaps, with "rumors and suspicions... swirling on Facebook and TikTok accounts all over the country" (Robertson & Cochrane, 2023, para. 8).

The ubiquity of public sensemaking through social media networks makes social media chatter a significant variable in understanding public uptake and rejection of official messaging and the formation of public opinion and action in crisis events. However, our capacity to trace such sensemaking lags behind its incredible power to galvanize publics. Understanding how narratives about political and social crises rise to the surface requires

FIGURE 1 These sample image memes illustrate attempts to make sense of the Ohio train derailment by situating narratives about the event within other contemporaneous circulating narratives that signal distrust of the government.

studying the entanglements between social media and legacy media discourses. While capacities exist for identifying narratives emerging from online discourse (Cordes, Applegate-Swanson, et al., 2021; Snowden, 2002), we are currently under-estimating a powerful vector of online narrative creation and dissemination—the image meme (Highfield & Leaver, 2016).

Figure 1 shows examples of image memes about the Ohio train derailment, selected from public posts on social media accounts, and presented without any identifying information. The examples come from a collection curated by the authors. Large-scale computational image meme research (e.g., Tommasini et al., 2023) typically draws image meme samples from (1) online encyclopedias like Know Your Meme, which invite crowd-sourced submissions and offer metadata on image memes such as date of origin, evolution, and cultural background, or (2) from online image meme sharing platforms like X (formerly Twitter), Facebook, and Reddit as well as smaller online communities like HiddenLol, Memedroid and Dump A Day (e.g., Morina & Bernstein, 2022), or (3) through Google Image search (e.g., Sharma et al., 2023b). Many of the meme examples presented in this paper are not cataloged on the Know Your Meme database, underscoring the importance of expanding and collating various image meme collections and catalogs for research.

Current events are regularly and rapidly absorbed into image meme discourse (Dancygier & Vandelanotte, 2017; Grundlingh, 2017). Beyond serving simply as a vehicle for transmitting narratives constructed on other media, image memes themselves can develop and amplify narratives by engineering quasi-arguments (Mascarenhas, 2021). These narratives have documented impacts on public belief, sentiment, and action (Cordes, David, et al., 2021). For example, image memes function as an "important element of participation in digital publics" engaged in environmental discourse (Jones et al., 2022). During the 2016 US presidential election, Internet memes "enabled users to rapidly take a stand on and react to developing political events in real time; they provided alternative parallel discourses to mainstream media viewpoints; and they enabled mobilizing voters outside of official political discourses" (Heiskanen, 2017, Abstract). Image memes also correlate with public health choices. Rates of HPV vaccination were lower in states where "memes expressing safety concerns, misinformation, and conspiracies comprised a higher proportion of Tweets" (Isaacs, 2020, p. 497). In fact, memetic circulation of such content correlated more strongly with vaccine uptake than other factors known to influence this choice, such as "race, ethnicity, education, and income" (Isaacs, 2020, p. 497).

In this paper, we present a rhetorical-ecological framework for studying image memes, as an effort to preserve the health of information ecosystems. We explain why examining image memes as quasi-arguments that advance claims, as well as tracing how those memetic claims develop, circulate, and evolve within information ecosystems, can give us a richer picture of the threats that image memes pose to information ecosystems by polluting them with misinformation and disinformation. Information ecosystems have been studied along multiple dimensions, including "information needs, information landscape, production and movement, dynamics of access, use of information, impact of information, social trust and influencers" (Kuehn, 2022, p. 438). Our work draws attention to an additional dimension within information ecosystems, namely the rhetorical form of

information artifacts. By tracking the role that a particular type of artifact (e.g., the image meme) plays within an information ecosystem, we gain insights into the other systemic dimensions outlined above. For example, high-level image meme activity contradicting mainstream narratives, in niche information ecosystems, can signal siphoning of social trust away from consensus-approved sources. Additionally, the virality of specific image meme content can also identify particular public needs for information, and therefore opportunities for engagement or intervention with publics.

We encourage taking image memes seriously as artifacts of public influence and posit that social media users become persuaded by the additive and interactive effects of memetic content, over time. Therefore, the capacity to trace cumulative impacts of image meme content can be useful. Kuehn (2022) conceptualized information ecosystems as dynamic aggregations of evidence across particular domains of knowledge. Accumulation of information about a topic over time builds latent potential for evidence synthesis, that is, comparing and contrasting information to extract evidentiary patterns, accumulating an evidence ecosystem for that topic. While the concept of evidence ecosystems in Kuehn's work pertains to knowledge domains like health sciences, we extend the concept of the evidence ecosystem to image meme circulation. As we explain later in this paper, memes function as quasi-arguments by furnishing or alluding to evidence, whether valid or not. The ability to identify traces of evidence aggregating across image memes sheds light on how public beliefs that contradict mainstream narratives come to hold persuasive power. Observing accumulation and change in evidence patterns can strengthen intervention efforts that seek to combat spurious beliefs because corrective messages can be refined by a deeper understanding of the cumulative and shared evidence patterns that underlie those beliefs. By situating images memes within an evidence ecosystem framework, we heed Ma's (2021) observation that "problematic information phenomena" such as misinformation and disinformation "have an individual transcending quality" (p. 1297), inhabiting, infecting, and driving collective epistemologies, instead. By focusing on an artifact of information pollution, that is, the image meme, we gain insight into the emergence and evolution of these collective epistemologies, without needing to access individuals' cognitions or beliefs.

2 | STATE OF THE ART IN IMAGE MEME RESEARCH

Image meme research is occurring at different scales and across methodologies. We can situate this breadth of work in approximately three areas—(1) smaller-scale qualitative analyses dedicated to understanding the cognitive processes that underlie sensemaking from image memes, (2) smaller-scale critical analyses that examine image memes as cultural artifacts, and (3) larger-scale computational analyses that leverage machine learning to detect and classify image memes, specifically according to sentiment.

Qualitative research on image memes focuses on understanding memes as patterns of language. For example, Zenner and Geeraerts (2018) applied a Cognitive Linguistics framework to examine wordplay in image memes. Some qualitative research has examined the mechanisms by which image memes function as speech acts—for example, Dynel's (2016) exposition of how image macros (memes with captions superimposed on visuals) reflect a "continuity with the classic joke format" (p. 668). Shifman (2014) applied a critical-cultural perspective, identifying key "logics" of participatory digital culture in photo-based meme genres (p. 341). Huntington (2013) used visual rhetoric which "combines elements of the semiotic and discursive approaches to analyze the persuasive elements of visual texts" for analyzing memes as "a form of subversive communication in a participatory media culture" (p. 2). Hahner (2013) made the case for treating memes as "visual arguments" (p. 153). And Milner and Wolff (2023) illustrated how image memes "hail participants into a collective identity" (p. 4). Qualitative approaches such as those taken in cognitive linguistics focus on memes as linguistic constructions, identifying "the cornerstones and building blocks" of image memes (Zenner & Geeraerts, 2018, p. 174), while rhetorical studies, including the one we propose, draw attention ultimately to the interpretive outcomes that emerge from the configurations of the building blocks within the image meme. In our framework, we explain how content and form within the image meme activate lines of reasoning to assert arguments.

Qualitative studies generate important insights about how memes create public sensemaking. However, they do not address the scale of social cognition forged by the sheer volume of image meme content generated and circulated online. Computational analyses, on the other hand, have observed image memes at large scales, using techniques such as image classifiers and optical character recognition (OCR) of text in images. Some of this work is dedicated to tracing where image memes originate from and how they spread across web platforms (Morina & Bernstein, 2022). Computational work has also focused on training automated systems to combine analysis of text and image modalities to detect offensive content, particularly hate speech (Afridi et al., 2021; Koutlis et al., 2023; Tung et al., 2023). In addition to focusing on text and image, the spatial placement of "faces, visual objects, and text clusters" in image memes has been

studied to conduct sentiment analysis (Hazman et al., 2023, p. 5). Computational image meme studies have also examined their virality (Barnes et al., 2021; Ling et al., 2021) and their evolution over time and across platforms (Beskow et al., 2020), including short-lived evolutionary trajectories described as memetic moments (Smith & Copland, 2022). Some studies have explored large-scale cataloging and analysis of memes (Kougia et al., 2023; Sharma et al., 2023b; Tommasini et al., 2023).

