

The history of women in engineering on Wikipedia

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This article was written by [Alice White](#)

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Abstract

This paper explores the representation of the history of women in engineering as it appears on the online encyclopaedia, Wikipedia. Using biography pages on women engineers for a high-level quantitative overview, and the 'History of women in engineering' page as a specific example for qualitative examination, this research highlights inequalities in how women engineers are represented compared with men engineers.

There are significantly fewer Wikipedia biography articles on women engineers compared with men engineers, and those articles are far less central and findable, with fewer incoming links. The article page on the 'History of women in engineering' is of poor quality and is flagged as such to readers.

Here, the under-representation of women engineers on Wikipedia is set in the specific context of Wikipedia. The context of societal differences beyond the internet is also explored. The paper concludes by discussing practical attempts to redress the imbalance, and challenges to consider in planning future efforts.

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Keywords

Women engineers, Wikipedia, Wikimedia Commons, gender gap, encyclopaedia, history of engineering, systemic bias, women in STEM

Introduction: the 'gender gap'

Wikipedia has a 'women problem' (Gleik, 2013). Engineering also has a women problem (Peters, 2018). Sadly, biases in the real world combine with biases in the online world, and the result is that women engineers are nowhere near as visible online as they should be. This article focuses on the way that women are poorly served, though there are other forms of systemic bias in Wikipedia too that mean that other groups of people are also under-represented.^[1]

This visibility is a real problem. A 2010 report conducted for the UK Research Councils found that 'the internet is central' to the provision of information about science, engineering and technology (Mendick and Moreau, 2010). Wikipedia ranks as the fifth most viewed website in the world (Gray, 2017), therefore it is central to the provision of information. Because of its widespread use, the way that the history of women in engineering is represented on Wikipedia is relevant to how the field is understood by large numbers of people.

This has relevance to the field itself, as well as its perception by a lay public. Choices concerning STEM careers are likely to be influenced by what people see online. A 2018 report by the Women's Engineering Society details how almost half of young women do not even consider careers in STEM sectors, in part because they believe that STEM careers are 'better suited to the opposite sex' (Peters, 2018). This report links such (mis-)perceptions acquired at an early age with a lack of enthusiasm for pursuing STEM careers. Though students and teachers are aware of potential credibility issues with Wikipedia, evidence indicates that both groups still use it to find information and that teachers even use Wikipedia more often than the average adult user of the internet.^[2] Young people and their teachers seeking information on engineering online are likely to have the view that engineering is not a field for women confirmed by what they find on Wikipedia.

Research has established that, despite possessing the goal to represent 'the sum of all human knowledge',^[3] Wikipedia actually under-represents women.^[4] Women are under-represented both in terms of the number of editors actively contributing to Wikipedia, and the number of articles about them (Hill and Shaw, 2013; Khanna, 2012). These two different forms of under-representation have been linked, and some researchers suggest that the emotional labour required of the smaller group of women editors of Wikipedia deters them from editing on topics that they perceive will receive pushback from the majority of (male) editors. Furthermore, in the articles about women that do exist, research indicates that Wikipedia editors are more likely to mention marital status in their metadata, less likely to include language relating to cognition compared with sex and are less central in link networks.^[5] Pages about women differ from those about men in terms of quantity and quality.

The danger of under-representation of women engineers on Wikipedia is that we often assume that everything to be known is there – and that if something is not there, this is because the topic, person or place is not important (Paling, 2015; Kennedy, 2017). Omissions of information about the work of women, or women themselves, suggest that women have not contributed.

This article analyses some of the pages in Wikipedia to establish how the 'gender gap' affects biographical pages about women engineers on a quantitative level and the 'History of women in engineering' at a qualitative level.

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The missing women: a quantitative problem

The Wikipedia account of the history of women in engineering is written in each individual page about a woman engineer, as well as in a dedicated page. In terms of the individual pages, there are various quantitative inequalities in the number and connectedness of pages about women engineers compared with men engineers. The disparity in the number of pages about women compared with men on Wikipedia holds true in the specific case of engineers.

