# Framing Artificial Intelligence in American Newspapers

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**Abstract**

Publics' perceptions of new scientific advances such as AI are often informed and influenced by news coverage. To understand how artificial intelligence (AI) was framed in U.S. newspapers, a content analysis based on framing theory in journalism and science communication was conducted. This study identified the dominant topics and frames, as well as the risks and benefits of AI covered in five major American newspapers from 2009 to 2018. Results indicated that business and technology were the primary topics in news coverage of AI. The benefits of AI were discussed more frequently than its risks, but risks of AI were generally discussed with greater specificity. Additionally, episodic issue framing and societal impact framing were more frequently used.

## Introduction

Artificial intelligence has been recognized as a strategic priority by the patent offices of the United States and many countries (IP Watch 2018), and as an important area for national policy as defined by the National Science and Technology Council. In a recent industry survey, 80% of the companies reported having AI applications in production (Teradata 2018). Additionally, AI has long been a topic of fascination in popular culture. Numerous sci-fi movies, television dramas, and novels have explored the power and danger of AI, illuminating human's complicated fears and yearnings towards technologies. With the recent technological breakthroughs, the gap between scientific reality and the popular culture imaginations is narrowing, resulting in a surge of media buzz on AI. However, the reportedly unlimited potential of AI (Khosravi 2016) has generated not only excitements, but also widespread concerns.

Publics' perceptions of new scientific advances such as AI are often informed and influenced by the information and arguments presented in media, particularly news media (Goodman and Goodman 2006). Similar to other innovative yet controversial scientific advances like nanotechnology, the social acceptance and adoption of AI depends on public's understanding of its power, limitations, and risks (Strekalova 2015). However, for emerging, unfamiliar technologies, public's affective attitudes may be formed before systematic, logical, cognitive information processing take place (Scheufele and Lewenstein, 2005). A 2017 survey by the Pew Research Center reveals that Americans are more concerned than enthusiastic about the prospect of AI-powered machines performing many human jobs, and anticipate more negative consequences than positive outcomes (Anderson 2017). Moreover, not only approximately 60% of American adults are reluctant to incorporate automation technologies such as driverless cars into their own lives, but 76% of Americans also worry that advances in robotics and AI will lead to more inequality in the future.

Research assessing how media cover AI thus is imperative to understand the forces shaping public opinion on this important technology. However, despite the numerous hypes and speculations about AI, there exists little empirical data regarding how AI is covered in news media. A notable exception is Fast and Horvitz's (2017) study that analyzed *New York Time*'s 30-year coverage of AI. They reported an overall optimistic view with growing concerns on various negative impacts of AI in recent years. However, their study is limited to the news articles in *New York Times*, and failed to provide a theory-based analysis of news coverage of AI. Based on the rich literature of framing theory in journalism and science communication (e.g., Strekalova 2015; Vicsek 2011), this study systematically examined the coverage of AI in major U.S. newspapers. By adopting the content analysis method from social sciences, we seek to illuminate how AI is discussed, contextualized, and presented to the public.

## Literature Review

### News Framing

The critical role of media in facilitating information dissemination and understanding of innovations is well-

documented (Brossard 2013). According to framing theory, the way an issue is framed and discussed through specific perspectives can influence how audiences make sense of the issue (Vicsek 2011). Entman (1993) defined framing as selecting "some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation to the item described" (p. 52). In their study of news framing of nanotechnology, Anderson, Allan, Petersen, and Wilkinson (2005) argue that the press helps establish the initial parameters of debate regarding nanotechnology and provides topic-defining reference points. Nelkin (1987) observed a decline in publics' consumption of a product powered by a controversial technology after media coverage of the scientific controversy. Strekalova (2015) also pointed out that publics' attitudes toward new technologies are often affected by specific applications, which is particularly relevant to AI which can be incorporated into numerous aspects of our daily lives, from entertainment, education, healthcare, to manufacturing.

