

COMPARISON OF DISCOURSE SURROUNDING CRISPR/Cas9 IN THE MEDIA AND PEER-REVIEWED LITERATURE

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ABSTRACT

Since its development in 2013, Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) Cas9 gene-editing technologies have dramatically impacted the field of genetics research. CRISPR/Cas9 has received a lot of attention in the news in recent years, and accurate portrayal of this technology by the mainstream media has the potential to shape its perception by the public in a way that is conducive to its possible implementation as a viable tool for genetic engineering. Our aim was to evaluate how the discussion of CRISPR/Cas9 in the mainstream media reflects and compares to that of the academic literature. We surveyed mainstream news articles (n=60) and scientific review articles (n=30) that discussed CRISPR/Cas9. Using an a priori coding scheme, we found that while the news does not accurately reflect the current state of CRISPR/Cas9 research and development, it provides more perspectives and considers broader social implications compared to the academic literature. Therefore, both news media and academic papers provide valuable contributions to the conversation but news articles in particular have the opportunity to improve the accuracy or thoroughness of their coverage on the topic.

INTRODUCTION

The ethical responsibility of public communicators of science has come under increasing scrutiny over the past years. Previous studies by Kamenova (2015) and Racine (2010) have shown that the media provides overly optimistic depictions of developing biotechnologies, emphasizing benefits over risks and fostering unrealistic expectations for the speed of application. We sought to analyze this type of reporting in the case of CRISPR/

Cas9, a gene-editing technique that has had a profound impact on the field of genetic research in recent years. Compared to its alternatives, such as TALENs (Transcription Activator-Like Nucleases) and ZFNs (Zinc Finger Nucleases), and Meganuclease, CRISPR offers clear cost advantages, being three to six fold cheaper per reaction (Samy, 2017). It has therefore provided a more accessible and efficient method of editing DNA.

While CRISPR/Cas9 has gained increasing attention both in mainstream media and in academic literature, to our knowledge, little research has been done that compares and analyzes the discussion on different platforms. Given CRISPR/Cas9's potential to impact both genetics research and society as a whole, we believe it is important that there is transparency among scientists, the mainstream media, and the general public regarding its major developments. Our aim was to evaluate how the discussion of CRISPR/Cas9 in the mainstream media reflects and compares to that of the academic literature. Results from our study can give us an understanding of the similarities and differences between expert and public discussion on the topic of CRISPR/Cas9 and gene editing more broadly.

METHOD

To compare the discussion of CRISPR/Cas9 in academic and non-academic sources, we conducted a scoping review consisting of the keywords, "CRISPR Cas9 human review", within the time frame of 2005 to 2017. We used PubMed as the search database for our academic sample and Google News for our non-academic sample. Despite the substantial amount of work that is currently being done with CRISPR/Cas9 in both human and non-human models, we focused on human applications of the technology due to its relev-

ance to the public. From our search, we retrieved 280 unique peer-reviewed articles from PubMed and 215 media articles from Google News. For the academic sample, we included only peer-reviewed articles that primarily focused on human applications of CRISPR ($n = 187$). From the 187 articles for the academic sample and 160 articles from the non-academic sample remaining, we randomly selected 30 academic articles and 60 non-academic articles. We ensured that each article was reviewed in its entirety, and not just specific sections of it.

We generated a coding frame informed by Benjamin, Lo, and Illes (2016) based on categorical variables representing tone, portrayal of the technology's salience, and discussion of the following elements: controversies, societal risks, applications, future projections, and engineered humans (Table 1). For tone, we considered the author's stance on the topic, which was coded as negative, neutral, or positive. For salience, we considered how strongly the author suggests the importance of the technology, which was coded as unimportant, expected, important, or revolutionary. In particular, "expected" indicates that the technology is portrayed as along the expected pace of scientific advancement, and "revolutionary" indicates that it is portrayed as a complete or dramatic change. Next, we considered whether controversies were discussed, whether societal risks were discussed, whether applications were discussed mainly in research or clinical contexts, whether future projections were the main focus of the article, and whether there was mention of engineered humans. We consider research applications to include the study of molecular genetics and human diseases, whereas clinical applications include germline editing, treating and curing diseases, and improving medical technology.

Coding of the articles was done by all three researchers, who were trained by coding a few articles separately, then discussing and resolving any disagreement. After training, the academic and non-academic samples were each split into three subsets, and each researcher coded one subset.

Finally, after quantitatively assessing each sample, we performed a Chi-Square test for independence to determine whether there was a significant association ($p < 0.05$) between each variable and either the academic or non-academic sample (Table 1).