Wikipedia has notability criteria; every person who is an engineer is not eligible for a page, only those who distinguish themselves by meeting certain standards.^[6] For a fair comparison, we should therefore measure Wikipedia against the 'notable' or senior figures who might be eligible for representation in an encyclopaedia, rather than the average for the field as a whole. In 2014, women accounted for four per cent of Fellows of the Royal Academy of Engineering. However, on the boards of British businesses, 13 per cent of FTSE Board Directors in STEM sectors were women as of 2012. Women are also better represented in academia, where 17 per cent of professors in STEM subjects are women (Peters, 2018). These qualities both meet Wikipedia's notability criteria, and thus it is fair to expect that somewhere between four per cent and 17 per cent of engineers

on Wikipedia should be women.

It is difficult to precisely count how many pages about women engineers are on Wikipedia, but using the categories into which pages are grouped, it is possible to estimate.^[7] At the time of writing, there are approximately 758 pages about women engineers on the English language version of Wikipedia. Eight people are identified as being transgender or transsexual. There are 18,345 pages about men engineers. Approximately four per cent of pages on engineers are therefore about women. The percentage remains the same if fictional characters are removed from the figures.^[8]

Figure 1



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Portraits of three women engineers: Margaret Rowbotham, Beatrice Shilling and Margaret Partridge. The contributions of notable women engineers such as Margaret Rowbotham and Margaret Partridge have only recently been added to Wikipedia

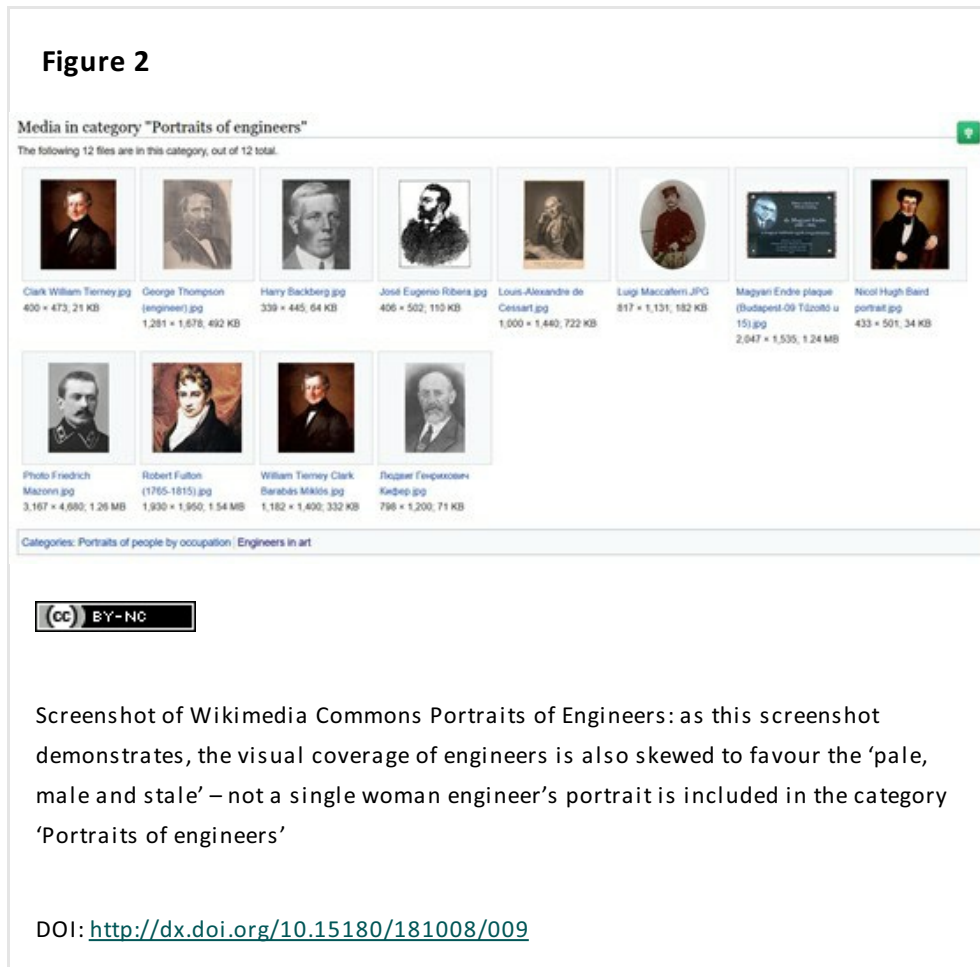
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On Wikidata, the sister site of Wikipedia that houses information in the form of linked open structured data, it is much easier

