Representing Gene-Editing in Newspapers. Between Science Dissemination and Fantasy[1]

Abstract: This paper investigates the popularised representations of gene-editing in the British broadsheets and tabloids over the two-year period 2017-2018. The basic assumption is that news reports serve as an important channel for dissemination of knowledge about gene-editing and are likely to influence the public opinion on this technology by constructing news stories in an interpretative way. This study sets to examine how tabloids and broadsheets frame gene-editing and genetic researchers linguistically and discursively, focusing on the selective representation of claims and the imagery associated with applications and implications of gene-editing. The methodological framework adopted is that of Corpus-Assisted Discourse Analysis. WordSmith Tools 6.0 software is used for lexical analysis and text search. The results indicate a convergent tendency of tabloids and broadsheets to explain and categorise the technology in a careful way, with tabloids relying more often on the quotes and attributions of scientists, and a divergent tendency in the use of loaded imagery.

Keywords: *corpus-assisted discourse analysis*, *gene-editing*, *newspapers*, *popularisation*

1. Introduction

Genetic breakthroughs have always mesmerized both the scientific community and the general public. Scientific advancements of the 1990s, with the first cloning case, and the 2000s, with the conclusion of the Human Genome Project, were widely overviewed by the popular press. Public perception fluctuated between hopes for new treatments and fears of the unknown. In general, the development of scientific knowledge which has consistently involved human intervention on nature was always met with a nervously ambivalent reaction, as it was perceived as tampering. Starting from the release of Mary Shelley's Frankenstein in 1818, the popular culture seemed to have imprinted on the image of Frankenstein,[2] which successfully resurfaced whenever advancements of bioscience appeared to breach some invisible boundaries[3] – be it the cloning of Dolly,[4] the applications of genetically modified foods[5] or the most recent technology of gene-editing. As a result, geneticists historically were eager to collaborate with the mass media as they wanted to promote a positive image of their

[1] This study contributes to the national research programme "Knowledge dissemination across media in English: continuity and change in discourse strategies, ideologies, and epistemologies", financed by the Italian Ministry of Education, University and Research for 2017-2019 (nr. 2015TJ8ZAS).

[2] Jon Turney, *Frankenstein's Footsteps: Science, Genetics and Popular Culture* (New Haven: Yale U.P., 1998).

[3] Henk van der Belt, "Playing God in Frankenstein's Footsteps: Synthetic Biology and the Meaning of Life", *Nanoethics*, 3.3 (2009), 257.

[4] Gina Kolata, *Clone: The Road to Dolly and the Path Ahead* (London: Allen Lane, 1997).

[5] Jennifer McGee, "Weird Science: Frankenstein Foods and States as Laboratories of Democracy", *Journal of Law and Health*, 30.1 (2017), 111.

work and to contrast the negative association of genetics with eugenics.[6] In this endeavour, the language of genetics became strongly associated with metaphors, since both researchers and journalists were aware of the potential of metaphors to facilitate the understanding of science.[7] Geneticists themselves created and deployed "a striking range of metaphors to promote their science, suggest its meanings and persuade the public of its value to health care and social policy".[8] The metaphors were "quickly migrating to these popular media, thus influencing public opinion"[9] and often amplifying the image to fashion a bigger public resonance.

Representations of the genome have coalesced into the image of a written document, a book, a text or a code,[10] which is framed in terms of a mystery to be unveiled, discovered and decoded. By contrast, the new technology of gene-editing has only just started to generate a specialized terminology and an imagery suited to convey such a novel concept.[11] The discourse of gene editing is still lacking a standard codification despite the fact that the technology itself is known to the general public: in a recent demographic study on the perception of gene-editing conducted in 185 countries in 2015 only 12.1% of respondents were not familiar with the technology before the survey.[12] In 2017 experts lamented language-related problems with labelling gene-editing[13] and with making it understandable to the public, including "(1) the ethical complexity of the technology; (2) an accurate description of the technology, how it works, and how it can be used; and (3) what is known and unknown about its potential consequences".[14] Such language-related problems, which are mirrored by unstable representations in popularised press, might hinder its effective regulation, because law has to rely on language. In fact, the European Court of Justice has banned the use of gene-editing in agriculture in Europe as a kind of genetic modification.[15] Although the label is similar, the underlying technology is different. Experts believe that a better understanding through linguistic means would be "the major determinant for public perceptions of human gene editing"[16] and observe that "public education is of great significance in this area".[17]

Media discourse on gene-editing is a privileged site for exploring the diverse and complex representations of this progress in genetics. Since media discourse plays a significant role in

[6] Dorothy Nelkin, "Promotional Metaphors and Their Popular Appeal", *Public Understanding of Science*, 3.1 (1994), 25-26.

[7] José Van Dijck, *Imagenation: Popular Images of Genetics* (New York: New York U.P., 1998), 23.

[8] Dorothy Nelkin, "Molecular Metaphors: The Gene in Popular Discourse", *Nature Reviews Genetics*, 2.7 (2001), 556.

[9] Meaghan O'Keefe et al., "'Editing' Genes: A Case Study About How Language Matters in Bioethics", *The American Journal of Bioethics*, 15.12 (2015), 3.