While the bulk of computational studies on image memes focuses on detecting and categorizing them according to sentiment, some computational research has attempted to unveil the sensemaking that produces sentiment effects, for example by identifying "whether the meme glorifies, vilifies, or victimizes each entity it refers to" (Sharma, Kulkarni, et al., 2023, p. 1). The latter study is an example of combining a qualitative paradigm, in this case "narrative framing" (p. 2), with tracking the sensemaking process across a large corpus of image memes. The need for bridging work between qualitative, critical, and quantitative research is particularly relevant currently, when image memes are playing a substantial role in the formation of beliefs and attitudes across digital publics. This opportunity is especially ripe in the field of information studies, which has begun the turn toward recognizing socio-cultural processes that underlie sensemaking in information ecosystems.

Tang et al. (2021) have urged paradigm shifts in information studies to address unprecedented changes in the "social, political, economic, and cultural dimensions" of "information as phenomena" (p. 253), including the pollution of information ecosystems by mis- or disinformation. In particular, they emphasized the need to move from individual user cognition and experience to models of "shared/distributed... cognition" (p. 254) and to "understand the sociomateriality of information artifacts embedded in various social-technical contexts" (p. 256). Recent scholarship in information studies has begun to examine social media contexts and modes of communication (Hagen et al., 2021; Potnis & Tahamtan, 2021).

We argue that image memes are a rich resource for understanding consequential collective social cognition, especially in information contexts that breed extremism. Studying the impact of image memes requires a combination of approaches. Researchers have underscored "the need to bridge... the computational and the cultural analysis of visual social media" (Highfield & Leaver, 2016). Cross-disciplinary collaboration can leverage multiple methodologies to grasp the widespread influence that image memes exert in developing shared public cognition. We join other voices in urging serious study of image meme-driven sensemaking and its potential to influence information ecosystems. Our framework contributes to efforts that span the gap between small-scale qualitative and large-scale computational analyses, to stimulate research on the impacts of image memes at varying scales.

Specifically, we combine rhetorical and ecological theoretical frameworks to encourage the development of analysis architecture and research questions for studying image memes. While image memes have already received attention as rhetorical artifacts (e.g., Hahner, 2013; Huntington, 2013), our paper furthers the application of rhetorical theory to the study of image memes by demonstrating how and why image memes should be analyzed as artifacts of public quasi-argumentation using the Toulminian argument framework (Toulmin, 1958). We also insert rhetorical analysis of image memes into a broader analytic framework guided by ecological theory in order to scale up the volume of image meme analysis. The integrated rhetorical-ecological framework holds promise for surfacing patterns of belief and sentiment formation across a wide range of public-interest topics, which in turn can help us understand the formation of consequential digital publics that become aligned around interests and worldviews forged through circulation of image memes on social media platforms.

3 | KEY TERMS AND ASSUMPTIONS

Before we present our approach for studying image memes, we clarify the terminology and assumptions used in this paper. First, we intentionally pluralize the term "ecosystem." Kuehn (2022) contrasts conceptions of the information ecosystem as a universal context of "information that is present in one's daily and public life" with recent usages of the term referring to "specific systems of social media and online communities" (p. 435). Because image meme sensemaking on social media intentionally feeds off official and mainstream sources of information, we assume fragmentation of the ecosystem, to recognize the entanglements between these disparate information contexts. Image memes also live more abundantly on some social media platforms rather than others due to the platforms' varied structural affordances and constraints. Accordingly, a study of the sensemaking role of image memes requires acknowledgment of these niche information ecosystems. Nonetheless, image meme sensemaking that originates in specific digital public spaces influences beliefs, opinions, and actions of other publics (digital and non-digital), thus transcending specific ecosystems of origin and perturbing the universal information ecosystem, as well.

Secondly, we clarify our definition of the term "image meme." Well-known meme creator, Saint Hoax,

described the meme "as a piece of media that is repurposed to deliver a cultural, social or political expression, mainly through humor" (Benveniste, 2022) and as an artifact that "has the ability to capture insight in a way that is in complete alignment with the zeitgeist," (as cited in Benveniste, 2022). The word "meme" has become semantically elastic—stretching from a general "unit of culture" to the specific form of the image-macro, which refers to "captioned images that typically consist of a picture and a witty message or a catchphrase" (Image Macros, 2020, para. 1). We use the term image meme to refer to a specific visual artifact that has become ubiquitous on social media platforms like Facebook, X (formerly Twitter) and Reddit (Morina & Bernstein, 2022). We distinguish this artifact by two features—form and function, that is, the rectangular box that demarcates the artifact as a discrete communication unit and the use of this communication unit to participate in public argumentation. Unlike image macros which necessarily comprise a combination of both images and verbal text, our definition of the image meme includes artifacts that rely on just images, just text, or a combination of both. Although image memes execute a variety of rhetorical functions (Guenther et al., 2020; Taecharungroj & Nueangjamnong, 2015), and many instances of image memes communicate humor on mundane issues rather than engage with social or political topics, we focus on a sub-genre of image memes that participate in public argumentation by advancing claims about political, social, or cultural issues (Tindale, 2017).

The presence of image memes online is mostly localized to three types of sites—meme generators for creation of image memes, social media platforms (e.g., forums, message boards, and media sharing sites) for circulation, and databases for image meme documentation. Although meme developers often create image memes anonymously with meme generator sites, most audiences encounter previously created image memes on social media rather than post self-created ones. Finally, sites like Know your Meme and databases like the Internet Meme Knowledge Graph (Joshi et al., 2023) house collections of memes with some cataloging and analysis capabilities. For purposes of understanding how politically and socially relevant claims shape the beliefs and opinions of various online publics, social media platforms emerge as a key focal ground for observing image memes. Different platforms tend to host different types of memes. Zannettou et al. (2018) collected memes from "Twitter, Reddit, 4chan's Politically Incorrect board (/pol/), and Gab" and found "a substantial number of politics-related memes on both mainstream and fringe Web communities" (Abstract) but racist memes were more present on the fringe online social communities such as /pol/ and Gab.

FIGURE 2 Image meme using the "Condescending Wonka" template that claims masks are ineffective against Covid-19.

Given that image memes capture cultural trends and address current issues, memetic ecosystems are highly dynamic. Some image memes have demonstrated longer lifespans than others. For example, according to the Know Your Meme website, the Condescending Wonka image meme, "featuring a screen capture of actor Gene Wilder in the 1971 musical Willy Wonka and the Chocolate Factory" and for which "the captions can be characterized as patronizing and sarcastic," has been in circulation since 2010 ("Condescending Wonka/Creepy Wonka," 2012). That particular image meme has been remixed in various iterations with text captions that signal condescension on a variety of topics. Figure 2 shows a version that circulated during the 2020 pandemic. Even though the image content can have a long-life, different text overlays repurpose the image content to create different memetic claims, thus ensuring the ongoing evolution of memes. Typically, image memes have shorter lifespans and pass out of circulation even if they have been popular for a while. Ford et al. (2021) in a study of 352 text memes, selected from Know Your Meme for their popularity and then followed across their circulation on Reddit between 2010 and 2020, found that meme lifespans have grown significantly shorter over time. While the creation and circulation of new memes is increasing, the memes are staying relevant for shorter durations. Here, it becomes crucial to distinguish between what Tommasini et al. (2023) refer to as "the template" which is the underlying cultural unit that can be repurposed (i.e., the Condescending Wonka image) from what they refer to as an "instance" where the template is deployed to make a statement in a particular case (p. 5), as in Figure 2. In our

framework, we foreground the identification of memetic claims which are typically present in instances of template deployment and require interpretation of the visual or verbal components, including of the template, within the instance. However, since we also consider image memes that may contain mostly or only text within the rectangular frame, our definition of the term applies even in those instances that may not use a culturally relevant template.

4 | COMBINING RHETORICAL AND ECOLOGICAL FRAMEWORKS

The objective of our paper is to instigate systematic studies, at various scales, of image memes and their role in public sensemaking. We outline a theoretical framework (the Digital Rhetorical Ecosystem framework or DRE3) to inspire the building of digital architecture and processes for meme collection and analysis across platforms and subject matter. Although the framework can inform a stand-alone pipeline for meme collection and analysis, it can also guide smaller-scale analyses of how memes shape public belief and sentiment in specific topic areas of public controversy, such as the COVID-19 pandemic, vaccine skepticism, and climate change.

