

Policy Evaluation of Policy Attention with Media Framing Effects in Biomedical Controversy Coverage

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Abstract

The rapid advancement of biomedical technologies has introduced unprecedented ethical, social, and economic dilemmas, frequently manifesting as highly visible public controversies. As these debates unfold, the mass media plays a critical role in framing the issues, thereby shaping public perception and influencing the allocation of policy attention. This study investigates the complex dynamics between media framing effects and subsequent policy attention, specifically utilizing policy evaluation as a critical mechanism in the context of biomedical controversy coverage. By analyzing a comprehensive corpus of news articles and legislative documents over a fifteen-year period, this research traces how specific media frames—namely ethical, economic, scientific progress, and risk frames—predict fluctuations in regulatory focus. Through advanced natural language processing and time-series analysis, the study demonstrates that media coverage emphasizing ethical risks exerts a disproportionately strong agenda-setting effect, triggering rapid policy evaluation and legislative responses. Furthermore, the findings indicate that the alignment between media narratives and existing policy evaluation frameworks significantly accelerates the transition from public discourse to formal policy attention. This research contributes to the broader literature on media effects and policy processes by providing empirical evidence of how complex biomedical issues are translated into actionable policy agendas through the mediating role of media framing.

Keywords: Media Framing; Policy Attention; Biomedical Controversy; Policy Evaluation; Multidisciplinary Research

1. Introduction

The governance of emerging biomedical technologies represents one of the most complex challenges facing modern political systems. Innovations such as genomic editing, stem cell therapy, and synthetic biology offer tremendous potential for societal benefit, yet they simultaneously provoke profound moral, ethical, and safety concerns. In the public sphere, these issues frequently evolve into intense controversies, where competing stakeholders vie for influence over the regulatory trajectory. The mass media serves as the primary arena for these contestations, selecting and emphasizing specific aspects of the technologies while obscuring others [1]. This process of selection and salience, known widely in academic literature as framing, fundamentally alters how both the general public and policymakers comprehend the stakes involved in biomedical advancements [2]. Understanding the precise mechanisms through which these media representations translate into tangible shifts in policy attention

is essential for comprehending the broader dynamics of technology governance in democratic societies [3].

Policy attention, defined as the allocation of scarce cognitive and institutional resources by government actors toward specific issues, is highly sensitive to the external environment. Because policymakers are boundedly rational and cannot attend to all issues simultaneously, they rely heavily on media signals to gauge issue severity and public sentiment [4]. When biomedical controversies erupt, media coverage often acts as an alarm mechanism, forcing issues onto the political agenda. However, the sheer volume of media coverage is not the sole determinant of policy attention. The specific frames employed by journalists and quoted experts dictate the nature of the policy response [5]. For instance, a controversy framed primarily as an economic opportunity may trigger attention from trade and industry committees, whereas the same controversy framed as a moral transgression is more likely to draw the scrutiny of ethics councils and regulatory oversight bodies.

Despite the acknowledged importance of this relationship, existing scholarship has struggled to definitively map the pathways through which distinct media frames interact with formal policy evaluation processes. Policy evaluation, which involves the systematic assessment of existing regulations and the anticipated impacts of proposed interventions, acts as a crucial filtering mechanism [6]. When media coverage highlights the inadequacy of current regulatory frameworks in managing a new biomedical risk, it essentially initiates an informal policy evaluation process in the public domain. This informal evaluation exerts pressure on institutional actors to conduct formal assessments, thereby elevating the issue within the policy hierarchy [7]. This study seeks to bridge the gap between media effects research and public policy literature by explicitly modeling policy evaluation as a mediating variable between media framing and policy attention.

To address these theoretical and empirical gaps, this research poses a central question regarding how different types of media frames applied to biomedical controversies predict the subsequent allocation and intensity of policy attention. The study relies on the premise that not all frames are equally effective at mobilizing institutional responses [8]. By utilizing a longitudinal dataset encompassing major biomedical controversies, the research meticulously tracks the prevalence of various frames over time and correlates these patterns with objective measures of policy attention, such as parliamentary debates, agency hearings, and the introduction of new legislation [9]. The overarching goal is to construct a robust predictive model that elucidates the temporal and structural dependencies characterizing the media-policy nexus.