[10] Nelkin, "Gene in Popular Discourse"; Brigitte Nerlich and Iina Hellsten, "Genomics: Shifts in Metaphorical Landscape", *New Genetics and Society*, 23.3 (2004), 255-268; Niklas Pramling and Roger Säljö, "Scientific Knowledge, Popularisation, and the Use of Metaphors: Modern Genetics in Popular Science Magazines", *Scandinavian Journal of Educational Research*, 51.3 (2007), 275-295.

[11] O'Keefe, "Editing Genes", 3.

[12] Tristan McCaughey, "A Need for Better Understanding Is the Major Determinant for Public Perceptions of Human Gene Editing", *Human Gene Therapy*, 30.1 (2019), 39.

[13] Sara Wells and Jean Stéphane Joly, "The Trouble with Collective Nouns for Genome Editing", *Mammalian Genome*, 28.7 (2017), 365-366.

[14] O'Keefe, "Editing Genes", 4.

[15] Case C-528/16, Judgment of the European Court of Justice (Grand Chamber) of 25 July 2018, curia.europa.eu.

[16] McCaughey, "Understanding Human Gene Editing", 36.

[17] Ibid., 41.

influencing public opinion, investigating discursive representations of gene-editing may help shed light on the way in which this technique is popularised with the public in order to foster its acceptance.

The pace and relevance of genetic advancements in the last 30 years have contributed to the prominence of gene-related stories in mass media,[18] and gene-editing is not an exception. The contemporary media could be said "to operate at the interface between genetic researchers and the public ... shaping public perceptions of genetics and its value and applications, by selectively presenting some subthemes and not others".[19] While it would be naïve to claim that media influence is straightforward and simple, the potential of media discourse to promote positions of power and ideologies has long been established,[20] and can be assumed to impact the social construction of genetic editing.

The interaction between science and the media has been traditionally studied in terms of its transmission mechanism, conceptualised as 'science popularisation'. Initially, such studies focused on the accuracy of 'translation' of specialist knowledge for a non-specialist audience[21] in a one-way direction, to render it accessible to the 'ignorant' layman. Later research rejected this unidirectional model and proposed a more interactive view on popularisation, where the public took on a more active role in knowledge processing, making popularisation "a matter of interaction as well as information".[22] Modern studies of popularisation view it as a process of re-contextualization of academic knowledge, which involves complex linguistic and discursive re-elaboration to tailor it to the interests and backgrounds of the receiving audience.[23]

The popularisation of science in mass media, and more specifically, in newspapers[24] is not devoid of manipulations and selectivity. On the one hand, journalists – who may find science intimidating,[25] not have the skills to critically evaluate it[26] or simply be under an imminent deadline pressure – extract information for further re-contextualisation from trusted sources, without any further checks. On the other hand, popularised science maintains the nature of journalistic discourse, which strives to amplify public response by highlighting the most newsworthy elements, often independently of their scientific relevance, just "to arouse as much interest as possible in readers".[27] At times the newsworthiness-based selection bestows a sensational flavour to genetic news and produces fantasy-like descriptions of genes. Apart from the Frankenstein imagery, one of the most notorious cases concerns the so-called

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18 Alan Peterson, "Biofantasies: Genetics and Medicine in the Print News Media", Social Science and Medicine, 52.8 (2001), 1255.

19 Ibid., 1256.

20 Norman Fairclough, *Media Discourse* (London: Edward Arnold, 1995).

21 Stephen Hilgartner, "The Dominant View of Popularization: Conceptual Problems, Political Uses", *Social Studies of Science*, 20 (1990), 519-539.

22 Ibid., 273.

23 Garzone, "Popularization as a Process", 77.

24 Ken Hyland, "Constructing Proximity: Relating to Readers in Popular and Professional Science", *Journal of English for Academic Purposes*, 9 (2010), 116-127; also Garzone, "Popularization as a Process".

25 Petersen, "Biofantasies", 1257.

26 Robert Logan, "Popularization versus Secularisation: Media Coverage of Health", in Lee Wilkins and Philip Patterson, eds., *Risky Business: Communicating Issues of Science, Risk and Public Policy* (New York: Greenwood, 1991), 47.

27 Giuliana Garzone, "News Production and Scientific Knowledge: Exploring Popularization as a Process", in Giuditta Caliendo and Giancarmine Bongo, eds., *The Language of Popularization: Die Sprache der Popularisierung* (Bern: Peter Lang, 2014), 91.

"gay gene": when the British media reported on a link between genetics and male homosexuality.[28] Similarly, media have dubbed other genes in a personified and somewhat fantastic way, extending images conveyed by scientists and attributing social qualities to genetic markers: in addition to gay genes, there would be obesity genes, risk genes, violence genes, genes for saving, genes for directional ability and genes for sinning[29] and even piano-playing genes.[30] Consequently, gene-editing representations in newspapers balance between popularisation processes and media framing, which invites to construe gene-editing in a certain way by the selective arrangement of information.[31] The framing typically emphasises either the risks or the benefits of biotechnology.[32] Finally, gene-editing representations in press are subjected to the journalistic strive to create an appealing story for readers.