to ascertain who has been attributed the values 'male', 'female' or 'transwoman' by writing queries to filter out those whose gender has not been explicitly stated.^[9] In Wikidata, there are 1,175 distinct entries for women and transwomen engineers, and there are 29,276 distinct entries for men engineers. Women and transwomen therefore account for 2.4 per cent of engineers whose gender is known. The similarities between the ratio of men to women in the data on Wikidata and the ratio based upon category data from Wikipedia suggests that Wikipedia articles are categorised in a way that accurately indicates gender proportions on Wikipedia, at least for the field of engineering.

Based on these figures, Wikipedia's coverage of women engineers approximately reflects the proportion of women considered to be notable by one of the field's most respected organisations (the Royal Academy of Engineering) but is well below the proportion of notable women in business and academia.

The current proportion of women engineers on Wikipedia is strongly influenced by the past.



Only 1.5 per cent of the engineers not listed as living are women.^[10] The low number of deceased (historic) women in engineering fits within a broader trend: Eduardo Graells-Garrido, Mounia Lalmas and Filippo Menszer observe that there is 'minimal presence of women [living before 1900] in Wikipedia' (Graells-Garrido et al, 2015). They attribute this to the notability guidelines for Wikipedia, which specify that biographies in Wikipedia should be about a person who has 'received a well-known and significant award of honour' or who has 'made a widely recognised contribution that is part of the enduring historical record in his or her specific field'.^[11]

Research has suggested that authors who edit online articles 'do not view online media as a site of intervention' in part because 'they generally view online representations as a reflection of offline contexts' (Mendick and Moreau, 2010). This is despite the fact that editorial decisions are largely individual decisions. The ratios of articles on women versus men on Wikipedia are not significantly different to the gender-balance of the field in broader culture, particularly when historical imbalances are taken into account.

Unlike many online authors, authors in the wider world have chosen to intervene in how women in engineering are presented.

Various authors have highlighted the difficulties that women through history have faced when attempting to participate in the field of engineering, often noting the lack of recognition of women's abilities and contributions.^[12] In *Mothers and Daughters of Invention*, first published in 1995, Autumn Stanley argues that 'serious treatment of women inventors is nothing less than to make a beginning at revising the history of technology' (Stanley, 1995). Because women have been systemically excluded from history and were typically not recognised, this means that Wikipedia perpetuates this omission of women. Wikipedia mirrors broader human culture in the way that women from the past are only credited in very small numbers for their work in the field of engineering.

By contrast, 6.3 per cent of living people categorised as engineers are clearly categorised as women. On Wikidata, 901 women and transwomen engineers are living, compared with 12,072 men, or around 6.9 per cent. Recent statistics from WES reveal that 11 per cent of the engineering workforce is female, and that the UK has the lowest percentage in Europe, with less than ten per cent (Peters, 2018). By this measure, Wikipedia under-represents women in engineering.

Figure 3



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Vicky Lawton's photograph 'Portrait of an Engineer': as this portrait commissioned by the IET indicates, the contemporary 'Portrait of an Engineer' is much more diverse

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Looking beyond the number of article pages, other statistics indicate the disparity between pages on women engineers compared with men. Pages on men engineers have, on average, 36 incoming links, and are 7116 bytes long. Pages on women have, on average, 11 links, and are 6850 bytes long. The difference in the number of links is substantial. It also has an impact on the visibility of women engineers. That women are only one third as likely to be linked to from another article compounds the relatively small ratio of women to men and means that it is much less likely that a person browsing Wikipedia will find a woman engineer than a man engineer. This supports previous research that found women to be less central in their networks. It is particularly problematic because structural information on Wikipedia is used to feed knowledge databases and is pulled through into search engines such as Google, rendering women less visible beyond the encyclopaedia itself (Wagner et al, 2016). The difference in length is relatively minor, though as we shall see in the following section, article length is not a

guarantee of quality.