Our theoretical framework begins with rhetorical analysis of memes, particularly through the application of Toulminian argument theory (Toulmin, 1958), to trace sensemaking possibilities emerging out of image meme circulation. As rhetorical analysis is a critical-qualitative small-scale approach, we also cross disciplinary boundaries to widen our analytic framework by integrating biological ecosystem metaphors for guiding large-scale studies of the aggregate impacts of memes on information ecosystems over time. The usefulness of the theoretical framework outlined in this paper is not restricted to adopting the entire integrated model. We encourage teams of researchers to draw, as needed, from the rhetorical and ecological frameworks or combinations of both.

4.1 | Rhetorical analysis of memes as quasi-arguments

Philosopher Bruno Latour observed that "whether or not a statement is believed depends far less on its veracity than on the conditions of its 'construction'—that is, who is making it, to whom it's being addressed and from which institutions it emerges and is made visible" (Kofman, 2018). We add that the believability of a statement also accrues from the rhetorical form in which the statement is presented, a phenomenon that is particularly vivid in the role that images memes play in the development of public beliefs. We advocate attention not only to the content of memes but to their structural logics that demonstrate the argument potential of the content. One type of discourse to which such an analysis can make significant contribution is the growth of conspiracism across online communities.

Introne et al. (2020) have advocated studying conspiracism not as a "deficient epistemic process" but rather as a "diverse and dynamic collective sensemaking process, transacted in public on the web" (p. 184). They applied a narrative paradigm to argue that conspiracy theories should be understood as stories that make sense of events by implicating "deceptive, coordinated actors working together to achieve a goal through an action or series of actions that have consequences that intentionally disenfranchise or harm an individual or population" (p. 186). They distinguish narrative cognition from the other primary type of human cognition—argumentation, because narratives are "liberated from slower, more deliberate verification processes" (p. 189). Our work contests this premise by blurring the distinction between narrative and argument as cognitive processes. Introne et al. examined text-based messages on online forums and found an "extraordinary diversity of... story elements that sustain... overall narrative[s]" (p. 188). We argue that image memes promoting conspiracism reveal such story elements in the form of small quasi-arguments that both reflect and aggregate into higher-order narratives. Image memes function as the argumentative building blocks of eventual conspiratorial narratives and of the cognitive process by which individuals are drawn into identification (Milner & Wolff, 2023) with online conspiratorial discourse communities.

We advocate the use of Toulminian argument theory (Toulmin, 1958) to understand the persuasive potential of image memes. Attending to the rhetorical form of image memes reveals the argumentative cognition compelled by the meme's components. Although image memes are typically perceived as light-hearted artifacts of humor, we advocate focusing on the persuasive dimensions of image memes circulated by social media users as a means of participating in public argument. While the rhetorical form of such image memes can and does infuse humor, the form can also structure the content into an argument. That is, the image meme can go beyond provoking a chuckle to assert a claim that the viewer is drawn to either accept or reject. Treating image memes as arguments allows us to identify the claim(s) advanced by them, as well as how those claims are bolstered by evidence and warrants that are either explicit or implicit in the meme. While the processing of an image meme may not simulate the painstaking process of argumentation

one exercises in an academic or legal setting, for example, we treat image memes as quasi-arguments because they do persuade by deploying components and processes of argumentation (Mascarenhas, 2021). Tracking memes as purveyors of argument can explain why they hold persuasive power in certain online discursive spaces, like conspiratorial communities that describe themselves as upholders of epistemic authenticity and truth-telling in opposition to "conventional and privileged ways of knowing" (Introne et al., 2020, p. 185). Our rhetorical approach is consistent with Grundlingh's (2017) assertion that memes are not just artifacts of speech, but that they should be regarded as "speech acts" themselves (p. 148). Image memes not only signify meaning but they accomplish social functions like asserting arguments and audience identity.

4.2 | Application of rhetorical analysis to extract memetic claims

Image memes tend to advance partial or implicit arguments, which makes the artifact especially potent in disrupting mainstream media messages by providing targeted counter-claims that are exempt from the obligations of rigorous elaboration required of more formal information artifacts. The truncated arguments in image memes create ambiguity and, accordingly, flexibility for audience interpretation. Across formats such as text-only, image-only, screenshot, and image-text juxtaposition, image memes "create the possibility of extracting multiple and multi-layered interpretations within a range of meanings" (Mascarenhas et al., 2021)—a semantic condition captured by the term polysemy (Boxman-Shabtai & Shifman, 2014). The semantic and syntactic elements of an image meme jointly generate rich and varied signification. However, meaning-making is ultimately guided by structural features in the meme, including strategic placement of images in relation to each other, or of the placement of text in relation to images. Another structural feature—the ubiquitous rectangular boundary of the meme—not only demarcates the meme's content but insulates it from the attack of counter-arguments, by creating the illusion of a self-evident non-porous argument. The visual boundary that restricts the amount of content that can be contained in an image meme, along with the expectations of limited textual material, and a logic that emerges out of image-text juxtaposition allow for image memes to assert truncated arguments. Because the artifact constructs an argument with limited information, it relies on audience engagement for decoding, and this cognitive investment makes the audience more impervious to counter-arguments. We show below, using Toulmin's argument framework, how truncated argumentation makes the image meme both a strong rhetorical force and simultaneously highly vulnerable to advancing spurious arguments.

A Toulminian approach can unravel the cognition demanded by an image meme to accept a particular belief proposition. The three major elements of an argument in the Toulmin model are the claim (the proposition the audience is required to accept), evidence (data supporting the proposition), and warrant(s) (assumption (s) connecting evidence to claim) (Toulmin, 1958). We analyze the image meme in Figure 1, Panel 3, using this approach. The meme juxtaposes a line of text above a photograph of a man whispering into the ear of former US President G.W. Bush. The text articulates what the man is presumably telling the president. The photograph is key to decoding the argument made by the meme. That image template is widely recognized for capturing the moment that White House Chief of Staff Andrew Card informed then-President Bush about the terrorist attack of September 11, 200, during the president's visit to a Florida classroom. The meme, as a whole, advances the claim that the February 2023 Ohio train derailment was a deliberate act orchestrated by the government. The argument is assembled by drawing an analogy between the Ohio derailment and the September 11 attacks, and relies on the audience's knowledge of another conspiracy theory about the US government's role in masterminding the September 11 attacks despite assigning responsibility to Osama Bin Laden. A Toulminian analysis of the argument assembled by the meme reveals the following structure: *Since the Ohio train derailment is like the terrorist attack (evidence invoked by the photograph), the derailment is a US government conspiracy against its own people (claim), because the 9/11 attacks were a government inside-job (warrant)*. The meme constructs this argument parsimoniously, with minimal image and text content. Since the meme is boxed within its rectangular boundaries, audiences drawn to this line of reasoning are inhibited from interrogating the implied evidence, that is, questioning why the two tragedies must in fact be similar to each other. The meme offers no reasons for asserting the analogy. Likewise, the meme does not furnish evidence (referred to as backing in the Toulminian framework) in support of the warrant. Rather, the meme counts on the audience believing that the 9/11 attacks were pre-planned by the US government and that, in the iconic photograph, the president was merely being informed about the execution of the plan. Warrants are often taken-for-granted assumptions that the audience is expected to fill in. Nonetheless, in a robustly constructed argument, backing is typically added to tighten the argument and make it resistant to counter-attack. Since image

memes offer limited visual space and benefit from containment within visual boundaries, they are rarely expected to elaborate warrants. Instead, they derive rhetorical power precisely by activating the audience's previous engagement with other related claims.

Barnes et al. (2021) found that text and image jointly enhance predictive power of a meme's virality. We note that text and image juxtapositions can enhance another impact of memes—their argument potency. In the meme in Figure 1, Panel 3, the logic of the argument is constructed by the iconic 9/11 image template. Audiences that follow the meme's logic do so because they are already aware of the alleged government conspiracy related to 9/11. The meme pits the audience that agrees with its claim against devious officials and gullible people who trust official narratives about the train derailment. The rhetorical deftness of this particular meme lies in its ability to draw an audience, in the course of a single engagement with the meme, into both the line of reasoning set up by the meme and into an audience identity. Even as a viewer encounters the meme's reasoning for the first time, having followed the reasoning and accepted it, the viewer comes to embody the persona of a skeptic of official narratives.