2. Study Design

This study aims to investigate the representations of gene-editing, its applications and scientists-geneticists in popular UK press over the two year period 2017-2018. The basic research objective is to assess how British tabloids and broadsheets frame linguistically and discursively gene-editing, genetic researchers and the results of their work, focusing on the selective representation of claims and the imagery associated with them.

The research adopts the method of Corpus-Assisted Discourse Analysis[33] combining Discourse-Analytical perspective and Corpus Linguistics quantitative possibilities. The data compilation stage took inspiration from Discourse-Historical Approach (DHA).[34] As DHA explores multifaceted phenomena in the society, "taking a whole range of empirical observations, theories and methods as well as background information into account",[35] the regulatory and socio-political setting of the UK was taken into consideration to contextualise the data gathered. The choice to focus on British newspapers in this period was dictated by the changing regulatory context of the United Kingdom. The UK Government is actively promoting the state's excellence in life sciences, with a strong focus on integration of genomics and gene-editing into the national health system[36] in order to solidify the state's position as a world leader in genomics. According to the UK Government, the country would benefit "from a regulatory landscape that allows the application of genome editing technology for a

[28] David Miller, "Introducing the 'Gay Gene': Media and Scientific Representations", *Public Understanding of Science*, 4.3 (1995), 269-284.

[29] Nelkin, "Gene in Popular Discourse", 557.

[30] From this corpus.

[31] Petersen, "Biofantasies", 1258; Anders Hansen, "Claims-making and Framing in British Newspaper Coverage of the 'Brent Spar' controversy", in Stuart Allan et al., eds., *Environmental Risks and the Media* (London: Routledge, 2000), 55-56.

[32] Leonie Marks et al., "Mass Media Framing of Biotechnology News", *Public Understanding of Science*, 16.2 (2007), 185-186.

[33] Paul Baker, Using Corpora in Discourse Analysis (London: Continuum, 2006); Paul Baker et al., "A Useful Methodological Synergy? Combining Critical Discourse Analysis and Corpus Linguistics to Examine Discourses of Refugees and Asylum Seekers in the UK Press", *Discourse and Society*, 19.3 (2008), 273-306. Alan Partington et al., "Corpora and Discourse, a Most Congruous Beast", in Alan Partington et al., eds., *Corpora and discourse* (Bern: Peter Lang, 2004), 11-20.

[34] Ruth Wodak and Martin Reisigl, "The Discourse-Historical Approach (DHA)", in Ruth Wodak and Michael Meyer, eds., *Methods of Critical Discourse Analysis* (London: Sage, 2009), 87-121.

[35] Ibid., 90.

[36] The UK Government Response to the House of Commons Science and Technology Committee's Third Report of Session 2017-19, "Genomics and Genome Editing in the NHS", July 2018, 1. Available at assets.publishing.service.gov.uk.

wide range of applications".[37] Currently, gene editing is an established tool in biological research in the UK: the technology is being developed for therapies involving somatic genome editing. In addition, the State has embraced a permissive approach to human genome editing in embryos or gametes for research purposes under licence from the Human Fertilisation and Embryology Authority (HFEA).[38] Notably, after Brexit the country will not be bound by a more restrictive EU legal framework, which could lead to a wider use of gene-editing, undoubtedly affecting the population. As a result, the public has to be duly informed about this new technology. Yet, the role of newspapers in the dissemination of knowledge on gene-editing has yet to be assessed. How are gene-editing and geneticists portrayed to the general public? Can we talk about a neutral or one-sided science representation? Is gene-editing depicted in the same way in broadsheets and tabloids, or do different readers receive different stories? This study attempts to provide a tentative answer to these questions.

The corpus for the study was compiled using the online search engines of individual tabloids (*Daily Mail* and *Mail on Sunday*, *London Evening Standard*, *Daily Mirror* and *Sunday Mirror*, *The Sun*) and broadsheets (*Daily Telegraph* and *Sunday Telegraph*, *The Times* and *the Sunday Times*, *The Guardian/The Observer*). The newspapers were selected based on their popularity and free availability, as the idea was to assess the potential impact of newspapers on the British public at large. This search employed the multiword terms "gene-editing" and "genome editing" in the period between a) 1 January 2017 and 31 December 2017 ("2017") and b) 1 January 2018 and 21 January 2019 ("2018").[39] A two-part corpus was compiled (see Table 1), comprising 166 broadsheet articles amounting to 115,937 words, and 149 tabloid articles amounting to 89,313 words. In order to make the numbers comparable, all data were normalised to 100,000 words. The significant frequency cut-off is set at 30 occurrences per 100,000 words, i.e. 0.03%.