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The history of women in engineering on Wikipedia

There are fifteen men mentioned on the Wikipedia 'History of engineering' page, but no women.^[13] The 'History of women in engineering' is represented in an article page of its own, in addition to being told through the biographies of individual women.^[14] That there is a separate page for the history of women in engineering implies that women are not a part of mainstream engineering history, but simply a sub-branch whose involvement is not necessary to know about to appreciate history as a whole. Wikipedia's categorisation of women in this way hit headlines when women were moved from the category 'American novelists' to 'American women novelists', as many critics argued that this implied that women were inferior (Filipacchi, 2013).

Examination of the 'History of women in engineering' page offers the opportunity to look at the quality of information and how Wiki-editors engage with the topic. A review of the page indicates that there are many reasons to be concerned about how the history of women in engineering is being written in a public forum. The page presents a 'History of women in engineering' to the English-speaking world that is limited in scope, disorganised, and visibly neglected by Wiki-editors. The effect of this is that the subject appears insignificant.

The 'History of women in engineering' page runs to 2,342 words, which is just over double the number of words in the general 'History of engineering' article page on Wikipedia. Though longer, the page specifically relating to women has been edited fewer times, and by half the number of individual editors.^[15] Both pages are ranked by Wiki-editors as being only 'Start-Class', a term that suggests significant room for improvement in coverage and in terms of referencing. However, despite the similar ranking, the impression presented to readers by the page specifically about women is worse.

This can be related to the 'gender gap' problem. On the article's Talk page, where content is scrutinised, discussed, and proposed, WikiProjects formed by groups of editors can lay claim to articles in order to help to maintain them. The WikiProject claims on the 'History of women in engineering' page demonstrates that it is considered a 'woman's topic' that is not of broader interest: both the 'History of engineering' page and the 'History of women in engineering' page have been claimed as being within the scope of WikiProject Engineering, but whilst the 'History of engineering' page has been rated as 'Top-importance', the page on the 'History of women in engineering' 'has not yet received a rating' despite it being flagged as relevant in November 2012.^[16]

The lack of interest in the topic from male Wiki-editors is reflected in the quality of the content of the article. The page on the 'History of women in engineering' currently has a warning banner stating that the 'article is written like a personal reflection or opinion essay that states a Wikipedia editor's personal feelings about a topic.'^[17] This banner has been on the page since August 2011, proclaiming to the world that the topic is neglected and badly written, without having achieved its goal to encourage those who see the banner 'please help improve', to respond actively.

Figure 4

History of women in engineering

From Wikipedia, the free encyclopedia



The **history of women in engineering** predates the development of the profession of engineering. Before engineering was recognized as a formal profession, women with engineering skills often sought recognition as inventors, such as **Hypatia** of Alexandria (350 or 370–415 AD), who is credited with the invention of the **hydrometer**. In the 19th century, women who performed engineering work often had academic training in mathematics or science. **Ada Lovelace** (1815–1852) was privately schooled in mathematics before beginning her collaboration with **Charles Babbage** on his **analytical engine** that would earn her the designation of the "first computer programmer." **Hertha Marks Ayrton** (1854–1923), a British engineer and inventor studied mathematics at Cambridge in the 1880s. **Elisa Leonida Zamfirescu** (1887–1973) is one of the first female engineers in Europe. In the early years of the twentieth century, a few women were admitted to engineering programs, but they were generally looked upon as curiosities by their male counterparts.

Alice Perry was the first woman in **Europe** to graduate with a degree in



Audodidact computer programmer **Jeri Ellsworth** at a 2009 Bay Area "Maker Faire" conference.



Screenshot of Wikipedia page 'History of women in engineering': the banner warning readers of poor quality diminishes the perception of women in engineering history even before they begin reading. The page does require improvement in terms of style and coverage, and has done for years

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This impression is apparent behind-the-scenes too. In 2016, a Wiki-editor named TheBlinkster wrote on the Talk page that they felt that context was missing from several parts of the article.^[18] The editor concluded: 'I agree that this reads like somebody's opinion essay rather than an NPOV description of women's participation in engineering, and frankly it looks biased.' They believed that the neutral point of view, a key 'pillar' of Wikipedia, was lacking: that the page is bad by Wiki-editor standards.