It is important to note that this study does not assume a causal relationship between media coverage and public's opinions about a particular issue. However, media as a powerful cultural institution (Hesmondhalgh 2006) may influence public's attitudes towards an emerging technology, particularly in the early stage when most people feel uncertain, wary, or anxious about an unfamiliar yet powerful technology. Therefore, understanding how news media frame AI is imperative to understand the perspectives and considerations in the formation of public opinion regarding the technology, and the wide-reaching impacts on public acceptance and policy.

## Research Questions

Prior content analyses of science communication have studied different news frames of technologies and scientific advances. The coverage of benefits and risks has been considered as the most commonly analyzed category (Friedman and Egolf, 2011), as well as topics of economic and business, policy and regulations, and ethics and moral issues (Strekalova 2015). Following Strekalova's (2015) approach, this study differentiated between topics and frames. Topic is defined as a manifest subject, an issue or event that provides message content. Frame, by contrast, is a perspective through which the content is presented. A single news article may incorporate multiple topics and multiple frames. Incorporating the key frames and topics identified in the literature, the present study aims to answer the following research questions:

**RQ1:** What topics were most prevalent in AI coverage in major U.S. newspapers?

**RQ2:** How was AI framed in major U.S. newspapers?

# Methods

## Sample

The authors used Lexis Nexis Academic and the ProQuest databases to identify news articles with the keyword "artificial intelligence." Fast and Horvitz (2017) observed that news coverage on AI have increased dramatically since 2009. Therefore, news article from January 2009 to September 16, 2018 (end of data collection) that mentioned artificial intelligence from most widely-read daily newspapers, *USA Today, The New York Times, Los Angeles Times, New York Post*, and *Washington Post* were identified.

Figure 1 shows the number of articles from the five U.S. newspapers. In total, 2,485 of articles were found, including 274 from *Los Angeles Times*, 14 from *New York Post*, 1,475 from the *New York Times*, 293 from *USA Today*, and 155 from *Washington Post*. It can be clearly observed that the number of AI-related articles increased over the years, especially since the year of 2016, and the majority of them were contributed by the *New York Times*.

We implemented stratified sampling with probability proportional to size to select articles for the content analysis. Articles were first divided into distinct categories based on the publisher and published year, and were then randomly selected in each category. The number of samples from a particular year is proportional to the ratio of the total number of articles in that year to numbers in other years. Similarly, the number of samples from a particular publisher is proportional to the ratio of the total number of articles from that publisher to numbers from other publishers. The final sample consisted of 399 articles. The unit of analysis is the complete news article.

## Variables

***Topics.*** We incorporated the key topics (nominal measure) identified in prior research, including Technology Development and Application, Business and Economy, Politics and Policy, Ethics, Threat, Science Fiction, Entertainment, and Education. The dominant topic of each article was coded. All discussed topics in a news article were also coded.

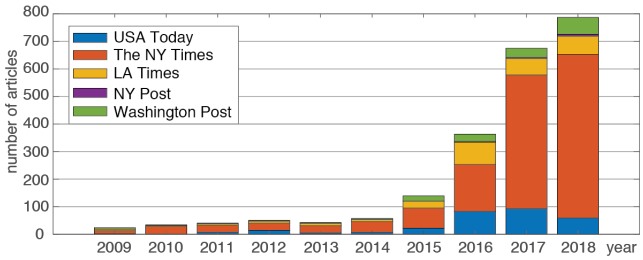


*Figure 1. Total number of articles across newspapers.*

***Risk and benefit.*** Previous content analyses have identified the coverage of risks and benefits as a crucial variable that drives public perception and attitudes towards emerging technologies (Coleman, Thorson, and Wilkins, 2011; Vicsek 2011). Specific types of risks analyzed in prior studies and commonly mentioned in mainstream media were coded, including loss of jobs, embedded bias, privacy concern, misuse, run-away-train, Pandora's Box (unforeseeable risk), ethical concerns, and shortcomings of AI. Similarly, specific types of benefits including economic benefit, improving human life and well-being, reducing human bias or social inequality were also coded. Moreover, when either a risk or benefit was mentioned, the mentioned risk or benefit was coded for how specific the risk or benefit was discussed in the news article using a 3-point Likert scale.