Image memes have constitutive potential; that is, they simultaneously call into being (constitute) audience groups while influencing their thinking and possibly action—a process that rhetoricians call interpellation (Charland, 1987). This constitutive potential is contained in the meme's ability to advance claims, provide/imply evidence, and rely heavily on a discursive community to supply the necessary warrants (assumptions) to complete the argument (Mascarenhas, 2021). The capacity of image memes to compel audience participation in semantic decoding enhances the persuasive strength of memes because deducing the meme's claim constructs a truth-seeking experience, and consequently a sense of shared in-group identity, for the audience. Having successfully decoded the meme, audiences are interpellated as truth-seekers which deepens their investment in the meme's claim.

Another rhetorical feature of image memes which makes them conducive to interpellating audiences as truth seekers is that image memes are often free-floating, appearing out of nowhere, and rarely disclosing their sources, unlike other digital content (Milner & Wolff, 2023). Image memes represent "an epistemic break" (Mascarenhas et al., 2021, p. 4). They gain credibility not because they are vetted by authoritative sources but precisely because they are sourceless. This attribute makes image memes "a powerful parallel discourse to more formal media channels and, in many cases, a direct challenge to information, claims, or narratives that emerge from publicly-vetted sources" (Mascarenhas et al., 2021, p. 4).

Figure 3 provides additional illustration of the argumentative potential of image memes. In this case, the visual compartmentalization of the meme-box is vital to the enactment of the argument. The sequence guides the viewer from the top to the bottom and from the left to the right. The image at top center shows the actor Bill Murray. The text superimposed on this image issues a dare from the person sharing the meme to the viewer. The assertion "Call me crazy all you want" alludes to the trope of the conspiracy theorist, a label typically applied to those who believe the government is guilty of large-scale wrongdoing. The rest of the meme-box assembles arguments to rebut the conspiracy theorist label.

The meme goes on to provide claim-evidence pairs in the smaller boxes on the left-hand side. Four claims about government malfeasance are supported with images meant to provide evidence. The first claim accuses the U.S. government of lying about medical treatments. The textual claim is placed over an image that invokes the Tuskegee syphilis study which abused black Americans in a deceptive government intervention (Tuskegee Study – Timeline – CDC – OS, 2022). The second claim accuses the government of destroying the planet and is substantiated with the paired image of a mushroom cloud that represents the atomic bombing of Hiroshima (The Editors of Encyclopedia Britannica, 2023). The third claim accuses the government of involvement in drug trafficking. The accompanying image evidence references the plane crash that exposed alleged CIA drug trafficking activities in Panama (Ex-CIA Airline Tied to Cocaine, 1987). The fourth box in the left-hand column claims the US government carries $21 trillion in debt. The paired image shows a vortex of dollar bills evoking the metaphor of "money down the drain." The preceding images which draw from historical archives establish a degree of credibility for the meme's claims, priming the viewer to accept the truth of the final claim, even though the fourth argument does not provide any direct empirical evidence.

The placement of image and text in the meme optimizes the restricted space of the meme-box to arrange a relatively complex argument comprising multiple claims and pieces of evidence. Each text-image pairing on the left aligns with the text-image pairing on the right to verbally and visually accomplish an *if-then* argument pattern. The claim-evidence pairs on the left act as evidence for the broader claims on the right. For example, the government's deception in the Tuskegee study acts as evidence for the claim that the government cannot be trusted to provide health care. The argument relies on the warrant that a nationalized health care system would

FIGURE 3 Bill Murray image meme. Described in text.

provide cover for the government to continue abuse of unsuspecting citizens. Likewise, the government's willingness to use military power to imperil the planet by deploying nuclear weapons is provided as evidence that the government should not be trusted to regulate gun ownership. This argument rests on the warrant that gun ownership provides security against military abuse. The boundary around the image meme suppresses consideration of contradictory warrants, such as the assumption that guns would be powerless in the face of nuclear destruction.

The goal of rhetorical analysis then becomes the identification of the primary and sub-claims within a meme, as well as of the evidentiary tropes that support those memetic claims. Focusing on claim-evidence-warrant in image memes allows us to track public sensemaking independent of demographic or psychographic data about discourse communities. Rhetorical analysis foregrounds the what rather than the who of public sensemaking, opening up potentially valuable information for intervention messages to target lines of reasoning that produce public beliefs and sentiments.

After explaining how single-image memes can be analyzed rhetorically, we turn toward the field of ecology for inspiration to scale up rhetorical analyses of memes. An ecological framework can allow us to trace how memetic claims interact with each other to produce evidence ecosystems that inform broader public narratives. Borrowing from ecological concepts, we can study the life cycle, movement, interaction, and impacts of image memes at broader scales.

4.3 | Ecological framework

Previous studies have described online discourse as information ecologies, drawing attention to striking similarities between features of virtual communication spaces and those of concrete physical ecosystems (Kuehn, 2022). For instance, both domains exhibit intricate networks of

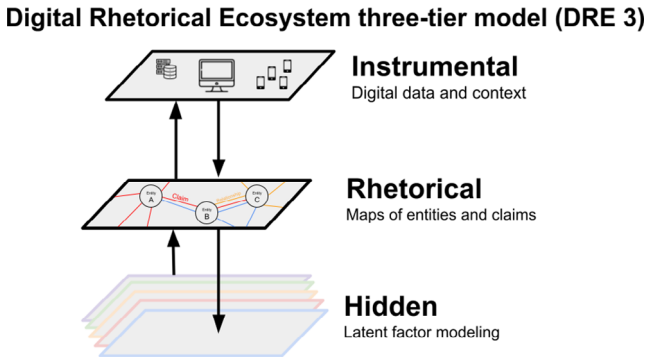

FIGURE 4 The Digital Rhetorical Ecosystem three-tier model (DRE3). The Instrumental, Rhetorical, and Hidden layers are described in the text.

interrelated elements, diverse populations, and dynamic interactions that shape and are shaped by their environments.

Ecosystem metaphors can be valuable tools in researching information flows. They enable scholars to more effectively apprehend abstractions by providing concrete frames of reference from the natural world. Such metaphors can be helpful when investigating phenomena such as online communities, where interactions among users resemble symbiotic relationships in natural ecosystems, or when examining the spread of information and ideas, which can mirror the propagation of species within a habitat. The use of ecosystem metaphors can play a central role in facilitating communication among researchers from different disciplinary backgrounds. By drawing upon ecology, scholars can bridge the gaps between their respective fields, fostering collaboration and the exchange of knowledge. This cross-disciplinary approach ultimately enriches our understanding of online information ecologies, revealing new insights and fostering innovation in the study of digital landscapes. Ecological perspectives have already been applied to image meme research. For instance, Morina and Bernstein (2022) conducted an ecosystem-level analysis to track where image memes originated and how they spread online.

Our framework, the Digital Rhetorical Ecosystem three-tier model (DRE3) (Figure 4), articulates a basic architecture for collecting, classifying, and analyzing memes to generate data about public beliefs and attitudes accruing from image meme circulation (Mascarenhas et al., 2021, 2022). Similar work has been operationalized, for example by Tommasini et al. (2023) who created the Internet Meme Knowledge Graph (IMKG) and Sharma et al. (2023) who created MemeX. Below, we identify how DRE3 can offer insights that are different from those produced by these existing analytic tools.

The DRE 3 theoretical framework comprises three layers of analysis that move from observations of concrete detail in image memes to inferences about the public sensemaking that arises from the circulation of and interaction between memes. The initial *Instrumental* layer describes empirical observations of the image meme artifacts (i.e., entities such as people, places, events represented in an image meme). The *Rhetorical* layer identifies the claims that emerge from an analysis of the semantic and syntactic interactions between entities in image memes. The *Hidden* layer traces broader narratives (that reveal beliefs and sentiments) coalescing from interactions between memetic claims. The DRE3 model fills in a gap in the current landscape of image meme research, by highlighting an intermediate rhetorical-semantic layer between the instrumental layer of data collection and the inferential layer that identifies deeper hidden states such as public narratives.