In a study from 2012, Bear and Collier concluded that women were uncomfortable being critical or editing other contributors' work (Bear and Collier, 2012). It appears that the page on the 'History of women in engineering' is considered a 'woman's topic', and women are less likely to make significant changes to a page, which perhaps explains how, in nearly seven years, no editor has improved this article sufficiently to warrant removal of the banner.

There are also tags within the main body text warning those who scroll further down the page to be wary of what they are reading. There are two tags requesting better sourcing, one requesting a more specific explanation of a statement, and another tagging a statement as 'dubious – discuss', both of which question the notability of a specific woman mentioned, Thelma Estrin. Tags warning a reader that they should not trust claims about the importance of one of the limited number of women mentioned in the article implicitly call into question the importance of any women engineer who might not have been cherry-picked for specific emphasis on the topic page.

Even discounting the warning banner and tags, the content covered on the page also signals that there are limitations to its quality. There is a short section on 'Inventors', naming Hypatia of Alexandria, Tabitha Babbit, Sarah Guppy and Mary Dixon Kies as examples of inventors working 'before engineering was recognized as a formal profession'. In leaping from a single example

from around the year 400 to three from the late eighteenth century without providing any context for these choices, this section of the page suggests to readers that no woman of note was an inventor between these periods.

After the 'Inventors' section, the page jumps forward to the nineteenth century, from which point it predominantly focuses on the 'History of women in engineering' in the USA. Information on two European women, Alice Perry and Elisa Leonida Zamfirescu, is duplicated and appears under both the nineteenth century and twentieth century headers. Further down the page, there are a smattering of statistics about women in engineering in the USA, Australia (one sentence) and the UK (two sentences).

This American-bias has not gone unnoticed. On the Talk page for the History of women in Engineering, Wiki-editor Actio wrote that:

It seems strange to leave out the 'History of women in engineering' in Eastern Europe especially after the foundation of the Soviet Union and its rapid modernization, and in the so-called East Bloc subsequently—not to mention elsewhere in the world, North, South, East, and West (Japan and China, and Latin America, for instance?) Hope this can be repaired by someone with access to relevant data.^[20]

This statement was written in June 2017 and has yet to be acted upon. The narrow geographical coverage suggests to readers that the History of women in engineering is a niche topic that few people feel is worthy of contributing to, and also that the topic itself is only relevant to the USA.

Thus, though the page on the 'History of women in engineering' is longer than the 'History of engineering' page, it is presented to the reader as being qualitatively much worse by Wikipedia editors' standards: 'women's history' of engineering is lower quality than the (implicitly male) neutral page, where women do not appear at all.^[21]

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Shifting the balance

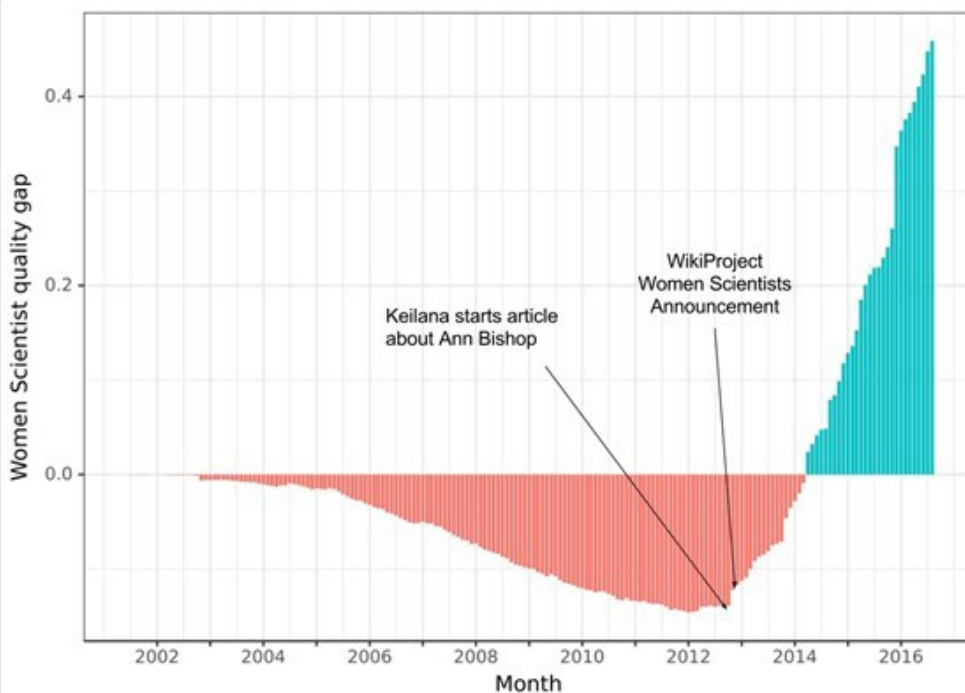
The Wikipedia pages on women in engineering are insufficient in number and quality. This is not a unique problem as women in other disciplines, such as mathematics, are also poorly represented. Marie Vitulli notes that even esteemed prizewinning notable women mathematicians are missing from the encyclopaedia's coverage (Vitulli, 2017). Overall, women have been severely underserved by Wikipedia. Despite various pushes from Wikimedia, the charity's founder Jimmy Wales was forced to admit in 2014 that they had 'completely failed' to fix the disappointing coverage of women.^[22] Though 'anyone can edit' Wikipedia, sociologists Heather Ford and Judy Wajcman have observed that the 'masculine culture of technoscience' on Wikipedia means that 'not everyone does' and that women are disinclined to participate compared with men, leading to underrepresentation of women and their interests (Ford and Wajcman, 2017).