***Societal versus Personal Impact Framing***. To illustrate how news media covered the impacts of AI, we analyzed whether AI was discussed via a personal or societal impact frame (Strekalova 2015). Specifically, personal framing presents the news story by focusing on individuals' opinions, experiences, or consequences of incidents. By contrast, societal framing addresses the general, overall consequences of the incidents, or broader societal decisions such as policy or public opinion. A middle category was coded if the news story gave equal attention to both aspects.

***Thematic versus Episodic Issue Framing***. To understand how AI was contextualized in news, we also analyzed issue framing of AI as a thematic or episodic issue (Strekalova 2015). Episodic framing presents an issue by offering a specific example, case study, or event-oriented report (e.g., covering a press conference for an AI-related product). By contrast, thematic issue framing discusses the technology in a broader, general context, such as how AI is changing various industries. A middle category was also included.

In addition to the key topics and themes identified in the literature, this study also coded the overall valence (i.e., positive, negative, mixed), and the sources cited in the article (Stephens 2005), including business, government/politician, mass media, scientist, non-scientist expert (e.g., scholars in ethics), celebrity, and ordinary individual.

**Intercoder Reliability**

Three graduate students in school of communication were trained as coders for this study. 40 articles were randomly selected from the dataset to establish intercoder reliability. The intercoder reliability was calculated by using Perreault and Leigh's (1989) formula. The average of 0.8 is achieved for intercoder reliability.

## Results and Findings

### Topics

Overall, newspaper coverage of A.I. was dominated by the topic of *Business and Economy* ($N = 143$, 35.1%), followed by *Science and Technology* ($N = 96$, 23.6%) and, *Policy and Politics* ($N = 49$, 12.0%). The dominant topic varied across the years. In 2009, *Business and Economy* ($N = 2$, 50.0%), and *Science and Technology* ($N = 2$, 50%) were the dominant topics. *Entertainment* ($N = 2$, 33.3%) topic about entertaining applications of AI, such as AI-powered robot dogs, was the dominant topic in both of 2010 and 2011. *Business and Economy topics* have been the dominant topic from 2012 to 2018 (2012 $N = 3$, 33.3%, 2013 $N = 2$, 25.0%, 2014 $N = 6$, 60.0%, 2016 $N = 28$, 41.8%, 2017 $N = 51$, 41.5%, 2018 $N = 43$, 30.3%). Only in 2015, *Science and Technology* emerged as a dominant topic ($N = 11$, 45.8%).

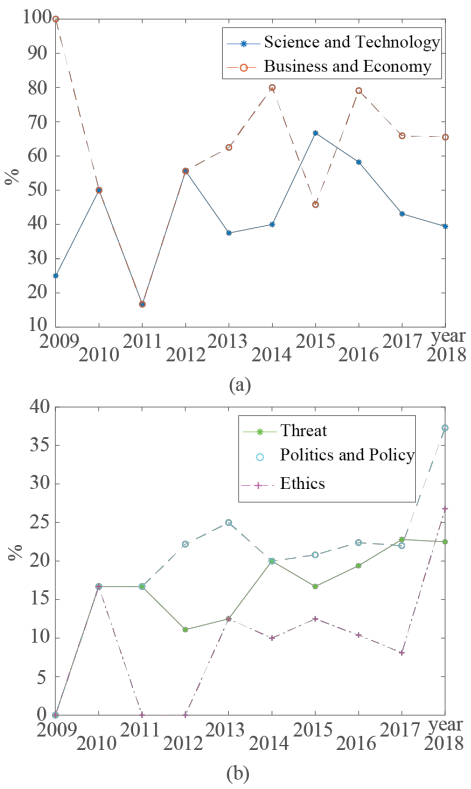


*Figure 2. Percentages of articles containing different dominant topics in each year.*