Coding variables	Academic articles (n = 30)	Non-academic articles (n = 60)	p-value
Tone of articles			0.000484
Negative	0%	17%	
Neutral	50%	68%	
Positive	50%	15%	
Discussion of social risks			0.000314
Yes	10%	40%	
No	90%	60%	
Discussion of applications			0
Mainly research	80%	3%	
Mainly clinical	20%	92%	
None	0%	5%	
Mention of engineered humans			0.002060
Yes	10%	50%	
No	90%	50%	
Discussion of controversies			0.00000003
Yes	23%	83%	
No	77%	17%	
Focus of article: Future projections			0.00000052
Yes	3%	58%	
No	97%	42%	
Salience			0.42
Unimportant	0%	3%	
Expected	50%	38%	
Important	43%	48%	
Revolutionary	7%	10%	

Table 1 Summary of main coding variables and p-values yielded from Chi-Square tests

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RESULTS

Six of the seven variables assessed showed a significant association between the variable and the type of source they were represented in: tone, discussion of controversies, discussion of societal risks, discussion of applications, discussion of future projections, and mention of engineered humans. In our news media sample, the majority of the articles (68.3%) depicted human applications of CRISPR/Cas9 in a neutral tone while only a small portion used negative (16.7%) or positive tones (15%). In contrast, the tone of the academic articles had an even divide between neutral (50%) and positive (50%) tones.

Societal risks were discussed more often in news articles (40%) than in academic articles (10%). Similarly, a higher percentage of non-academic sources (83%) discussed controversies of CRISPR/Cas9 in human applications compared to academic articles (23%).

There was also a significant difference in how academic and non-academic articles portrayed applications of the technology—while most non-academic articles (92%) focused on clinical applications, most academic articles (80%) focused on research applications. We also observed a significant difference in the

mention of engineered humans between the two types of sources with half of the news articles (50%) mentioning engineered humans whereas far fewer academic articles (10%) did the same.

In terms of the future projections of the technology, the vast majority (96.7%) of the academic articles provided no claims for the future of CRISPR/Cas9, while they were brought up in more than half (58.3%) of the non-academic articles.

CONCLUSION AND DISCUSSION

In our research, we found statistically significant differences between article sources in six of the seven topics that we investigated. Overall, the news media's discussion of applications and future projections was not reflective of the discussion in the academic literature. As we expected, in academic articles, CRISPR/Cas9 is still being discussed almost exclusively in the research context. On the other hand, the media focuses largely on usually futuristic applications to humans. More specifically, academic papers often discuss CRISPR/Cas9's application to the study of human diseases and molecular genetics, while news articles discuss the possibility and implications of using CRISPR/Cas9 for germline editing, treating and curing diseases, and "engineering" humans. Similarly, the majority of media articles discuss future projections of CRISPR/Cas9 as its main subject, while academic articles rarely do, focusing on present work instead.

Furthermore, we found that the news media is more attentive to the societal risks and controversies involved with this technology, including policy guidelines for CRISPR/Cas9's continued development and ethical controversies surrounding germline editing. Since it is not necessarily the responsibility of researchers to answer this question, it is valuable that the news media creates a forum for this discussion. In general, the greater distribution of tone in news media indicates that it may offer more perspectives.

Future studies could determine what factors cause the differences found in the discourse surrounding CRISPR/Cas9 in the academic literature and news media. A better understanding of these factors would provide insight into how scientific research on CRISPR/Cas9 is translated by the mainstream media. Learning to reduce or control these factors could promote more scientifically and socially responsible communications

about the promises and limitations of CRISPR/Cas9. This has the potential to shape the understanding of the public, which could then aid the successful implementation of CRISPR-based technologies.

News media and academic articles have differing perspectives and information to offer. As we expected, academic literature provides a thorough account of CRISPR/Cas9 research and development that is being done. While the news does not accurately reflect the current state of this research, it brings in more perspectives and considers broader social implications. Therefore, it is important for expert and non-expert perspectives alike to be involved in the conversation. At the same time, news articles in particular have the opportunity to improve the accuracy or thoroughness of their coverage on the topic. Accurate portrayal of this technology by the mainstream media has the potential to shape its perception by the public in a way that is conducive to its possible implementation as a viable tool for genetic engineering.

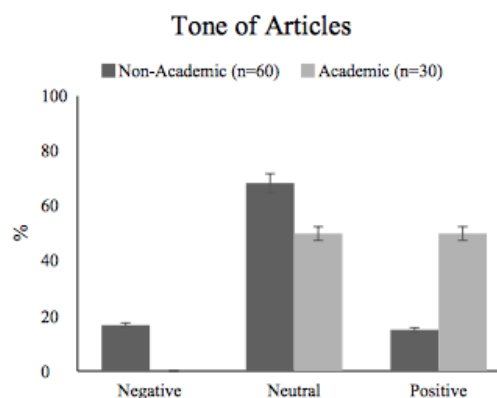


Fig. 1 Tone of discussion represented in non-academic (n = 60) and academic (n = 30) articles