However, this has not deterred people from continuing to battle for improvement in the Wikipedia gender balance; there are various initiatives to improve the representation of women on Wikipedia. One of the largest is Wikiproject Women in Red, which aims to turn women's names that are red links (which indicate a page not yet created) into blue links that can be clicked to learn more about notable women. In November 2014, just over fifteen per cent of biography pages on English language Wikipedia were about women. By May 2017, the project had witnessed the creation of more than 45,000 pages about women and as of September 2018, the percentage of biographies about women had grown to 17.79 per cent.^[23] This sustained growth of coverage of women indicates that with determination and concerted effort, improvements can be made.

Similarly, Wikiproject Women Scientists was created in 2012 to specifically focus on creating and improving pages on women in science. The creator of this project, Emily Temple-Wood edits under the username 'Keilana' and she and the project have had such a remarkable effect on the quality of pages on women scientists that a phenomenon called the 'Keilana Effect' was recorded by researchers (Elder and Erhart, 2017). They observed that from 2002 until 2013, the quality of pages on women scientists lagged well behind the average quality on the encyclopaedia. Then, when Keilana publicly announced efforts to improve pages, a shift took place and the quality drastically improved; pages about women scientists are now just more than

forty per cent better than the average page.

Figure 5



EpochFail, 'The Keilana Effect': this graph demonstrates that focussed attention and energy can directly lead to qualitative improvement of pages on Wikipedia

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Some women have discussed how editing is part of their feminist activism, and argue that 'there needs to be a critical mass of women to actually make changes and be more than token voices that can easily be dismissed' (Erb, 2016; Kennedy, 2017). Others, such as Maggie MacAulay and Rebecca Visser, have argued that 'borrowing from corporatized diversity initiatives... [does not] address the underlying reasons behind women's low representation and participation' and warn that it is not sufficient to 'just add women and stir' (MacAulay and Visser, 2016). Whilst women may find it empowering to edit, and an increase in women editors could quite possibly benefit everyone, women are not responsible for their own under-representation and it should not be incumbent on them to make all of the improvements whilst adapting to a masculine culture. Improving the coverage of women in engineering on Wikipedia would benefit anyone interested in the field and should be achieved through the participation of everyone interested in the field, regardless of gender.

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Conclusion

This initial examination of how women engineers appear on English language Wikipedia suggests that they are poorly represented, both in terms of the ratio of articles about women compared with men, and the poor quality of articles about women signalling their lower significance to the field.

Wikipedia receives a huge amount of internet traffic, and measures of traffic to the site itself do not include other ways that information and data are increasingly drawn from Wikipedia to support commercial information-providers' services, such as YouTube, Siri or Alexa. [24] Wikipedia is an important source of online information, and has the potential to impact young

people's career choices, yet at present the information to be found there is likely to confirm young women's perception that the field is not for them.