Most articles covered multiple topics. Figure 2 shows the percentage of articles coded with a specific topic in each year. Most frequently appearing topics were *Business and Economy* ($N = 264$, 66.2%) and *Science and Technology* ($N = 181$, 45.4%) as shown in Figure 2 (a). *Politics/Policy* had been increased slightly from 2016 (2016: 22.4%, 2018: 37.3%) as presented in Figure 2 (b). Although *Ethics* was not a dominant topic or one of the most popular topocs, its occurrence dramatically increased between 2017 (8.1%) and 2018 (26.8%). *Threat* also reached a new record high in 2018 as shown in Figure 2 (b).

## Cited Sources

A news article could cite multiple sources, and all observed sources were coded. Given the dominance of business and technology topics, it is not surprising that the most frequently cited sources were individuals associated companies or businesses ($N$ = 258, 64.7%), followed by scientists ($N$ = 116, 29.1%) and non-science experts ($N$=94, 23.6%). Sources associated with science and research institutions were cited more frequently in earlier years between 2009 and 2012. Government and politician were not popular sources for AI-related news but had been increasingly cited from 2015.

## Valence

Figure 3 shows the number of articles coded with positive, negative, or mixed valence in each year. Note that before 2015 when the number of AI-related articles were very few, such articles were mostly coded as positive or mixed valence. As the number of AI articles dramatically increased, the number of articles with negative valence increased as well, especially in the current year (2018).

## Risks and Benefits Framing

Among the 399 news articles analyzed, 52.9% of articles ($N$ = 211) discussed at least one type of benefits and 47.6 % of articles ($N$ = 190) covered at least one type of risks. An article can be coded for multiple types of risks and benefits. Figure 4 presents the total number of occurrences of different types of risks and benefits. It can be observed that in general, benefits, such as economic benefits (economy) and improving human life or well-being (well-being), were used much more often to frame AI topics than risks. The most frequently discussed risks included shortcoming of the technology (shortcoming), loss of jobs, and privacy concerns.

Figure 5 shows the average specificity level of benefits and risks discussed in news articles, with error bars indicating 95% confidence interval.

Three types of benefits, including economic benefits (economy), improving human life or well-being (well-being), and reduce human biases or inequality (reduce biases), had similar level of average specificity but the last one has much fewer cases.

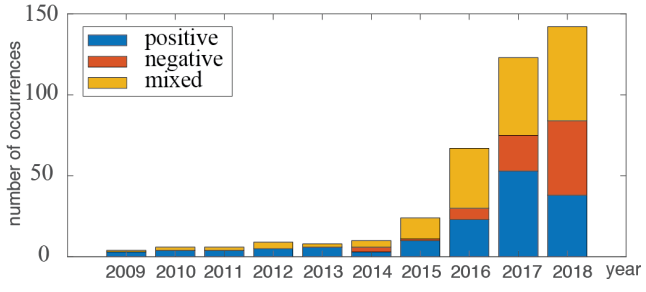


*Figure 3. Number of articles coded with positive, negative, or mixed valence in each year.*