Type	Broadsheets		Tabloids	
Year	2017	2018	2017	2018
No. articles	69	97	74	75
No. words	50,104	65,833	38,491	50,844
Total no. article	166		149	
Total no. words	115,937		89,313	
Normalisation base	100,000		100,000	

Table 1: Corpus composition

This research started from a pre-formed objective to assess the portrayal of the technology ('gene-editing' and 'genome editing') and its applications, along with people involved in its implementation ('scientists', 'researchers' and 'geneticists'), formed during the initial close reading of the documents at the corpus compilation stage. However, additional mapping of the corpus using the corpus linguistics software Wordsmith Tools 6.0 was carried out to quantify and pinpoint other statistically relevant areas of interest, because Corpus Linguistics, to rephrase Partington, in addition to confirming

[37] Ibid., 13.

[38] Ibid.

[39] A period of three weeks in the beginning of January 2019 was added to the 2018 corpus to guarantee recency. The number of texts dated January 2019 is minor and does not leave a notable impact on the findings.

the already noted phenomena has the potential to unveil "patterns of use previously unthought of".[40] Corpus technology was used for the study of concordances, patterns and key words, and CDA notions were applied to group, categorise and analyse findings.

Specifically, the research adopted the classification of discursive strategies developed by Critical Discourse Analysis in the DHA vein:[41] nomination (for the discursive construction of gene-editing and its stakeholders), predication (for the negative or positive discursive qualification of gene-editing technology and geneticists), argumentation (including topoi and/or fallacies for justification of positive or negative traits) and perspectivation or framing (to assess the opinions expressed with regard to gene-editing or geneticists).[42]

3. Findings

3.1. *Explaining and describing gene-editing*

As the recent international scientific events demonstrate, there is still no unanimous decision concerning the choice between the terms 'gene-editing' and 'genome editing'. Recently, two international summits on this topic took place. The first one, held in December 2015, was titled *International Summit on Human Gene Editing*, whereas the second one, held in November 2018, was denominated *Second International Summit on Human Genome Editing*. As the two versions are still used interchangeably, with no clear preference among the scientific community,[43] it was decided to use a wildcard with 'gen*' to search for suitable terminological candidates. Collocates of 'edit*' demonstrated that the technology is also frequently introduced by the abbreviation 'CRISPR', standing for 'clustered regularly interspaced short palindromic repeats'. The latter abbreviation was often further specified by the addition of 'Cas9' or 'Cas12'; however, not all texts deciphered the abbreviations.

Nomination	BR	TB	categorisation	BR	TB	action	BR	TB
gen* editing	471	682	technology	254	282	change	368	487
CRISPR	192	409	technique	132	208	editing	98	267
			tool	80	144	mechanical	239	468

Table 3: Gene-editing nomination, categorisation and action as explained in broadsheets (BR) and tabloids (TB)

As Table 3 shows, the corpora categorised gene-editing as a technology, technique or a tool. These findings confirm previous research on similar corpora[44] carried out in a cross-linguistic perspective. Interestingly, the metaphor of tool – in the hands of scientists (see section 3.2) – takes on a more

[40] Alan Partington, *The Linguistics of Political Argumentation: The Spin-Doctor and the Wolf-Pack at the White House* (London: Routledge, 2003), 12.

[41] Martin Reisigl and Ruth Wodak, *Discourse and Discrimination: Rhetorics of Racism and Anti-Semitism* (London: Routledge, 2001).

[42] Wodak and Reisigl, *DHA*, 95.

[43] Charis Thompson, "Governance, Regulation, and Control: Public Participation", *Commissioned Papers of the International Gene Editing Summit* (Washington D.C, 2015), 45.

[44] Jekaterina Nikitina, "Representation of Gene-Editing in British and Italian Newspapers: A Cross-Linguistic Corpus-Assisted Discourse Study", *Lingue e Linguaggi*, special issue edited by Paola Catenaccio and Giuliana Garzone, forthcoming.

important role in tabloids than in broadsheets (144 vs. 80 occurrences), and this prevalence seems to acquire an important reading in terms of responsibility attribution for the correct use of this tool. On logical grounds, the readership of tabloids would get the idea that the tool is left to the discretion of scientists more frequently than the readership of broadsheets.

In terms of discursive construction and explanation of gene-editing – how it works and how it can be used – through verbal collocates, three main semantic fields were identified. These semantic fields are 'change' (including verbs of change, modification, alteration and manipulation, see (1), typically framed as a change of genes that are 'faulty', 'defective', 'disease-causing' or 'flawed', see (4)); 'text-editing' functions (such as 'find and replace' or 'cut and paste', see (2)); and 'mechanical operations' (including actions of cutting and splicing (3), removing and repairing, turning or switching on and off (4)). The latter category includes also other verbs denoting adjustments ('tinker', 'warp', 'tweak', see (5)) and some unwanted or unskilled repairs ('meddle', 'tamper', 'interfere', see (6)). These semantic fields were created analysing and counting verbal collocates of 'gen*' or 'DNA' within the range of ten words to the left (L10) and ten words to the right (R10). Emphasis is added in all examples.