If the DRE3 framework is used to guide an image meme analysis pipeline, by making argument claims the key analytic feature, the analysis can trace not just the movement and evolution of specific image memes but rather the claims they generate, which result in evidence ecosystems that ultimately influence public sensemaking. Currently, many large-scale computational studies of image memes identify broader sentiments that image memes produce (e.g., racial hatred). As Tommasini et al. (2023) have noted, studies of image memes have thus far primarily examined "their spread over time" or engaged in "high-level classification tasks like hate speech detection, while a principled analysis of their stratified semantics is missing" (p. 1). Their creation, the Internet Meme Knowledge Graph, does arrive at a semantic analysis of image memes. In comparison, the DRE3 model refines semantic analysis by honing in on the claims produced by image memes, that is, their persuasive potential. The image meme of G.W. Bush being informed about 9/11 is important to recognize as a cultural touchstone. However, more important are the implicit claims this image evokes each time it is deployed in a meme that includes text (i.e., the claim that the government has lied about a particular public event). Therefore an uptick in public distrust of the government (sentiment) can be traced back to specific trending claims that help explain how the government's role in current events is being perceived in online ecosystems and contributing to the uptick in distrust.

In order to arrive at meaningful inferences in the hidden layer, the DRE3 framework invites the development of two processes—a method for collecting image memes as they appear across social media networks to generate image meme data at large scales, and the automation of claim identification by moving from trained human

coders to trained machine learning systems. To note, DRE3 could complement other approaches (e.g., already existing computational studies using entity recognition and Optical Character Recognition). In fact, DRE3 could be integrated with existing image meme knowledge graphs such as the previously mentioned Internet Meme Knowledge Graph and MemeX. DRE3's unique offering, however, is its foregrounding of the rhetorical layer of analysis, namely the articulation of quasi-arguments that build evidence ecosystems with claims, a focus which is not currently represented among computational analyses of memes or meme encyclopedias. Once capabilities are developed for capturing and tracing the emergence, movement, and decline of memetic claims across digital publics, inferences about public beliefs and sentiments can be more closely tied to the underlying persuasive mechanisms (specifically the evidence ecosystems) that produce these hidden state effects.

Besides conceptualizing the impact of image meme circulation in terms of evidence ecosystems, ecological theory can inform the generation of research questions to yield rich data about the ways in which image memes and the arguments they assert interact to produce social cognition. Some ecosystem concepts that can provide useful parallels for queries in a large-scale computational analysis of image memes are Life History, Niche Succession, and Complex Interactions. Below, we define each of these concepts and transpose the ecological perspective onto image meme analysis. While previous work has examined memes ecologically (e.g., Ford et al., 2021; Morina & Bernstein, 2022), the advantage of the DRE3 framework is the application of argumentation analysis to trace memetic claims. As such, while other studies have examined the evolution of memes (templates and captions), the interaction of memes with their semiotic backgrounds, and the competition between memes, DRE3 pushes the inquiry further to ask about the development and eclipse of memetic claims as well as how claims might interact with each other and with their semiotic environments to produce dynamic evidence ecosystems that drive belief, sentiment, and action in different online publics.

4.3.1 | Life history of image memes arguments

Life history, in ecology, refers to the series of events an organism goes through from birth to death. While websites like Know Your Meme maintain records of the origin, evolution, and spread of image memes, the application of DRE3 can trace the same dynamics for memetic claims. Life history analysis could also yield insights about how cultural and social events produce semiotic contexts that influence the emergence, development, or decline of image memes and their claims.

4.3.2 | Niche succession in online communities

Niche succession is the process by which the composition of species in a particular ecological community changes over time in response to changes in the physical or biological environment. This concept could be applied to trace changes in the rhetorical composition (i.e., patterns of claims) through time, for a given sampling location (e.g., a forum or content channel). Changes in diversity of memetic claims could also yield useful insights about how online communities may be converging around specific beliefs or if there is competition between memetic claims in online communities.

4.3.3 | Complex interactions between memetic claims

Complex interactions refer to the many ways in which ecological entities interact with each other and with their environments. These interactions can be direct or indirect, and can occur at many different spatial and temporal scales. Likewise, within image meme ecosystems, researchers could trace collaboration, competition, or conflict between memetic claims gaining insight into how evidence ecosystems for particular beliefs crystallize, endure, or dissolve.

5 | OPERATIONALIZING COLLABORATIVE ANALYSIS OF MEMETIC CLAIMS

In previous work (Mascarenhas et al., 2021), we have offered guidance for operationalizing DRE3 into data collection and analysis architectures. In this paper, we offer clarification of one particular analytic hurdle that is likely to accompany large-scale annotation of claims from image meme data—that is, conflicting interpretations of memetic content and resulting claims. DRE3 is a relatively uncomplicated research paradigm to identify memetic claims and hidden states for the individual analyst or small teams of analysts (with the capacity to establish inter-coder reliability). However, scaling up to make inferences about massive volumes of image meme data will require larger-scale and more complex collaboration, both to gather vast quantities of image memes and to facilitate human and eventually machine annotation of entities within image memes and the claims asserted by

the memes. Image meme discourse can be highly subjective, volatile, fluid, and cloaked in rapidly changing slang, symbolism, or esoterica, as well as heavily dependent on local information contexts. When multiple agents analyze claims produced by image memes, conflicts over both trivial and critical aspects of interpretation will be inevitable. To resolve this, large scale implementation of DRE3 could benefit from the use of fuzzy set theory.

Any classification system, because of subjectivity of meaning and class membership, will have to manage conflicts in classification of objects (Mascarenhas et al., 2022; Russell, 2009). This problem is generally addressed using agreed upon evaluative standards. However, in a highly subjective information space with a diversity of use-cases, disagreement over standards themselves can make universal or near-universal voluntary adoption of standards impossible, and their forced adoption, counterproductive. Unresolvable conflicts over criteria and classifications would cause difficult-to-measure information quality problems (Mascarenhas et al., 2022). The use of fuzzy set theory holds promise for converting problems of inconsistency among classifications and standards for identifying memetic claims into a valuable source of data that can inform the study of image memes and allow for qualitative analyses at scale.

Set theory is a mathematical field concerned with measurement of and operations on sets or collections of abstract elements, where elements might be numbers, abstract objects, potential outcomes of an event, or other sets. In standard set theory, there is no ambiguity regarding the member of an element in a set (e.g., The set of integers less than or equal to 5). However, outside of pure mathematics, an empirical world of ambiguity often leaves membership of an object to a category an ongoing conflict, even where there appear to be clear rules and evaluative criteria (e.g., "Is a hotdog a sandwich? Or an exception to the class sandwich?", "Does this meme refer to that entity? Or another?"). Fuzzy set formalism is a scale- and context-agnostic answer to address this inconvenient inconsistency or fuzziness in evaluation of real-world object membership to semantic sets and objects with dynamic values to mathematical sets (Zadeh, 1965; Zimmermann, 2010). Any individual element can be described as a 2-dimensional vector, (1) the abstract object familiar in traditional set theory and (2) the probability of its membership to a given set. For example, consider the element: "The result of rolling a six sided die" (d6), which resolves to some number between 1 and 6, and the set: "Numbers which are less than or equal to 3" (set A); d6 can be represented as belonging to set A in terms of its probability of resolving to a number less than or equal to 3 (i.e., $\{d6, 0.5\} \in A$ or "d6 has a 50% chance of belonging to set A").

Within the context of DRE3, fuzzy formalisms allow an analyst's process of entity detection and claim identification from an image meme to produce a fuzzy output in the form of an entity assertion or claim assertion, wherein the analyst's assignment is not a final classification, but a contribution to a set of fuzzy annotations about the presence of an entity or implication of a claim in a given image meme (Figure 5). Fuzzy annotations could also include negative values in order to facilitate disputes over classification (e.g., where an analyst is disputing another's assertion, and feels ~80% sure that an entity is not present in the image meme, the divergence might be represented as an assertion of the entity at a value of −0.8). A final assignment or classification within this scheme is not required. Instead, conflict in outputs is no longer noise in measurement or a problem of intercoder reliability, but, rather, valuable data. Disparities in classification and assignment are rendered valuable measurements, indicating polarization, volatility in classification, or differences in training and knowledge of the meme's semantic contexts among analysts. These disparities offer opportunities beyond the analysis of image memes, such as the assessment of analyst bias and the production of structured training data for automated systems. The fuzzy set approach also circumvents the need for universal adoption of one standard, as any method with outputs that associate claims or entities with image memes (e.g., machine learning and similar approaches) could be assigned probability values (either by manual estimation or calculation) and integrated as assertions. Any relevant data representation which makes use of fuzzy formalisms would lend itself to interoperability.