The significance of this investigation extends beyond academic theorizing. For science communicators, public health officials, and policy advocates, understanding the framing dynamics that command policy attention is a vital strategic asset [10]. Furthermore, as biomedical innovation continues to accelerate, the capacity of political institutions to respond appropriately and proportionally to emerging controversies will be severely tested. By identifying the conditions under which media coverage facilitates constructive policy evaluation rather than mere political grandstanding, this study offers valuable insights into improving the resilience and responsiveness of technology governance systems [11].

2. Literature Review and Theoretical Framework

2.1 The Dynamics of Media Framing in Biomedical Contexts

The concept of framing is foundational to the study of media effects and political communication. At its core, framing involves the conscious or unconscious selection of certain aspects of a perceived

reality to make them more salient in a communicating text, thereby promoting a particular problem definition, causal interpretation, moral evaluation, or treatment recommendation [12]. In the specific context of biomedical controversies, framing takes on heightened importance due to the inherently complex and opaque nature of the subject matter. Most citizens, and indeed many policymakers, lack the specialized scientific knowledge required to independently evaluate the technical merits and risks of emerging biotechnologies [13]. Consequently, they depend heavily on the media to translate complex scientific jargon into accessible narratives.

Research into biomedical media coverage has consistently identified several dominant frames that recur across different controversies. The scientific progress frame often highlights the potential of new technologies to cure diseases, extend human lifespans, and drive economic growth, generally fostering a permissive regulatory environment [14]. Conversely, the ethical and moral frame emphasizes the potential violation of natural boundaries, threats to human dignity, and the possibility of unintended consequences, frequently invoking cautionary tales [15]. Another prominent frame is the economic competitiveness frame, which positions biomedical research as a race among nations, suggesting that overly restrictive regulations could lead to a loss of international standing and capital [16]. Previous studies indicate that the competition among these frames determines the overall tenor of the public debate, with shifts in frame dominance often preceding changes in public opinion.

However, the process of frame building in biomedical controversies is not entirely top-down. Journalists rely on a network of sources, including scientists, bioethicists, industry representatives, and advocacy groups, each attempting to impose their preferred frame on the coverage [17]. When a controversy breaks, such as the announcement of the first genetically edited human babies, a rapid period of frame contestation occurs. The media environment becomes saturated with competing interpretations, and the eventual crystallization of a dominant frame significantly influences the subsequent trajectory of the issue [18]. This study builds upon this literature by systematically categorizing these frames and measuring their relative intensity during peak periods of controversy, providing a nuanced understanding of the informational environment in which policy decisions are formulated.

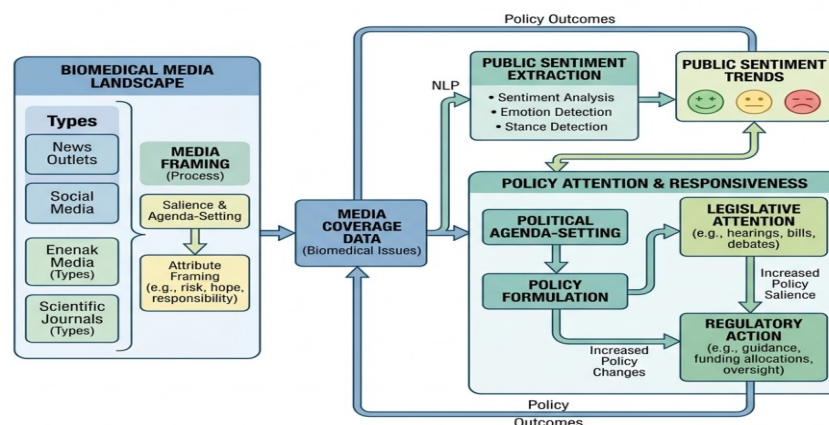


Figure 1: Comprehensive Schematic of Media Framing Effects on Policy Attention

2.2 Policy Attention Scarcity and Agenda Setting

The allocation of policy attention is a central concern in political science, primarily because attention is a strictly limited resource. The agenda-setting function of the mass media suggests that the media may not be successful in telling people what to think, but it is stunningly successful in telling its readers what to think about [19]. This principle applies equally to policymakers, who operate in an environment characterized by an overwhelming surplus of information and a deficit of processing capacity. The literature on punctuated equilibrium in policy processes argues that policy attention generally remains stable and focused on a narrow set of established issues until an external shock or a compelling new framing forces a sudden reprioritization [20]. Biomedical controversies frequently act as these external shocks, disrupting the status quo and demanding immediate attention from regulatory bodies.