(1) Scientists' favourite method, Crispr/Cas9, makes *precise changes* to individual genes, even *changing* a single "letter" of the genetic code. [Broadsheets]
(2) CRISPR-Cas9 is a *technology* that allows scientists to essentially *cut-and-paste* DNA, raising hope of genetic fixes for disease. [Tabloids]
(3) New scientific techniques, such as *CRISPR-Cas9 - molecular "scissors"* that allow scientists to *snip the genome* at specific points - have transformed genetics in recent years and raised questions about what is practically possible and ethically acceptable. [Broadsheets]
(4) The cut strands of DNA then *repair themselves*, incorporating the new genetic information. If nothing is inserted, the *repair process* can silence, or *'turn off'*, a *faulty gene*. [Broadsheets]
(5) This time, the *gene tinkering* is happening in a precise way inside the body for the first time. [Tabloids]
(6) But it raises questions about the ethics of *tampering with the human genome*, the coded instructions that make us what we are. [Broadsheets]

The technique, along with the functional explanation, is also attributed qualitative characterisations as to its mode of use, with implicit or explicit evaluation following (see Table 4). Table 4 gathers attributes of gene-editing nomination and categorisation nodes, collected through the analysis of concordance lines in the close reading technique.

Description	BRS	TBL	Attitude
Fast	30	36	Positive stance towards the speed of progress
Cheap	20	10	Positive stance – accessibility; negative stance – lack of control because of its availability
Easy	48	68	Positive stance – accessibility; negative stance – lack of control because of its availability
Precise	55	81	Positive stance – possibility of cures or tailor-made solutions for agriculture; negative stance – risk of human enhancement
Available / accessible	19	22	Positive stance – possibilities for everyone to cure diseases / improve agricultural yield; negative stance – risks connected to the uncontrolled use of the technique

Table 4: Gene-editing predication and framing in broadsheets (BR) and tabloids (TB)

Gene-editing is most frequently portrayed as a highly precise technique, which allows scientists to make precise changes and corrections (see (1) above). In this way it is typically associated with positive stance towards the technique. At the same time, it is frequently depicted as cheap and easy, which translates into its high accessibility (7), (8).

(7) Previous techniques for messing with the genome were either hit-and-miss or prohibitively expensive. But CRISPR is *very cheap and easy to use*, to the extent that there is literally an app for it: off-the-shelf computer software for deleting or adding instructions to the target DNA. [Broadsheets]
(8) As well as being the latest tech lexicon entry to dispense with its final vowel, Crispr is a technique that allows scientists to edit genes *quickly*, *cheaply* and *precisely*. [Tabloids]
(9) The technique used by the Chinese scientist is so *cheap and simple*, it could augur a world in which any would-be mad professor can *rewrite* the very blueprint of life, with no respect for the risks. [Tabloids]
(10) For, most worryingly, the science behind CRISPR editing is fast becoming *cheap and accessible*. Professor Charis Thompson, a genetic ethics expert at the London School of Economics, predicts that *amateurs* may even start *playing with the technology in their garages with relative ease*. [Tabloids]
(11) The techniques involved are becoming *easier and cheaper* - potentially bringing them within *reach of despots and jihadi maniacs intent on mass murder*. [Tabloids]

Yet, the potential high availability of the technique inherently involves a lack of control over the persons who will use it (9) and the applications it may lead to (10). The following section addresses the issue of gene-editing stakeholders in the newspapers in more detail, whereas the implications of gene-editing are addressed in Section 3.3.

3.2. *The people behind the science*

The mapping of the wordlists shed light on a vast semantic field of science professionals mentioned in news reports. Table 5 groups together the most prominent nodes.

Main node	Broadsheets	Tabloids
Scientists	280	459
Scientist	75	91
Researchers	81	172
Researcher	15	55
Dr	65	386
Doctor	12	3
Professor	93	177
Prof	27	38
Team	48	125
University	159	261

Table 5: References to science stakeholders across the corpora

While both corpora referred extensively to science professionals, the data above established a clear pattern of tabloids to mention them more frequently. For instance, the most recurrent node 'scientists' was used almost twice more frequently in the tabloid subcorpus than in the broadsheet supcorpus (280 occurrences in broadsheets vs. 459 in tabloids). Tentatively, it can be construed as a greater desire of tabloids to establish credibility by means of 'name-dropping'.

Another regularity across both subcorpora was a preference for the plural ('scientists', 'researchers') or for collective nouns ('university', 'team') over the singular ('scientist', 'researcher', 'professor'). This choice draws a distinction between the (often unidentified) scientific community and real, identifiable people operating in the field of gene-editing. As examples below illustrate, the plural form is most frequently used in connection with the discoveries and potential of the gene-editing technology.