Authors underestimate their power to affect change online ([Bear and Collier, 2012](#)). But with the 'History of women in engineering' page currently still showing failings first noticed in 2011, there is a great deal of scope to follow the Wikipedia slogan and 'be bold', joining other Wiki-editors and historians beyond Wikipedia in writing women back into engineering history.

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Appendix: Wikidata queries

Male Engineers

```
SELECT DISTINCT ?human ?humanLabel ?sex_or_genderLabel WHERE {
  SERVICE wikibase:label { bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en". }
  ?human wdt:P31 wd:Q5.
  ?human wdt:P21 wd:Q6581097.
  ?human (wdt:P106/wdt:P279*) wd:Q81096.
  OPTIONAL { ?human wdt:P21 ?sex_or_gender. }
}
```

Female Engineers

```
SELECT DISTINCT ?human ?humanLabel ?sex_or_genderLabel WHERE {
  SERVICE wikibase:label { bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en". }
  ?human wdt:P31 wd:Q5.
  { ?human wdt:P21 wd:Q6581072. }
  UNION
  { ?human wdt:P21 wd:Q1052281. }
  ?human (wdt:P106/wdt:P279*) wd:Q81096.
  OPTIONAL { ?human wdt:P21 ?sex_or_gender. }
}
```

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Tags

- [Engineering](#)
- [History of science](#)
- [Science in the Media](#)
- [Twenty-first century](#)
- [Women in science and engineering](#)

Footnotes

1. For further discussions of these see: Mark Graham, Bernie Hogan, Ralph Straumann and Ahmen Medhat (2014) 'Uneven Geographies of User-Generated Information: Patterns of Increasing Informational Poverty,' *Annals of the Association of American Geographers*, 104.4, pp 746–764; Alex Hern (2015) 'Wikipedia's View of the World Is Written by the West', the *Guardian*, 15 September; and Mark Graham, Ralph Straumann and Bernie Hogan (2015) 'Digital Divisions of Labor and Informational Magnetism: Mapping participation in Wikipedia,' *Annals of the Association of American Geographers* 105.6, pp 1158–1178.
2. For more information on how teachers and students use Wikipedia see: Marte Blikstad-Balas, "'You Get What You Need": A Study of Students' Attitudes towards Using Wikipedia When Doing School Assignments', *Scandinavian Journal of Educational Research*, 60.6 (2016), pp 594–608 <https://doi.org/10.1080/00313831.2015.1066428> and Kristen Purcell and others, 'How Teachers Are Using Technology at Home and in Their Classrooms', *Pew Research Center: Internet, Science & Tech*, 2013 <http://www.pewinternet.org/2013/02/28/how-teachers-are-using-technology-at-home-and-in-their-classrooms/> [accessed 5 June 2018]
3. 'Wikipedia: Prime Objective', *Wikipedia*, 2017 https://en.wikipedia.org/w/index.php?title=Wikipedia:Prime_objective&oldid=804044130
4. Other groups are also significantly under-represented on Wikipedia. See: 'Wikipedia: Systemic Bias', *Wikipedia*, 2018 https://en.wikipedia.org/w/index.php?title=Wikipedia:Systemic_bias&oldid=833738243
5. For the male bias of Wikipedia see Wagner, C, Graells-Garrido, E, Garcia, D and Menczer, F, 2016, 'Women through the glass ceiling: gender asymmetries in Wikipedia', *EPJ Data Science* 5.1
6. There are a number of articles that discuss the gender bias implicit in the notability criteria. For example, see Michelle Moravec, 'The Endless Night of Wikipedia's Notable Woman Problem', *boundary2*, 2018 <https://www.boundary2.org/2018/08/moravec/> [accessed 1 August 2018]
7. This article uses an analysis based on the [PetScan tool](https://petscan.wmflabs.org/) created by Magnus Manske to help Wikimedians to better understand Wikipedia and its sister sites. The data returned will change, reflecting Wikipedia's changing contents over time; the figures included in this article were based on those returned at the time of writing. For the basic numbers, a Category depth of 3 was used to ensure that articles within subcategories are included in the tally. The category Engineers had negative categories of Women engineers and Women scientists applied to remove these women and leave a list of male engineers: <https://petscan.wmflabs.org/?psid=5770640>. The category Women engineers was combined with the Subset of the categories Engineer and Women scientists in order to produce a list of pages about women engineers: <https://petscan.wmflabs.org/?psid=5770641> and <https://petscan.wmflabs.org/?psid=5770643>
8. When including fictional characters in the list, a significant number of the highest-linked pages were characters from British soap opera *Coronation Street* who worked as machinists in a textiles factory. Fictional characters were excluded to check whether this television show might be skewing the data.
9. See Appendix for the Sparql queries written to ascertain the numbers on Wikidata.
10. There is no category for dead people: where it is known that the subject of a biography page is alive, their biography is tagged as being a Biography of a Living Person (BLP). For the purposes of analysis, this article considers all those not tagged as potentially deceased.
11. 'An idea of the debate around notability can be found on the Wikipedia talk page 'Wikipedia Talk: Notability', *Wikipedia*, 2018 https://en.wikipedia.org/w/index.php?title=Wikipedia_talk:Notability&oldid=843814740 [accessed 31 May 2018].
12. See, for example, Jill S Tietjen, 2016, *Engineering Women: Re-Visioning Women's Scientific Achievements and Impacts*, (Springer); Monique Frize, 2010, *The Bold and the Brave: A History of Women in Science and Engineering* (University of Ottawa Press); Margaret E Layne, 2009, *Women in Engineering: Pioneers and Trailblazers* (ASCE Publications)
13. 'History of Engineering', *Wikipedia*, 2018 https://en.wikipedia.org/wiki/History_of_engineering [accessed 5 June 2018]
14. 'History of Women in Engineering', *Wikipedia*, 2018 https://en.wikipedia.org/w/index.php?title=History_of_women_in_engineering&oldid=840058278 [accessed 5 June 2018]
15. The page has been edited 103 times by 58 editors in total, compared with the broader history page which has 148 edits by 97 editors.
16. 'Talk: History of Engineering', *Wikipedia*, 2017 https://en.wikipedia.org/w/index.php?title=Talk:History_of_engineering&oldid=814743526 [accessed 5 June 2018]; 'Talk: History of Women in Engineering', *Wikipedia*, 2017 https://en.wikipedia.org/w/index.php?title=Talk:History_of_women_in_engineering&oldid=808829944