Consequently, DRE3 represented through the use of fuzzy formalisms can both extend the value of other methods as opposed to replace them, and, where adopted, can take what used to be an information quality problem (i.e., disagreement on classification) and convert it into an opportunity for communities with disparate views to interoperate and collaborate. In this process, a diverse sampling of assertions about memetic claims is as important as a diverse sampling of the memes themselves. As such, DRE3 annotation should complement and enrich the analysis of observation-based models that focus on variables such as the spread of specific identical image memes (e.g., as done by Hui et al., 2018).

6 | PROVOCATIONS FOR FUTURE RESEARCH USING A RHETORICAL-ECOLOGICAL-COMPUTATIONAL FRAMEWORK

We offer DRE3 as a paradigm for research on image memes as public sensemaking artifacts. DRE3 can inform

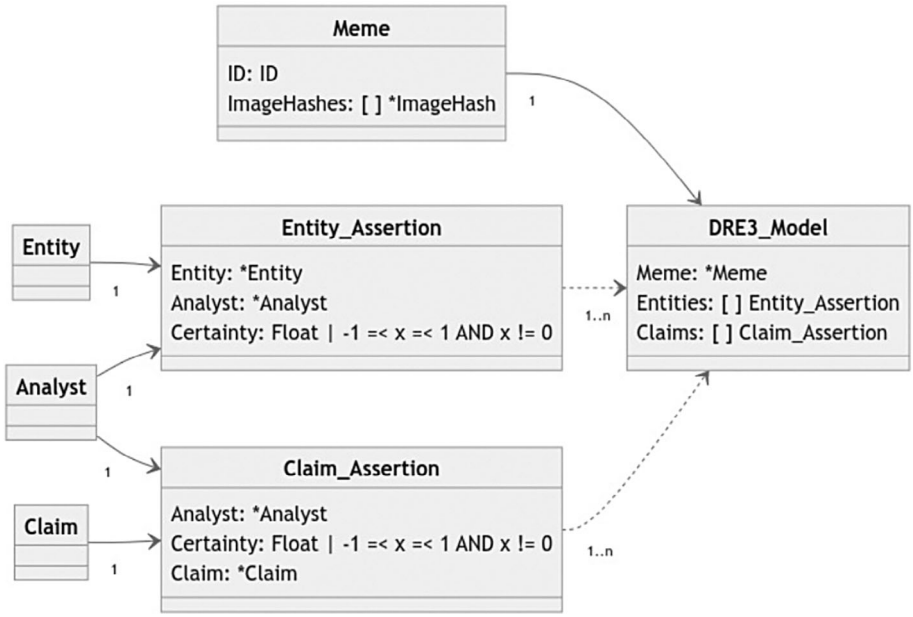

FIGURE 5 Potential fuzzy data representation of the DRE3 model. An asterisk represents a pointer to an external object, and brackets indicate an array of objects.

the development of a stand-alone pipeline for collecting image memes, annotating claims, and tracing evidence ecosystems accruing from interactions between claims. However, the key feature of DRE3 (identification of arguments and specifically claims in image memes) can also be incorporated into already developed knowledge graphs for image memes.

DRE3 builds interdisciplinary synthesis between the fields of rhetoric, ecology, and information sciences, benefiting from the transferable insights of these fields. Large-scale computational analyses can be semantically enhanced by incorporating the rhetorical layer (identification of claims). DRE3 can be human-interfaceable which ensures that the system can maintain semantic accessibility even when scaling up. Additionally, DRE3 can be utilized independently at any scale without the need for internet connectivity or significant computational resources. DRE3 also goes beyond snapshot analyses of image memes, which may quickly become outdated, to offer a research framework that aligns with the dynamic nature of image meme ecosystems.

We urge cross-disciplinary teams of researchers to draw from the DRE3 framework to construct collection and analysis pipelines that foreground memetic claims or to incorporate claim annotation in existing image meme encyclopedias or knowledge graphs. A particular use case for DRE3 application is modeling patterns of emergence and circulation of image memes and their underlying claims within information ecosystems, so as to track abnormalities that may indicate facilitation of information pollution by state actors or paid influence groups (see Cunningham, 2023). DRE3's ecological analysis of image memes may offer valuable data to support intervention efforts. For example, tracing the life history of image memes and sharing that data publicly could potentially serve as a more neutral and impactful intervention when compared with current fact-checking practices. When provided statistics about a meme's content, origin, and trajectory, audiences could be made aware, for example, of whether a memetic claim was spread inorganically by a state actor or influence agent, rather than by more typical social media circulation patterns. Access to such data may undermine the meme's impact in spreading the claim without need for refutation of the meme's argument, itself.

DRE3's rhetorical focus on the argumentative elements of the image meme could also offer more targeted data to support current fact-checking practices. Earlier, fact-checking was the domain of "news agencies and other independent vetting organizations such as Snopes, PolitiFact, factcheck.org [that] posted fact-check notices on misleading claims... not... in situ alongside the original misinformation, but [...] on the vetting agency's own website alongside samples of the misinformation" (Wasike, 2023, p. 1). However, as information pollution accelerated on social networking sites, such as Facebook and X (formerly Twitter), these sites began to issue their own fact-checking artifacts "via obvious warning labels that accompany questionable posts" (Wasike, 2023, p. 1) getting users' attention at the moment of encountering spurious information, itself. Fact-checking by social media companies is vigorously debated. The states of Texas and Florida, in the United States, passed laws, currently being argued before the U.S. Supreme Court, that curtail the ability of social media companies to moderate content on their platforms, citing partisan censorship in

content moderation (Howe, 2024). Specific fact-checking practices such as X's Community Notes (Elliott & Gilbert, 2023) and Facebook's use of particular fact-checking organizations (Meade, 2023) have also generated controversy, highlighting the contested and evolving nature of fact-checking in an information landscape that itself is increasingly dynamic and difficult to monitor. Further, research has shown that fact-checking efficacy is mixed. Walter et al.'s (2020) meta-analysis found some evidence that "exposure to fact-checking carries positive influence" in correcting beliefs but that "the effects of fact-checking on beliefs are quite weak and gradually become negligible the more the study design resembles a real-world scenario of exposure to fact-checking" (p. 367). Wasike (2023) found that "social media fact-checks had a minimal impact on the likelihood to share misinformation" p. 5). Self-report data revealed that social media users "who had been fact-checked before were also more likely to post misinformation than those who had not been fact-checked... [similar to] users who had experienced content deletion" (Wasike, 2023, p. 5). Self-report assertions that individuals who post misinformation are not deterred by fact-checking may suggest that image memes are self-consciously used to challenge mainstream positions, and that spreaders of misinformation may believe their positions are upheld by reasoning that is superior to that provided in fact-checks.

Hameleers and van der Meer (2020) found that responses to fact-checking efforts reflect confirmation bias (i.e., viewers are drawn to facts they already hold to be true). Audiences are likely to ignore content that leads with a claim that counters their own. This possibility raises the need to study the rhetorical forms common to fact-checking artifacts and the persuasive efficacy of these conventions against memetic claims. For example, fact-checking that tends to focus more heavily on asserting corrective claims, rather than on debunking arguments that support spurious claims, leaves intact the spurious evidence ecosystems that memetic claims build over time. Efforts to safeguard the health of information ecosystems could pay closer attention to how memetic arguments produce evidence ecosystems in support of beliefs. By analyzing claims across large data sets of image memes, analyses can go beyond identifying what spurious or harmful beliefs may be circulating in information ecosystems to tracing why audiences come to accept those claims because of the evidence ecosystems that grow from the claims, evidence, and warrants carried by image memes. Tracing memetic claim circulation can expose the strength of particular beliefs, potentially before those beliefs are expressed in public action. For example, retrospective analysis of Facebook posts from only a subset of public groups on the social media site, revealed strong social belief momentum "attacking the legitimacy of Joe Biden's victory" alongside "calling for executions or other political violence," indicating the potential for disruption on the January 6th counting of Electoral College votes (Silverman et al., 2022). An advantage of focusing on image memes and their claims is that tracking public beliefs does not require tracking online users because the memes themselves are regarded as units of social cognition.