(12) CRISPR-Cas9 is a technology that *allows scientists to* essentially *cut-and-paste DNA*, raising hope of genetic fixes for disease. [Tabloids]
(13) Harvard *University scientists* are among *a team which used gene editing tool* CRISPR Cas9 to produce 37 piglets free of porcine endogenous retrovirus. [Tabloids]

The singular form, on the contrary, is evoked to substantiate the journalists' claims with direct or indirect quotes by different authoritative sources in the field through the mechanism of 'projection'[45] or 'attribution'.[46] The highly recurrent academic titles 'Dr' and 'Professor' are used before surnames of different scientists, accompanied by affiliations ('from the University of...') or other regalia, to lend credibility to journalistic stories. The most frequent verbal collocates of these nodes belong to the categories of communication verbs (e.g. 'say', 'claim', see (14)) and are comparable with Halliday's 'Sayer',[47] or mental activity verbs[48] ('believe', 'consider', 'warn', see (15)), which can be paralleled to Halliday's 'Senser'.[49]

(14) "Research on human embryos has changed our fundamental understanding of the genetics of cell biology," *says* Alison Murdoch, *professor of reproductive medicine at Newcastle University*. [Broadsheets]
(15) *Professor* Henry Greely, *a genetic ethics expert* at Stanford University in California, *has warned* that there is the very real risk of rogue genetic editing by malicious parties. [Tabloids]

Academic sources are used to explain the technology, or at least to put it against a general scientific background (14). Alternatively, these sources are often used to provide evaluations of the technology or of the parties involved (15), thus shifting the burden of responsibility for any statements

[45] M.A.K. Halliday, *An Introduction to Functional Grammar* (London: Edward Arnold, 1994), 250.
[46] John Sinclair, "Fictional Worlds", in Malcolm Coulthard, ed., *Talking about Text: Studies Presented to David Brazil on his Retirement. Discourse Analysis Monographs No. 13*, (University of Birmingham: English Language Research, 1986), 43-60; Monika Bednarek, *Evaluation in Media Discourse: Analysis of a Newspaper Corpus* (London: Continuum, 2006).
[47] Halliday, *Functional Grammar*, 140.
[48] Douglas Biber et al., *Longman Grammar of Spoken and Written English* (Harlow, Essex: Pearson Education Ltd, 1999), 360-363.
[49] Halliday, *Functional Grammar*, 117.

to the external sources. Such quotes or attributions,[50] especially those that are backed by socially validated affiliations,[51] may create in the reader an impression that information in the news report is unmediated and, hence, reliable. However, previous research[52] demonstrated that journalists often strip other conventional sources without any additional checks. This strategy is significantly more widespread in tabloids than in broadsheets, marking a difference between the two newspaper types.

Whereas the technology of gene-editing was portrayed showing both the positive and negative possibilities (see 3.1), its operators, when they are not used as sources of information, are frequently characterised in a negative light, pinning down the responsibility for unethical uses of gene-editing on scientists or quasi-scientists. As a consequence, newspapers are interspersed with colourful epithets, denoting gene-editing operators as irresponsible (see (16)), amateur (17) and unscrupulous (18), "playing" with people's lives (19) and engaging in dangerous experiments (20), up to the point of being defined insane (21). Table 6 below reports data of the main semantic fields with negative connotations used to describe scientists, their behaviour or their work.

Main node	Broadsheets	Tabloids
Irresponsible / unethical / reckless	47	52
Dangerous / risky /threatening	34	39
Out of control: amateur / rogue / mad	25	39

Table 6: Negative strategies for predication and framing of scientists across the corpora

(16) But Dr David King, director of the Human Genetics Alert, which opposes all tampering with the human genome, said: "If *irresponsible scientists* are not stopped, the world may soon be presented with a fait accompli of the first GM baby."[Broadsheets]

(17) More worrying than bespoke babies, Crispr's low-cost and relative ease of use have raised fears of bioterrorists using it to unleash genetic destruction from *amateur laboratories in their garages*. [Broadsheets]

(18) [I]t places enormous potential power in the hands of *ordinary scientists*. It is also internationally widespread, and beyond the control of any single nation now. So *reckless and unethical experiments* were only to be expected. [Broadsheets]

(19) One British scientist, who described the experiment as 'monstrous', said the researchers involved were *playing 'genetic Russian Roulette'* with healthy babies. [Tabloids]

(20) Another major threat is *rogue scientists* making existing bacterial and viral diseases more *dangerous*. [Tabloids]

(21) But, as DNA editing technology becomes more accessible, fears have grown over *amateur scientists* creating *dangerous* substances or *harming people*. [Tabloids]

Interestingly, the scientists-authors of quotes are not given explicitly positive evaluations; this function is performed mentioning their social status as renowned experts in the field, vouching implicitly for their trustworthiness.

3.3. *Implications and applications of gene-editing*

50 Sinclair, "Fictional Worlds".

51 Bednarek, *Evaluation in Media Discourse*, 17.

52 Petersen, "Biofantasies", 1257.

In terms of gene-editing perspectivation,[53] or discursive construction of potential or current results of gene-editing application, both corpora introduced them by verbs of caution (warn, caution, fear, see (22)) as opposed to the idea of hopes for cures (23). Often these ideas were expressed together, meaning that they were not mutually exclusive (24). Another frequent conventional representation concerned the revolutionary (25) and innovative (26) potential of gene-editing, yet it was relatively underused in tabloids in favour of bolder images (see Table 8).