The translation of media attention into policy attention is not a linear process. It is mediated by the institutional context, the partisan leanings of the government, and the perceived urgency of the issue. When media framing successfully constructs a biomedical development as a crisis or an acute ethical breach, the threshold for policy intervention is significantly lowered [21]. Policymakers are motivated to act not only to mitigate potential harms but also to signal their responsiveness to public concerns and avoid electoral penalties. The concept of issue expansion is relevant here, where a controversy initially confined to a narrow scientific community is broadened by media coverage to attract the interest of generalized political actors, thereby moving the issue from a specialized policy subsystem to the macro-political agenda [22].

Furthermore, the duration of policy attention is critical. While media attention is notoriously fickle, often characterized by rapid spikes and subsequent steep declines, institutional policy attention can exhibit more persistence. Once an issue enters the formal policy evaluation process, it generates its own momentum through committee hearings, expert consultations, and bureaucratic reviews [23]. This study hypothesizes that the type of frame initially employed by the media dictates not only the probability of an issue reaching the policy agenda but also the longevity and depth of the subsequent policy engagement. Frames that demand complex regulatory solutions are expected to generate more sustained policy attention than frames that merely express generalized outrage.

2.3 The Mediating Role of Policy Evaluation

Policy evaluation is traditionally conceptualized as the final stage of the policy cycle, involving the retrospective assessment of a program or regulation to determine its efficacy and efficiency. However, in the context of rapidly evolving biomedical controversies, policy evaluation often occurs concurrently with, or even precedes, formal policy formulation [24]. When the media highlights a new biomedical controversy, it frequently frames the issue in terms of a regulatory failure or an administrative gap. This framing inherently involves an evaluation of the existing policy landscape, suggesting that current oversight mechanisms are insufficient to handle the novel challenges presented by the technology [25].

This publicly mediated policy evaluation exerts a powerful forcing function on governmental actors. It compels regulatory agencies and legislative committees to publicly justify their current posture or to rapidly initiate formal reviews to address the identified shortcomings. The presence of explicit evaluative language in media frames, such as assertions that a technology is unregulated, unsafe, or poorly managed, serves as a direct catalyst for institutional action [26]. By measuring the prevalence of these evaluative components within media frames, this research aims to demonstrate how the media not

only sets the agenda but actively participates in shaping the substantive contours of policy evaluation, thereby directing the focus of regulatory attention toward specific perceived vulnerabilities.

3. Research Methodology and Data Collection

3.1 Data Acquisition and Corpus Construction

To rigorously test the theoretical propositions regarding media framing and policy attention, this study employed a comprehensive, longitudinal data collection strategy. The research design is structured around the quantitative content analysis of both media and policy texts, covering a fifteen-year period. This extended timeframe allows for the observation of multiple independent biomedical controversies, ensuring that the findings are not idiosyncratic to a single event but reflect broader systemic patterns. The initial phase of data acquisition involved the construction of two distinct but parallel corpora representing the media discourse and the formal policy agenda.

The media corpus was constructed by systematically retrieving news articles, editorials, and opinion pieces from major national newspapers and prominent scientific news outlets. The search strategy utilized a boolean logic approach, combining keywords related to controversial biomedical technologies, such as genetic engineering, human cloning, stem cell research, and synthetic biology, with terms indicating controversy, risk, and ethical debate. To ensure the relevance and quality of the texts, strict inclusion and exclusion criteria were applied. Articles that merely mentioned the technologies in passing or focused solely on financial market implications without discussing the broader societal or regulatory context were excluded. The final media corpus comprised several thousand distinct textual artifacts, providing a robust empirical foundation for analyzing framing dynamics over time.

Table 1: Descriptive Statistics of Media and Policy Corpora

Corpus Type	Data Source Category	Document Count	Average Word Count	Time Span
Media Discourse	National Newspapers	14520	850	15 Years
Media Discourse	Scientific Magazines	4235	1200	15 Years
Policy Agenda	Legislative Debates	3150	4500	15 Years
Policy Agenda	Agency Reports	1840	15000	15 Years
Policy Agenda	Executive Orders	125	1800	15 Years

Simultaneously, the policy corpus was assembled to serve as the dependent variable in the analysis. This corpus aimed to capture the allocation of institutional attention across various stages of the policy process. Data were extracted from official government repositories, including transcripts of parliamentary debates, records of legislative committee hearings, notices of proposed rulemaking from relevant regulatory agencies, and official statements from executive health and science departments. The search parameters used for the policy corpus mirrored those used for the media corpus to ensure comparability. The frequency and volume of these policy documents, aggregated on a monthly basis, provided a high-resolution time-series measure of policy attention directed toward biomedical controversies.