Analyzing the evidence ecosystems that accrue from the circulation of image meme claims could also provide in-roads for addressing breakdowns in social consensus on various public issues, for example climate change skepticism. Applying Toulminian analysis to identify claims, evidence and warrants, both explicit and implicit within image memes, can help trace lines of reasoning applied by online audiences who challenge mainstream positions on these issues. Audiences who share image memes that contradict mainstream positions tend to be invested in the belief that they think more critically than the norm. Therefore, the advantage to grasping "how" online publics support their beliefs is that any intervention efforts, such as fact-checking, can focus on rebutting particular memetic arguments that are salient to audiences. A new potential avenue for countering disinformation also opens up. Memes can be used to expose the weakness of target memes, by addressing missing evidence or implied warrants using the image meme vernacular, itself. With this strategy, corrective image memes would not introduce competing claims (as current fact-checking efforts do), but rather they would demonstrate the weakness of memetic arguments in already circulating image memes, a strategy that could undermine audiences' confidence in using image memes as displays of critical thinking. Constructing and studying image memes that attack lines of reasoning in memetic arguments warrants its own future work.

In this paper, we have made the case for why image memes should be treated as quasi-arguments, how Toulminian theory can be applied to analyze arguments made by image memes, how combining rhetorical and ecological approaches can offer analytic advantage, and how fuzzy set theory can address the problem of ambiguity in image meme interpretation. Our purpose in articulating the DRE3 framework is to provoke the construction of an image meme repository and analysis pipeline that can add to ongoing development in this area. However, elements of the framework can also be incorporated piecemeal into existing computational architectures that study image memes. In particular, we encourage analyses to regard image memes as argument artifacts that assert

claims and to trace how these memetic claims assemble into evidence ecosystems for a variety of issues, especially those impacted by breakdowns in social consensus.

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REFERENCES

Afridi, T. H., Alam, A., Khan, M. N., Khan, J., & Lee, Y.-K. (2021). A multimodal memes classification: A survey and open research issues. *Innovations in Smart Cities Applications*, *4*, 1451–1466. https://doi.org/10.1007/978-3-030-66840-2_109

Barnes, K., Riesenmy, T., Trinh, M. D., Lleshi, E., Balogh, N., & Molontay, R. (2021). Dank or not? Analyzing and predicting the popularity of memes on Reddit. *Applied Network Science*, *6*(1), 21. https://doi.org/10.1007/s41109-021-00358-7

Benveniste, A. (2022, January 26). The meaning and history of memes. *The New York Times*. https://www.nytimes.com/2022/01/26/crosswords/what-is-a-meme.html

Beskow, D. M., Kumar, S., & Carley, K. M. (2020). The evolution of political memes: Detecting and characterizing internet memes with multi-modal deep learning. *Information Processing & Management*, *57*(2), 102170. https://doi.org/10.1016/j.ipm.2019.102170

Boxman-Shabtai, L., & Shifman, L. (2014). Evasive targets: Deciphering polysemy in mediated humor. *The Journal of Communication*, *64*(5), 977–998. https://doi.org/10.1111/jcom.12116

Charland, M. (1987). Constitutive rhetoric: The case of the peuple québécois. *The Quarterly Journal of Speech*, *73*(2), 133–150. https://doi.org/10.1080/00335638709383799

Condescending Wonka / Creepy Wonka. (2012, January 13). Know your meme. https://knowyourmeme.com/memes/condescending-wonka-creepy-wonka

Cordes, R. J., Applegate-Swanson, S., Friedman, D. A., Knight, V. B., & Mikhailova, A. (2021). Narrative information management. In R. J. Cordes & D. A. Friedman (Eds.), *Narrative information ecosystems: Conflict and trust on the endless frontier* (pp. 1–64). COGSEC.

Cordes, R. J., David, S., Maan, A., Ruiz, A., Sapp, E., Scannell, P., & Shah, S. (2021). In R. J. Cordes (Ed.), *The narrative campaign field guide – First edition* (1st ed.). Narrative Strategies Ink. https://www.narrative-strategies.com/ncfg

Cunningham, A. (2023). Image warfare: The use of memes in the production of misinformation. http://www.cornellpolicyreview.com/image-warfare-the-use-of-memes-in-the-production-of-misinformation/

Dancygier, B., & Vandelanotte, L. (2017). Internet memes as multimodal constructions. *Cognitive Linguistics*, *28*(3), 565–598. https://doi.org/10.1515/cog-2017-0074

Dynel, M. (2016). "I has seen image macros!" Advice animals memes as visual-verbal jokes. *International Journal of Communication Systems*, *10*, 29.

Elliott, V., & Gilbert, D. (2023). Elon Musk's main tool for fighting disinformation on X is making the problem worse, insiders claim. *Wired*. https://www.wired.com/story/x-community-notes-disinformation/

Ex-Cia Airline Tied to Cocaine. (1987, January 20). The Washington Post. https://www.washingtonpost.com/archive/politics/1987/01/20/ex-cia-airline-tied-to-cocaine/d7e5a04f-462f-479f-bf45-11502e772082/

Ford, T., Krohn, R., & Weninger, T. (2021). Competition Dynamics in the Meme Ecosystem. *arXiv* [cs.SI]. http://arxiv.org/abs/2102.03952

Grundlingh, L. (2017). Memes as speech acts. *Social Semiotics*, *28*, 147–168. https://doi.org/10.1080/10350330.2017.1303020

Guenther, L., Ruhrmann, G., Bischoff, J., Penzel, T., & Weber, A. (2020). Strategic framing and social media engagement: Analyzing memes posted by the German Identitarian movement on Facebook. *Social Media + Society*, *6*(1), 2056305119898777. https://doi.org/10.1177/2056305119898777

Hagen, L., Greyson, D., Fox, A., Koltai, K., & Dumas, C. (2021). Social media, vaccines, and partisan division of health information. *Proceedings of the Association for Information Science and Technology*, *58*(1), 594–597. https://doi.org/10.1002/pra2.506

Hahner, L. A. (2013). The riot kiss: Framing memes as visual argument. *Argumentation and Advocacy*, *49*(3), 151–166. https://doi.org/10.1080/00028533.2013.11821790

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

Hazman, M., McKeever, S., & Griffith, J. (2023). Meme sentiment analysis enhanced with multimodal spatial encoding and face embedding. *Artificial Intelligence and Cognitive Science*, 318–331. https://doi.org/10.1007/978-3-031-26438-2_25

Heiskanen, B. (2017). Meme-ing electoral participation. *European Journal of American Studies*, *12*(2). https://doi.org/10.4000/ejas.12158

Highfield, T., & Leaver, T. (2016). Instagrammatics and digital methods: Studying visual social media, from selfies and GIFs to memes and emoji. *Communication Research and Practice*, *2*(1), 47–62. https://doi.org/10.1080/22041451.2016.1155332

Howe, A. (2024). *Supreme court skeptical of Texas, Florida regulation of social media moderation*. SCOTUSblog. https://www.scotusblog.com/2024/02/supreme-court-skeptical-of-texas-florida-regulation-of-social-media-moderation/

Hui, P.-M., Weng, L., Sahami Shirazi, A., Ahn, Y.-Y., & Menczer, F. (2018). Scalable detection of viral memes from diffusion patterns. In S. Lehmann & Y.-Y. Ahn (Eds.), *Complex spreading phenomena in social systems: Influence and contagion in real-world social networks* (pp. 197–211). Springer International Publishing. https://doi.org/10.1007/978-3-319-77332-2_11

Huntington, H. E. (2013). Subversive memes: Internet memes as a form of visual rhetoric. https://spir.aoir.org/ojs/index.php/spir/article/view/8886/pdf

Image Macros. (2020). Know your meme. https://knowyourmeme.com/memes/image-macros

Introne, J., Korsunska, A., Krsova, L., & Zhang, Z. (2020). Mapping the narrative ecosystem of conspiracy theories in online anti-vaccination discussions. *International Conference on Social Media and Society*, 184–192. https://doi.org/10.1145/3400806.3400828

Isaacs, D. (2020). Memes. *Journal of Paediatrics and Child Health*, *56*(4), 497–498. https://doi.org/10.1111/jpc.14755

Jones, M., Beveridge, A., Garrison, J. R., Greene, A., & MacDonald, H. (2022). Tracking memes in the wild: Visual rhetoric and image circulation in environmental communication. *Frontiers in Communication*, *7*. https://doi.org/10.3389/fcomm.2022.883278

Joshi, S., Ilievski, F., & Luceri, L. (2023). Contextualizing internet memes across social media platforms. *arXiv* [cs.SI]. http://arxiv.org/abs/2311.11157