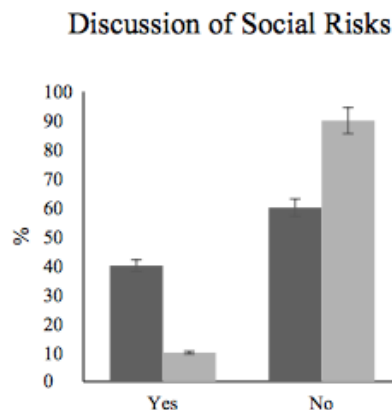


Fig. 2 Discussion of social risks in non-academic (n = 60) and academic (n = 30) articles

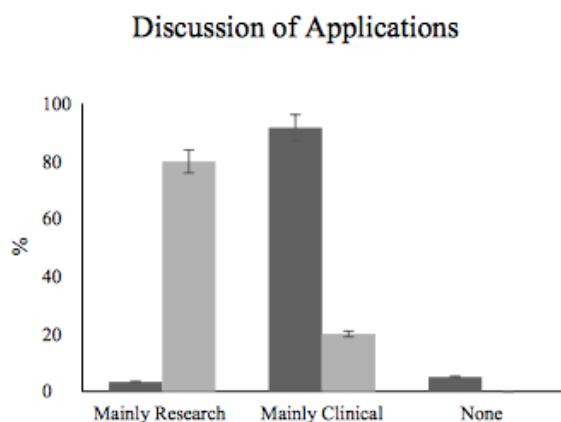


Fig. 3 Discussion of applications in non-academic (n = 60) and academic (n = 30) articles

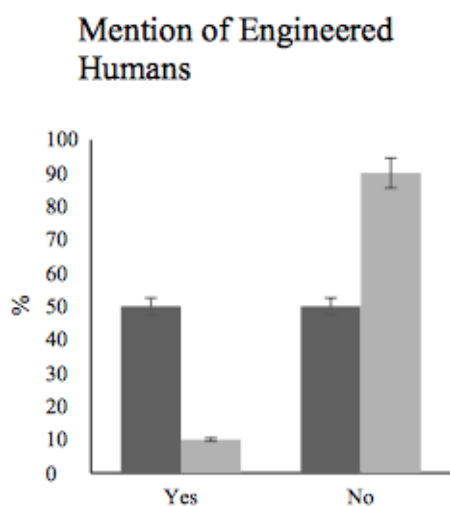


Fig. 4 Mention of engineered humans in non-academic (n = 60) and academic (n = 30) articles

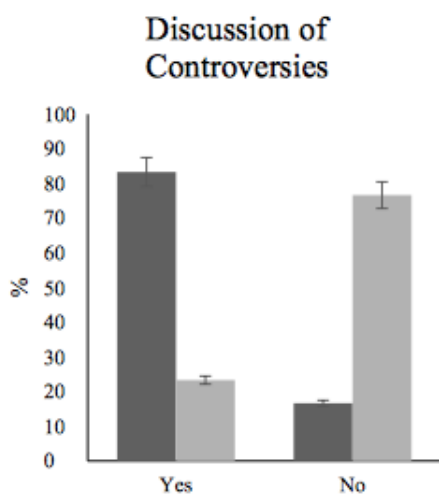


Fig. 5 Discussion of controversies in non-academic (n = 60) and academic (n = 30) articles

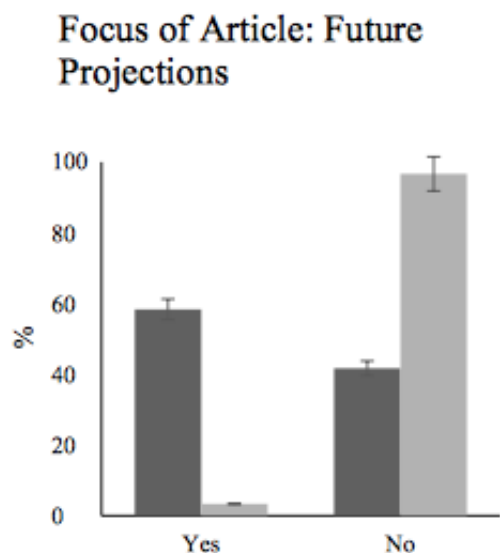


Fig. 6 Future projections as the focus of discussion in non-academic (n = 60) and academic (n = 30) articles

REFERENCES

Benjaminy, S., Lo, C., & Illes, J. (2016). Social Responsibility in Stem Cell Research - Is the News All Bad? *Stem Cell Reviews and Reports*, 12(3), 269-275.

Kamenova, K., & Caulfield, T. (2015). Stem cell hype: media portrayal of therapy translation. *Science Translational Medicine*, 7(278), 278ps4.

Racine, E., Waldman, S., Rosenberg, J., & Illes, J. (2010). Contemporary neuroscience in the media. *Social Science and Medicine*, 71(4), 725-733.

Samy M. (2017, September 15). Gene-Editing Could Modify and Cure Disease: CRISPR vs. TALENs. Retrieved from <https://ark-invest.com/research/crispr-vs-talens>

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