(22) What's more, one of Britain's most renowned scientists recently *warned from beyond the grave* that we should abandon this field of science for ever - or risk destroying humankind. [Tabloids]
(23) These results bring *hope for a targeted gene therapy* and widen the application of the technology. [Broadsheets]
(24) This treatment is a *potential game changer*. In the space of a few years gene editing has given us a possible treatment for all these diseases. We need to be *cautious but also hopeful*. [Broadsheets]
(25) The world is in the midst of a *genetics revolution*. In five years a technology called Crispr Cas9 has turned the fiddly job of editing genetic code into something bordering on routine. [Broadsheets]
(26) "People say it's the *biggest innovation in life sciences in a century*," said Lorenz Mayr, who heads Astra Zeneca's Crispr programme. "I agree. I totally agree." [Broadsheets]

Main node	Broadsheets	Tabloids
Caution / fear / warning	91	128
Hopes / cure	132	144
Future with positive prospects	40	54
Future with negative prospects	20	21
Revolution / innovation	63	38

Table 7: Perspectivation of gene-editing applications

Remarkably, the positive perspectivation tended to prevail over the negative perspectivation in broadsheets, while the numbers in tabloids suggested that both prospects of cures and fears were nearly equally overviewed. This could be construed as a subtle invitation to the readership of broadsheets to be open to the positive potential of gene-editing, which has already been introduced in the UK in the research field and is about to be included to the NHS list of services.

The implications of gene-editing were typically projected towards its future use (node 'future'), or future consequences, and in general in two thirds of cases both tabloids and broadsheets framed the use of gene-editing in a more positive light, underlining new opportunities for research, cures for diseases and agricultural improvement.

In addition to general observations about the future use of the technology, both corpora make recourse to a number of popular images and topoi to denote the applications and implications of gene-editing. Table 8 below reports normalised frequencies of the most recurrent imagery – presented in several macro-groups – used to refer to the results or potential results of gene-editing, excluding any uses where the image is not used metaphorically (e.g. 'mutant genes') or not to denote gene-editing (e.g. having a dream). Every concordance line was analysed following CDA principles to assess

[53] Carl Friedrich Graumann and Werner Kallmeyer, eds., *Perspective and Perspectivation in Discourse* (Amsterdam-Philadelphia: John Benjamins, 2002).

whether the image was used to construct a positive (P) or a negative (N) representation of gene-editing, analysing images, their framing and argumentation. The results of this analysis are listed under the subheading 'framing' and indicated as per cent out of the total number of occurrences of every image.

Image	Broadsheets		Tabloids	
	NF	Framing	NF	Framing
I. Fantastic creatures				
Franken*	26	P=17%; N= 83%	16	P=42%; N=58%
Monst*	46	P=0, N=100%	10	P=0, N=100%
Mutant*	19	P=0; N=100%	1	P=100%, N=0
Super*	44	P=30%; N=70%	20	P=35%; N=65%
Total	**135**	**P=14%; N=86%**	**47**	**P=31%; N=69%**
II. Science-fiction and dystopian views				
Dystopi*	3	P=0, N=100%	8	P=66%; N=33%
Brave New World	1	P=0, N=100%	10	P=50%; N=50%
Science-fiction / sci-fi	3	P=33%; N=66%	1	P=100%; N=0
Fantas*	6	P=100%, N=0	6	P=71%; N=29%
Dream*	4	P=100%; N=0	5	P=66%; N=33%
Nightmar*	11	P=0; N=100%	4	P=0; N=100%
Curse	4	P=75%; N=25%	2	P=100%; N=0
Total	**32**	**P=43.3%; N=56.6%**	**36**	**P=55%; N=45%**
III. Interventions into human reproduction				
Playing God /Creator	4	P=0; N=100%	7	P=14%; N=86%
Designer baby/embryo	79	P=35%; N=65%	46	P=38%; N=62%
Total	**83**	**P=33.3%; N=66.6%**	**53**	**P=34%; N=66%**
IV. Gene-editing as a weapon				
Weapon*	11	P=20%; N=80%	3	P=100%; N=0
Terroris*	12	P=0; N=100%	6	P=0; N=100%
War / warfare	12	P=0; N=100%	22	P=15%; N=85%
Military	3	P=0; N=100%	3	P=100%; N=0
Troops	8	P=71%; N=29%	0	-
Soldier*	6	P=0; N=100%	1	P=0; N=100%
Mass destruction	4	P=0; N=100%	5	P=17%; N=83%
Total	**57**	**P=12%; N=88%**	**40**	**P=28%; N=72%**
V. Impact on the mankind/ "our species"				
Humankind future / end	29	P=17%; N=83%	12	P=42%; N=58%
Disast*/ catastroph*	7	P=0; N=100%	4	P=50%; N=50%
Total	**36**	**P=14%; N=86%**	**16**	**P=44%; N=56%**
Grand total	**343**	**P=19%; N=81%**	**191**	**P=41%; N=59%**

Table 8: Imagery used for discursive construction of gene-editing applications and implications

As Table 8 shows, both corpora use strong images to portray potential gene-editing applications. Yet, tabloids use such images significantly more (343 vs. 191 occurrences), with a clearly predominant negative colouring (81% of all images were negatively framed, see examples (27) and (28) below) as

opposed to a more balanced representation in broadsheets (41% of occurrences were used positively and 59% were used negatively), see (29) and (30).