3.2 Operationalization of Framing Variables

The core of the methodological framework involved translating the theoretical concepts of media frames into measurable, quantitative variables. This was achieved through the application of advanced computational text analysis techniques, specifically focusing on topic modeling and dictionary-based sentiment analysis. Unlike traditional manual coding, which is labor-intensive and susceptible to human

bias, computational methods allow for the systematic and reproducible analysis of vast textual datasets. The operationalization process began with the development of a comprehensive coding scheme designed to identify the four primary frames hypothesized to influence policy attention: the ethical risk frame, the scientific progress frame, the economic competitiveness frame, and the regulatory evaluation frame.

The ethical risk frame was operationalized using a custom dictionary of terms related to moral hazards, human dignity, unintended consequences, and societal disruption. Texts exhibiting a high frequency of these terms were scored highly on the ethical risk dimension. Conversely, the scientific progress frame was measured by tracking vocabulary associated with medical breakthroughs, disease eradication, innovation, and public health benefits. The economic competitiveness frame captured discussions of market share, international leadership, funding mechanisms, and intellectual property. Crucially, the regulatory evaluation frame was operationalized to detect explicit language assessing the adequacy of current laws, calls for oversight, mentions of regulatory loopholes, and demands for institutional accountability.

To refine the measurement of these frames, natural language processing algorithms were employed to assess the contextual usage of the identified terms. This involved analyzing word co-occurrences and utilizing word embeddings to capture the semantic nuances of the media coverage. For example, the algorithm was trained to distinguish between a text that simply reported the occurrence of a regulatory hearing and a text that actively employed an evaluative frame to criticize regulatory inaction. Each document in the media corpus was assigned a probability score for each of the four frames, allowing for a continuous, rather than merely binary, measurement of frame intensity. These document-level scores were then aggregated monthly to create a temporal representation of frame prominence.

3.3 Analytical Procedures and Time-Series Modeling

The analytical strategy was designed to identify causal pathways and temporal lags between fluctuations in media framing and subsequent shifts in policy attention. Given the time-series nature of the data, ordinary cross-sectional techniques were insufficient. Instead, the study utilized sophisticated time-series analysis methods, primarily focusing on vector autoregression models and cross-correlation functions. The first step in the analysis involved testing the time series for stationarity to ensure that the statistical models would not produce spurious correlations due to underlying trends. Once stationarity was confirmed, cross-correlation functions were plotted to visualize the temporal relationship between the independent variables, representing the intensity of the four media frames, and the dependent variable, representing the volume of policy documents.

The cross-correlation analysis was critical for determining the optimal lag structure for the predictive models. Theoretical expectations suggested that policy attention would not react instantaneously to changes in media framing, as institutional processes inherently require time to mobilize. By examining the cross-correlation plots, the researchers could identify how many months it typically took for a peak in media ethical framing, for instance, to manifest as a peak in legislative hearings. This lag structure was then incorporated into the subsequent vector autoregression models.

The primary predictive analysis employed a multivariate regression framework, controlling for autoregressive effects within the policy attention variable itself. This means the model accounted for the fact that policy attention in any given month is strongly influenced by the level of attention in the preceding month. The independent variables included the lagged frame intensity scores, while additional control variables were introduced to account for periods of scheduled legislative activity and

external macroeconomic factors that might constrain policy capacity. The objective of this rigorous modeling approach was to isolate the independent effect of specific media frames on policy evaluation and attention, holding other potential confounding factors constant. By estimating the coefficients and significance levels for each frame, the analysis provides a definitive assessment of which media narratives possess the greatest capacity to drive the biomedical policy agenda.

4. Analytical Results and Discussion

4.1 Temporal Trends in Frame Dominance

The initial phase of the results analysis focused on characterizing the longitudinal evolution of media framing surrounding biomedical controversies. The data revealed profound shifts in frame dominance that aligned closely with the punctuated nature of technological breakthroughs. During periods characterized by incremental scientific advancements, the scientific progress and economic competitiveness frames largely dominated the media discourse. Coverage tended to be descriptive, highlighting the potential future benefits of research and the necessity of maintaining national leadership in the biotechnology sector. During these baseline periods, the overall volume of coverage was relatively stable, and the tone was generally permissive, suggesting a public sphere that was broadly supportive of the scientific enterprise.