[accessed 5 June 2018]

17. 'Wikipedia – History of Women in Engineering' https://en.wikipedia.org/wiki/History_of_women_in_engineering
18. Specifically, they thought that the context for why many women in the USA entered engineering in the 1970s and 80s was lacking from the page, as was an explanation for the decline in women taking a degree in computer science from 1985 onward.
19. 'Wikipedia: Five Pillars', Wikipedia, 2018 https://en.wikipedia.org/w/index.php?title=Wikipedia:Five_pillars&oldid=834330089 [accessed 5 June 2018]
20. 'See the Wikipedia talk page for 'History of Women in Engineering' https://en.wikipedia.org/wiki/Talk:History_of_women_in_engineering [accessed 5 June 2018]
21. On the implicit 'neutrality' of the male, see the section 'Why does "Queen-Empress" redirect to "King-Emperor"?' In Sati Houston and Chris Schilling, 'Inspire Campaign's Final Report Shows Achievements in Gender Diversity and Representation within the Wikimedia Movement – Wikimedia Blog', *Wikimedia Foundation Blog* <https://blog.wikimedia.org/2017/01/12/inspire-campaign-final-report/> [accessed 5 May 2018]
22. 'Wikipedia 'completely failed' to fix gender imbalance', *BBC News*, 2014 <https://www.bbc.co.uk/news/av/business-28701772/wikipedia-completely-failed-to-fix-gender-imbalance> [accessed 5 June 2018]
23. See 'Wikiproject Women in Red', Wikipedia, 2018, https://en.wikipedia.org/wiki/Wikipedia:WikiProject_Women_in_Red [accessed 17 September 2018]. See also Samir Elsharbaty 'Community digest: Women in Red's impact on Wikipedia's gender gap', *Wikimedia Foundation Blog*, 2017, <https://blog.wikimedia.org/2017/05/02/digest-women-in-red/> [accessed 5 June 2018]
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Author information



Alice White

Digital Editor

[Contact this author >](#)

Dr Alice White is a Digital Editor and Wikimedian in Residence at Wellcome Collection. She is a historian of science by training and obtained her PhD from the University of Kent