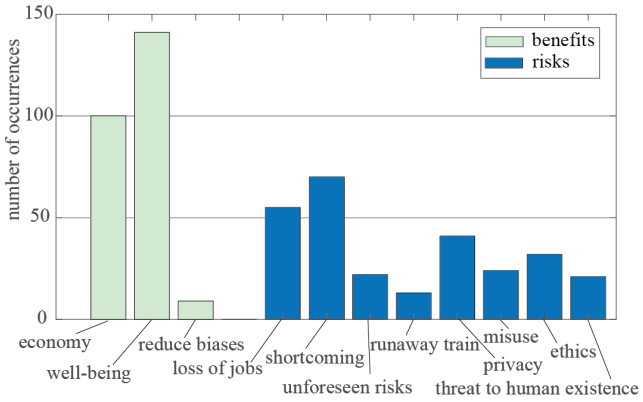


*Figure 4. Total number of articles coded with each type of benefits and risks.*

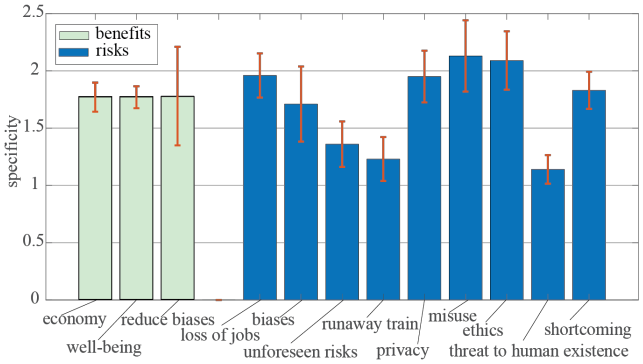


*Figure 5. Average specificity of benefits and risks with 95% confidence interval indicated.*

The top five risks in terms of specificity level are misuse of AI (misuse), ethical or moral problems (ethics), loss of jobs, privacy, and shortcoming of the technology (shortcoming). Notably, the average specificity of all these five risks is higher than any of the benefits. Risks such as threat to human existence, runaway train, and unforeseeable risks were discussed in newspapers with relatively low level of specificity.

## Topics in Risks/Benefits Framing

To examine how topics were framed in relation to benefits and risks, we consolidated the coding into four categories: risks only, benefits only, risks and benefits, neither risks nor benefits. Overall, the four categories in risk/benefit framing are evenly presented: risks only ($N$=89, 22.31%), benefits only ($N$=96, 24.06%), risks and benefits ($N$=99, 24.81%), neither risks nor benefits ($N$=115, 28.82%). However, a chi-square test indicated a significant relationship between topics and risk/benefit framing, $\chi^2$ (24, $N$ = 399) = 87, $p$ < .001.

A cross-tabulation of risk-benefit framing and dominant topic variables is shown in Table 1. By examining the calculated standardized residuals, more detailed information about the relation between these variables can be obtained.

For example, the *Business and Economy* topic is more likely to be covered in articles that discussed benefit only and less likely in articles that discussed risks only. Both *Science Fiction* and *Ethics* topics are likely to be covered in articles discussing risks only, while *Entertainment* is likely to be covered in articles that discussed neither risks nor benefits of AI.

### Impact Framing (Personal vs. Societal)

Impact framing examines the manner in which topics are covered from personal, societal, or mixed angles. Overall, the reviewed articles were most frequently covered in societal frames ($N$ = 192, 48.1%), followed by mixed framing ($N$ = 106, 26.6%), and personal framing ($N$ = 101, 25.3%).

A chi-square test was conducted and the result indicated significant relationship between dominant topics and impact frames, $\chi^2$ (16, $N$ = 398) = 48.35, $p$ < .001. *Business and Economy*, *Science Fiction*, and *Entertainment* topics were more likely to be associated with the personal impact frame, while *Threat*, *Politics/Policy*, and *Ethics* topics were more likely to be associated with the societal impact frame. *Science/Technology* and *Education/Career Advice* were more related to the mixed frame.

### Issue Framing (Episodic vs. Thematic)

Issue framing addresses whether topics are discussed as singular incidents (episodic), or related to a broader theme (thematic), or mixed. In this study, episodic framing was observed in the majority of cases ($N$ = 244, 61.2%). Thematic framing was coded for 26.8% of cases ($N$ = 107). Mixed framing was observed the least ($N$ = 48, 12.0%).