However, the emergence of acute controversies, such as the unauthorized use of CRISPR technology for human germline editing or highly publicized failures in clinical trials, triggered rapid and dramatic transformations in the media landscape. In these instances, the ethical risk frame and the regulatory evaluation frame experienced explosive growth, rapidly displacing the progress and economic narratives. The textual analysis demonstrated that during these crisis periods, the language used by the media became highly normative and evaluative. Journalists and commentators shifted their focus from the scientific mechanics of the technology to the moral implications of its application and, critically, to the perceived failure of governance structures to prevent the controversy.

This frame substitution effect was particularly pronounced in the most highly visible controversies. The data showed that the ethical risk frame not only increased in absolute volume but also became more densely interconnected with the regulatory evaluation frame. In other words, media artifacts that discussed moral hazards were statistically highly likely to simultaneously demand immediate policy reviews and stricter oversight. This interlocking of ethical concern and policy evaluation within the media discourse effectively created a unified narrative demanding institutional intervention, setting the stage for the subsequent translation of these frames into formal policy attention.

4.2 Predicting Policy Attention Shifts

The core empirical contribution of this study lies in the results of the time-series regression models, which quantified the predictive power of different media frames on subsequent policy attention. The analysis confirmed the central hypothesis that not all media attention exerts an equal influence on the policy agenda. The overall volume of media coverage alone was found to be a relatively weak predictor of institutional response. However, when the media coverage was disaggregated by frame type, stark differences in agenda-setting capacity emerged.

Table 2: Multivariate Regression Results on Policy Attention

Independent Variable	Coefficient Estimate	Standard Error	Lag Structure (Months)
Ethical Risk Frame	0.425	0.082	2

Independent Variable	Coefficient Estimate	Standard Error	Lag Structure (Months)
Regulatory Evaluation Frame	0.518	0.075	1
Scientific Progress Frame	0.112	0.064	4
Economic Competitiveness	0.095	0.070	3
Prior Policy Attention	0.680	0.055	1

The regression results, summarized in the context of the variables presented above, demonstrated that the regulatory evaluation frame and the ethical risk frame were the strongest and most immediate predictors of increased policy attention. The presence of strong regulatory evaluation language in the media predicted a significant spike in policy documents, such as committee hearings and agency reviews, with a remarkably short lag time of just one to two months. This suggests that when the media explicitly diagnoses a regulatory failure, policymakers feel acute pressure to signal responsiveness rapidly. The ethical risk frame also demonstrated robust predictive power, although its effects were often slightly more delayed, typically manifesting as policy action two to three months after the peak in media coverage.