Kofman, A. (2018, October 25). Bruno Latour, the post-truth philosopher, mounts a defense of science. *The New York Times*. https://www.nytimes.com/2018/10/25/magazine/bruno-latour-post-truth-philosopher-science.html

Kougia, V., Fetzel, S., Kirchmair, T., Çano, E., Baharlou, S. M., Sharifzadeh, S., & Roth, B. (2023). MemeGraphs: Linking memes to knowledge graphs. *arXiv* [cs.LG]. http://arxiv.org/abs/2305.18391

Koutlis, C., Schinas, M., & Papadopoulos, S. (2023). MemeFier: Dual-stage modality fusion for image meme classification. *arXiv* [cs.CV]. http://arxiv.org/abs/2304.02906

Kuehn, E. F. (2022). The information ecosystem concept in information literacy: A theoretical approach and definition. *Journal of the Association for Information Science and Technology*, *74*, 434–443. https://doi.org/10.1002/asi.24733

Ling, C., AbuHilal, I., Blackburn, J., De Cristofaro, E., Zannettou, S., & Stringhini, G. (2021). Dissecting the meme magic: Understanding indicators of virality in image memes. *Proceedings of the ACM Human-Computer Interaction*, *5*-(CSCW1), 1–24. https://doi.org/10.1145/3449155

Ma, Y. (2021). Understanding Information: Adding a Non-individualistic Lens. *Journal of the Association for Information Science and Technology*, *72*(10), 1295–1305. https://doi.org/10.1002/asi.24441

Mascarenhas, M. (2021). Memes as quasi-argument: An insidious threat to public debate. In *Local theories of argument* (1st ed., pp. 385–390). Routledge. https://doi.org/10.4324/9781003149026-65

Mascarenhas, M., Cordes, R. J., Bleu Knight, V., Murphy, S., & Friedman, D. A. (2022). Tracking public Sensemaking through rhetorical annotation of memes. In S. David, R. J. Cordes, & D. A. Friedman (Eds.), *Structuring the information commons: Open standards and cognitive security* (pp. 310–350). COGSEC.

Mascarenhas, M., Cordes, R. J., & Friedman, D. A. (2021). Digital rhetorical ecosystem analysis: Sensemaking of digital memetic discourse. In R. J. Cordes & D. A. Friedman (Eds.), *Narrative information ecosystems: Conflict and trust on the endless frontier* (pp. 65–134). COGSEC.

Meade, A. (2023). RMIT's fact check reinstated by Facebook two months after suspension over News Corp voice complaints. *The Guardian*. https://www.theguardian.com/australia-news/2023/nov/08/rmit-factlab-fact-check-service-reinstated-facebook-suspension-voice-referendum

Milner, R. M., & Wolff, P. (2023). On the meme train to Sylt: Memetic becoming and ambivalent identification online. *Social Media + Society*, *9*(1), 20563051231158825. https://doi.org/10.1177/20563051231158825

Morina, D., & Bernstein, M. S. (2022). A web-scale analysis of the community origins of image memes. *arXiv* [cs.HC]. http://arxiv.org/abs/2204.05439

Potnis, D., & Tahamtan, I. (2021). Hashtags for gatekeeping of information on social media. *Journal of the Association for Information Science and Technology*, *72*(10), 1234–1246. https://doi.org/10.1002/asi.24467

Robertson, C., & Cochrane, E. (2023, February 15). In Ohio town where train derailed, anxiety and distrust are running deep. *The New York Times*. https://www.nytimes.com/2023/02/15/us/ohio-train-derailment-anxiety.html

Russell, B. (2009). *The philosophy of logical atomism*. Routledge. https://play.google.com/store/books/details?id=jNOLAgAAQBAJ

Sharma, S., Kulkarni, A., Suresh, T., Mathur, H., Nakov, P., Akhtar, M. S., & Chakraborty, T. (2023). Characterizing the entities in harmful memes: Who is the hero, the villain, the victim? *arXiv* [cs.CL]. http://arxiv.org/abs/2301.11219

Sharma, S., Ramaneswaran, S., Arora, U., Akhtar, M. S., & Chakraborty, T. (2023). MEMEX: Detecting explanatory evidence for memes via knowledge-enriched contextualization. *arXiv* [cs.CL]. http://arxiv.org/abs/2305.15913

Shifman, L. (2014). The cultural logic of photo-based meme genres. *Journal of Visual Culture*, *13*(3), 340–358. https://doi.org/10.1177/1470412914546577

Silverman, C., Timberg, C., Kao, J., & Merrill, J. B. (2022, January 4). Facebook hosted surge of misinformation and insurrection threats in months leading up to Jan. 6 attack, records show. https://www.propublica.org/article/facebook-hosted-surge-of-misinformation-and-insurrection-threats-in-months-leading-up-to-jan-6-attack-records-show

Smith, N., & Copland, S. (2022). Memetic moments: The speed of twitter memes. *Journal of Digital Social Research*, *4*(1), 23–48. https://doi.org/10.33621/jdsr.v4i1.95

Snowden, D. (2002). Narrative patterns: Uses of story in the third age of knowledge management. *Journal of Information & Knowledge Management*, *01*(1), 1–6. https://doi.org/10.1142/S021964920200011X

Taecharungroj, V., & Nueangjamnong, P. (2015). Humour 2.0: Styles and types of humour and virality of memes on Facebook. *Journal of Creative Communications*, *10*(3), 288–302. https://doi.org/10.1177/0973258615614420

Tang, R., Mehra, B., Du, J. T., & Zhao, Y. C. (2021). Framing a discussion on paradigm shift(s) in the field of information. *Journal of the Association for Information Science and Technology*, *72*(2), 253–258. https://doi.org/10.1002/asi.24404

The Editors of Encyclopedia Britannica. (2023). Atomic bombings of Hiroshima and Nagasaki. *Encyclopedia Britannica*. https://www.britannica.com/event/atomic-bombings-of-Hiroshima-and-Nagasaki

Thompson, S. A. (2023, February 16). "Chernobyl 2.0"? Ohio train derailment spurs wild speculation. *The New York Times*. https://www.nytimes.com/2023/02/16/technology/ohio-train-derailment-chernobyl.html

Tindale, C. W. (2017). Replicating reasons: Arguments, memes, and the cognitive environment. *Philosophy & Rhetoric*, *50*(4), 566–588. https://doi.org/10.5325/philrhet.50.4.0566

Tommasini, R., Ilievski, F., & Wijesiriwardene, T. (2023). IMKG: The internet meme knowledge graph. *The Semantic Web*, 20th International Conference, 354–371. https://doi.org/10.1007/978-3-031-33455-9_21

Toulmin, S. E. (1958). *The uses of argument*. Cambridge University Press. https://philpapers.org/rec/TOUTUO-2

Tung, P. T. H., Viet, N. T., Anh, N. T., & Hung, P. D. (2023). Semi-Memes: A semi-supervised learning approach for multimodal memes analysis. *arXiv* [cs.LG]. http://arxiv.org/abs/2304.00020

Tuskegee Study – Timeline – CDC – OS. (2022, December 20). The untreated syphilis study at Tuskegee timeline. https://www.cdc.gov/tuskegee/timeline.htm

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

Wasike, B. (2023). You've been fact-checked! Examining the effectiveness of social media fact-checking against the spread of misinformation. *Telematics and Informatics Reports*, *11*, 100090. https://doi.org/10.1016/j.teler.2023.100090

Zadeh, L. A. (1965). Fuzzy sets. *Information and Control*, *8*(3), 338–353. https://doi.org/10.1016/S0019-9958(65)90241-X

Zannettou, S., Caulfield, T., Blackburn, J., De Cristofaro, E., Sirivianos, M., Stringhini, G., & Suarez-Tangil, G. (2018). On the origins of memes by means of fringe web communities. *Proceedings of the Internet Measurement Conference*, *2018*, 188–202. https://doi.org/10.1145/3278532.3278550

Zenner, E., & Geeraerts, D. (2018). One does not simply process memes: Image macros as multimodal constructions. In *Cultures and traditions of wordplay and wordplay research* (pp. 167–194). De Gruyter. https://doi.org/10.1515/9783110586374-008/html?lang=en

Zimmermann, H.-J. (2010). Fuzzy set theory. *WIREs Computational Statistics*, *2*(3), 317–332. https://doi.org/10.1002/wics.82

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