(27) If you think *mutant soldiers* with unstoppable physical and mental powers sound like nothing more than science fiction, you may be in for a shock. A chilling Government report today warns that the *breeding of genetically-modified troops* could be a reality within a generation. [Tabloids]
(28) No less an authority than Professor Stephen Hawking feared such experiments would one day create *a race of 'super-humans', ending mankind as we know it*. [Tabloids]
(29) The debate about human gene editing is less about what may happen tomorrow than about *fundamental fears of dystopian change*. "It is not fanciful to say that... *the end of human beings as a wild breeding race* could be in sight," claimed the Times. [Broadsheets]
(30) By doing so, the argument goes, scientists would ensure the babies born as a result would eventually pass on their tweaked, *disease-resistant genes* to their own children, so *ending the curse of devastating inherited conditions such as Huntington's*. [Broadsheets]

The repertoire of images also demonstrates some divergent tendencies: for instance, tabloids widely exploit the topoi of danger and threat, implying that gene-editing will lead to the creation of super-race, mutants and Frankenstein monsters that will be used as weapons. Broadsheets use the same metaphors at least twice less frequently. Instead, broadsheets rely on the dystopian images (31) and Huxley's Brave New World – underused in tabloids – to exploit the topoi of caution and well-weighed choice about our future.

(31) *Dystopias* may involve the consequences of unfettered choice. *Let's not allow fear of the worst to drive out any hope of the good*. [Broadsheets]
(32) If scientists find a safe way to eliminate genetic disease, Britons will not benefit as the law stands. This *blanket rule* rests on a *bad argument*: that it is wrong to meddle with the DNA of future generations. [Broadsheets]
(33) For now, though, if there's going to be anything even vaguely resembling the *popular designer-baby fantasy*, Greely says it will come from embryo selection, not genetic manipulation. [Broadsheets]

In addition to the usual negative associations related to some of the images, the broadsheets used them to argue in favour of gene-editing dismantling the negative argument (31), (32). In 41% of occurrences of images presented in Table 8, the argument to be overturned is presented and explained – recurring to the popular metaphors, such as 'designer babies', for instance, – and then dismantled disproving its validity (33).

Consequently, a solid demarcation line can be drawn between the two newspaper types by their use of popular imagery: tabloids with sensational images and broadsheets with more balanced representational choices.

4. Conclusions

Against the changing social and regulatory background of the UK, where public attitudes play an increasingly prominent role in decision-making processes – as the Brexit referendum has shown, – the level of public awareness of gene-editing is not to be underestimated. This paper started from the premise that newspapers exert an influence on the lay public's understanding of this new and

controversial technology. The study examined linguistic and discursive construction of gene-editing, its implications and stakeholders in tabloids and broadsheets between 2017 and 2018. It emerged that all newspapers presented their readership with a clear explanation of this technology, also categorised as a technique or a tool. The basic mechanism of gene-editing was explained in terms of changes it makes to the genetic make-up of plants, animals or humans through a range of editing functions – based on the Word Processor metaphors – and mechanical operations of cutting and form-modification. The technology was further explained as a simple, fast and cheap operation, relying on the opinion of scientists and shifting the responsibility for its application to the field operators, with the risk of uncontrolled parties foregrounded. The ethical complexity of the technology was problematized in nearly every news report, with strategies ranging from calls for a cautious yet hopeful approach to an open scaremongering. In addition to recurrent negative descriptions of rogue scientists or third parties, the newspapers made an attempt to open a debate around the potential consequences and implications of gene-editing. In this last regard, a stark contrast between tabloids and broadsheets was observed, focusing on the selective representation of claims and the imagery associated with the technology. It emerged that tabloids made recourse to a rich pool of loaded images with prevalently negative connotation, painting the future world as a gene-edited outrage. In addition, tabloids abounded in quotes and references to credible sources from academia, which could lead to a conclusion that such a perspectivation is the most widespread view on the technology.

The broadsheets also deployed an arsenal of connoted metaphors, yet these were of a less gruesome nature (cf. mutants or monsters vs. the Brave New World). In addition, the broadsheet subcorpus used them argumentatively, often refuting the negative argument in favour of a more balanced opinion, "cautious but hopeful". While it is true that different media might undertake different dissemination paths by tailoring the information to the expectations and tastes of the prospective public, it could potentially lead to a societal divide. Those UK citizens who read tabloids are guided towards a gloomy perspective, and those who read broadsheets are invited to ponder the different perspectives. In a hypothetical scenario of a future public consultation on the use of gene-editing, such a varied perception might prove problematic. Consequently, further dissemination efforts are to be introduced at the governmental level to create a more harmonised knowledge base among the population.

The method of Corpus-Assisted Discourse Analysis allowed me to identify and quantify the tendencies above, yet further work on a downsample would be recommended to provide a more in-depth evaluation of the phenomena involved. In addition, further research with an ethnographic element evaluating how the newspapers affect the public perceptions would be a precious asset. The topicality of gene-editing calls for further research of its linguistic dimension, including other media and channels of knowledge dissemination, as well as ways of its regulation in national and international legal documents which are on their way.