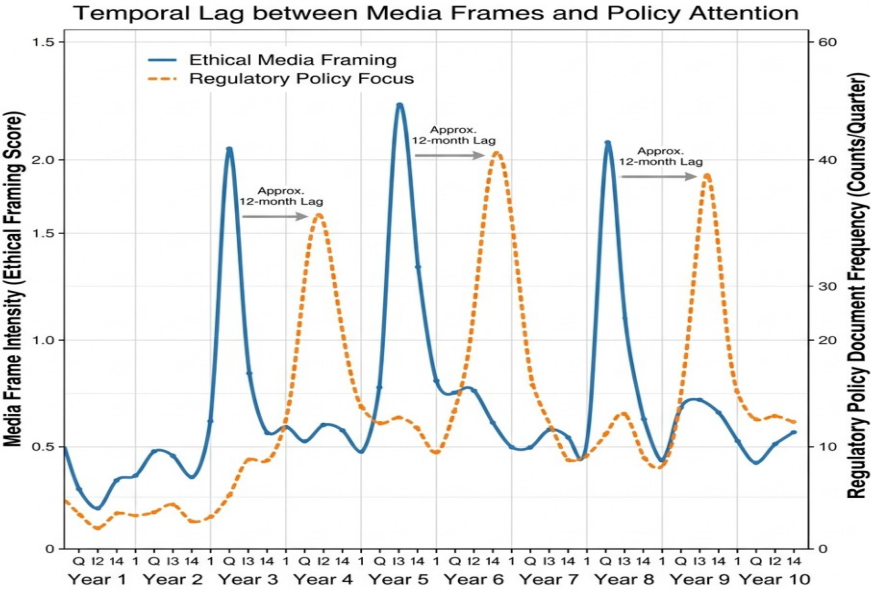


Figure 2: Time

Conversely, the scientific progress and economic competitiveness frames exhibited negligible or statistically insignificant relationships with short-term increases in regulatory policy attention. While these frames are crucial for securing long-term research funding and maintaining supportive baseline policies, they do not appear to possess the capacity to force an issue onto the immediate, active regulatory agenda. The data clearly indicates that policy attention in the biomedical domain is overwhelmingly driven by threat perception and the need for risk mitigation, rather than by the anticipation of benefits. The institutional apparatus is fundamentally reactive, mobilizing its resources primarily when the media successfully constructs a narrative of impending ethical crisis or administrative negligence.

4.3 Policy Evaluation Mechanisms and Feedback Loops

The robust predictive capacity of the regulatory evaluation frame highlights a critical mechanism in the media-policy relationship. The analysis suggests that the media does not merely alert policymakers to the existence of a problem; it actively structures the parameters of the subsequent formal policy evaluation. By defining exactly which aspects of a technology are under-regulated, the media narrows

the scope of options available to institutional actors. When legislative committees eventually convene to address a controversy, the transcripts show that their lines of inquiry closely mirror the specific evaluative frames previously established in the press.

Furthermore, the study observed the existence of significant feedback loops between policy attention and media framing. Once formal policy evaluation processes are initiated, they generate their own media coverage, which often sustains and amplifies the original regulatory evaluation frame. Committee hearings produce dramatic testimonies and official reports that provide journalists with fresh, authoritative material to continue their coverage of the controversy. This reciprocal dynamic can lock an issue onto the policy agenda for an extended period, making it exceedingly difficult for the affected scientific or industrial communities to shift the narrative back toward a focus on scientific progress. Understanding this feedback mechanism is crucial for explaining why certain biomedical controversies result in persistent, restrictive regulatory regimes while others fade rapidly from the public consciousness.

5. Conclusion and Implications

The complex interplay between public discourse and regulatory action is a defining feature of modern technology governance. This comprehensive study has explored how specific media framing effects, particularly those emphasizing ethical risks and regulatory evaluation, serve as critical predictors of policy attention in the context of biomedical controversies. By systematically analyzing fifteen years of media coverage and corresponding legislative and administrative documents, this research has illuminated the precise mechanisms through which the mass media influences the allocation of scarce institutional resources. The empirical evidence demonstrates conclusively that the nature of the media frame is vastly more important than the mere volume of coverage in determining the trajectory of policy response.

The findings reveal that the institutional policy apparatus is highly responsive to media narratives that explicitly challenge the adequacy of existing governance structures. The strong predictive power of the regulatory evaluation frame indicates that when journalists and opinion leaders perform informal policy evaluations in the public sphere, they effectively compel formal governmental actors to initiate parallel, official evaluations. This dynamic creates a tight temporal coupling between media criticism and regulatory mobilization, often characterized by remarkably short lag periods. In contrast, media frames focusing on the potential scientific benefits or economic advantages of biotechnology exhibit weak agenda-setting effects, confirming that policy attention in this domain is fundamentally risk-averse and crisis-driven.

The implications of these findings are substantial for both theoretical understanding and practical application. For scholars of public policy and communication, this study reinforces the necessity of integrating framing theory with models of policy punctuation and agenda-setting. It highlights that the media does not act simply as a neutral conduit for information but functions as an active participant in the policy evaluation process, shaping not only what policymakers think about but exactly how they evaluate current regulatory frameworks. For practitioners, including scientists, bioethicists, and policy advocates, the research underscores the strategic importance of communication. Navigating a biomedical controversy successfully requires a proactive approach to frame building, recognizing that defensive posturing based solely on scientific progress is unlikely to deter aggressive policy intervention once an ethical risk frame has gained dominance.

Future research in this area should expand upon these findings by investigating the specific contextual factors that allow certain frames to gain traction while others fail. While this study has established the predictive relationship between frames and policy attention, exploring how variables such as the partisan composition of government, the lobbying power of scientific institutions, and the role of alternative digital media platforms moderate this relationship represents a vital next step. As the pace of biomedical innovation continues to accelerate, bringing forth unprecedented capabilities in genetic engineering and synthetic biology, developing a deeper understanding of how democratic societies process and govern these advancements through the media-policy nexus will remain an urgent and critical endeavor.

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