A chi-square test also showed a significant relationship between dominant topics and issue frames, $\chi^2$ (16, $N$ = 398) = 50.63, $p$ < .001. *Business and Economy* topics were more likely to be associated with the episodic frame. *Threat* and *Politics*/*Policy* were more likely to be covered via thematic framing.

## Conclusion

The study results revealed that AI was primarily covered in American newspapers via the topics of *Business and Economy* and *Science and Technology*. Notably, the topic of ethics has been increasingly discussed in recent years. A close examination of the articles that discussed ethics or moral issues as the dominant topic indicated that both positive and negative aspects were addressed. For instance, a news article discussed the use of AI to combat unethical wildlife trade. However, most news articles did not discuss a particular ethical issue in-depth, but raised general questions about potential ethical concerns, such as privacy and misuse of AI in the title, introduction, or conclusion paragraph, without providing specific discussions. As news media influence people's attitudes towards an emerging technology, more in-depth and concrete discussion of the risks and benefits of AI in news media is needed to allow critical assessment of the use and misuse of AI. Additionally, prior media framing studies suggest four stages of news coverage of an emerging issue: initial, scientific, human, and political (Rogers et al.,1991). The dominant topic of *Science and Technology*, coupled with the dominant episodic issue frame, suggests that the media coverage of AI is in the early stage and new information is constantly released and discussed. However, the findings that societal impact frame was used in nearly half of the news articles analyzed, and the *Politics/Policy* topic has been increasingly covered, suggest that news coverage has begun to transition into the human and political stage as more people are affected by the technology.

*Table 1. Dominant topic and frequencies, expected counts, and standardized residuals in its risks/benefits coverage.*

| | Risks and benefits coverage | | | |
|---|---|---|---|---|
| Topics | Risks only | Benefits only | Risks and benefits | Neither risks nor benefits |
| *Science and Technology* | | | | |
| Count | 23 | 24 | 29 | 20 |
| Expected count | 21.41 | 23. 1 | 23.82 | 27.67 |
| Standard residual | 0.34 | 0.19 | 1.06 | -1.46 |
| *Threats* | | | | |
| Count | 13 | 0 | 17 | 4 |
| Expected count | 7.58 | 8.18 | 8.44 | 9.8 |
| Standard residual | **1.97** | **-2.86** | **2.95** | -1.85 |
| *Business and Economy* | | | | |
| Count | 15 | 51 | 31 | 46 |
| Expected count | 31.9 | 34.41 | 35.48 | 41.22 |
| Standard residual | **-2.99** | **2.83** | -0.75 | 0.74 |
| *Science Fiction* | | | | |
| Count | 7 | 2 | 2 | 4 |
| Expected count | 3.35 | 3.61 | 3.72 | 4.32 |
| Standard residual | **1.99** | -0.85 | -0.89 | -0.15 |
| *Politics and Policy* | | | | |
| Count | 16 | 6 | 8 | 19 |
| Expected count | 10.93 | 11.79 | 12.16 | 14.12 |
| Standard residual | 1.53 | -1.69 | -1.19 | 1.3 |
| *Ethics* | | | | |
| Count | 12 | 3 | 6 | 4 |
| Expected count | 5.58 | 6.02 | 6.2 | 7.21 |
| Standard residual | **2.72** | -1.23 | -0.08 | -1.2 |
| *Entertainment* | | | | |
| Count | 3 | 2 | 0 | 8 |
| Expected count | 2.9 | 3.13 | 3.23 | 3.73 |
| Standard residual | 0.06 | -0.64 | -1.8 | **2.19** |
| *Education* | | | | |
| Count | 0 | 4 | 5 | 6 |
| Expected count | 3.35 | 3.61 | 3.72 | 4.32 |
| Standard residual | -1.83 | 0.21 | 0.66 | 0.81 |
| *Other* | | | | |
| Count | 0 | 4 | 1 | 4 |
| Expected count | 2.01 | 2.17 | 2.23 | 2.59 |
| Standard residual | -1.42 | 1.24 | -0.82 | 0.88 |

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