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When Search Engines Discriminate

The Posthuman Mimesis of Gender Bias

> "An important feature of a learning machine is that its teacher will often be very largely ignorant of quite what is going on inside, although he may still be able to some extent to predict his pupil's behaviour. This should apply most strongly to the later education of a machine arising from a child-machine of well-tried design (or programme)."[1]

Already in 1950, Alan Turing disapproves the idea that a machine can only do what it is told to do; but rather postulates that machines are able to change induced rules. While at the time of writing his work "Computing Machinery and Intelligence" his ideas may have seemed rather abstract, we are now confronted with the digital aftermath. For example: Where would you turn when searching for (practical) information or an image? The approximately 3.5 billion Google searches carried out every day[2] reveal the ubiquity of the online search engines in modern life. If one considers search engines as the epicentre of information requests, the underlying architecture of Artificial Intelligence (AI) powered search technologies demands to be disclosed. While AI has undoubtedly democratised information and communication processes, the digital mediation of search engines is accompanied by new societal challenges. There are various definitions of AI; notwithstanding, this work defines AI as constituting the algorithms that function on behalf of learning and automatized decision-making processes.[3] AI intends to optimize and simplify everything. However, experts wonder if the coherent algorithms perpetuate bias and misinterpret societies as more homogenous than they are.[4] With the prominence of search engines as the informative arbitrators of social realities, raising these concerns is vital. Research has found a number of cases that prove structural gender-based discrimination embedded in the knowledge platforms. For example, search engines that show well-paying technical and executive positions to men rather than women;[5]

1 Turing, Alan M.: Computing Machinery and Intelligence. In: Mind LIX 236 (1950), p. 433–460.

2 Internet Live Stats, Google search statistics 2020, https://www.internetlivestats.com/google-search-statistics/

3 Howard, Ayanna/ Borenstein, Jason: The Ugly Truth About Ourselves and Our Robot Creations: The Problem of Bias and Social Inequity. In: Science and engineering ethics 24(5) (2018), p. 1521–1536.

4 Rainie, Lee; Anderson, Janna: The Future of Jobs and Jobs Training. Pew Research Center, 2017, https://www.voced.edu.au/content/ngv%3A7734

5 Howard; Borenstein 2018.

or search engine platforms that give a wrong impression about gender representations in occupations[6] and promote gender-related attractiveness stereotypes.[7] But can gender bias in search engines be interpreted as a feature of patriarchal structures? This question may arise if one considers that most of the AI systems are developed by mostly (white) men. The UNESCO report highlights that, in 2017, solely 12 per cent of the leading machine-learning researchers are represented by women.[8] Google represents one example of poor gender diversity, with women representing only one third of the total employees and even less in leadership positions.[9] But the discriminating patterns cannot only be found in Google's choice of workforce, but also in the algorithms they create. For example, Google Translate translates the Turkish phrase "O bir doktor" as "he is a doctor" in English, even though the Turkish pronouns are gender neutral. Yet, if the word doctor is replaced by the Turkish word for nurse, "hemsire", the translation becomes "she is a nurse".[10]

In the information age we live in, search engines act as a ubiquitous mediator between societies and knowledge production; but also play a pivotal role in the transformation of sociocultural norms. Research confirms that the answers provided by search engines have a significant effect on an individual's attitude, behaviour and preference.[11] Thus, the question arises of whether and how the curated, gendered realities presented by information intermediaries influence societies? Can AI have agency? And if so, how can we disobey in order to destabilize the technology-induced reproduction of inequalities? By breaking down the subject-object duality, this work will address these questions through the example of search engines. The following will open the

6 Kay, Matthew; Matuszek, Cynthia; Munson, Sean A.: Unequal representation and gender stereotypes in image search results for occupations. In: Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (2015), p. 3819–3828.

7 Magno, Gabriel/ Araújo, Camila S./ Meira Jr., Wagner/ Almeida, Virgilio: Stereotypes in Search Engine Results: Understanding The Role of Local and Global Factors. In: DAT'16

8 UNESCO: I'd blush if I could: closing gender divides in digital skills through education (2019), https://en.unesco.org/Id-blush-if-I-could

9 UNESCO 2019.

10 Johnston, Ian: AI robots are learning racism, sexism and other prejudices from humans: In: The Independent (2017), https://www.independent.co.uk/life-style/gadgets-and-tech/news/ai-robots-artificial-intelligence-racism-sexism-prejudice-bias-language-learn-humans-a7683161.html

11 Epstein, Robert; Robertson, Ronald E.: The search engine manipulation effect (seme) and its possible impact on the outcomes of elections. In: Proceedings of the National Academy of Sciences 112(33) (2015), p. E4512–E4521.

debate by outlining research that focuses on (gender) bias in search engines. Next, this work will explore the concept of (non)human agency from an agential realist perspective in order to discuss whether artificial entities are capable of pursuing specific objectives and affecting the social world. With the growing responsibility of AI, I suggest that search engines can be interpreted as agency bearer; especially as they induce the posthuman mimesis of gender. Thus, this work can be seen as another endeavor to discuss the (re)emergence of asymmetries due to (non)human entanglements. The objective of this paper is to outline the analytical advantages of a diffractive methodology in order to point out the loop of gendering which has to be tackled by reversing the rules. Crucially for this work is the idea that responsibility is not limited to human-conditioned action, as technologies increasingly determine decisions. By bridging theories of feminist posthumanism with (trans)national practical examples of search engine bias, this work points out that technologies always imply (gender-hierarchical) power relations and therefore constitute a social field[12], which needs to be approached as such.

Let me Google that...

"These search engine results, for women whose identities are already maligned in the media, only further debase and erode efforts for social, political, and economic recognition and justice."[13] This quote from Safiya Umoja Noble[14] warns against the enormous power of search engines such as Google as knowledge producers. Noble[15] emphasises the urgent need to question the underlying influence of prominent information platforms—the following discussion will. Unlike this work, which will be peer-reviewed for the accuracy of its information and sources, the legitimacy of Google is ensured just by its pure dominant market position. As Google has become a synonymous with Internet search, covering a global desktop market share of around 87% and

12 Hummel, Diana; Stieß Immanuel; Sauer Arn: Technikfolgenabschätzung und Geschlecht: Bestandsaufnahme und Identifizierung von Diskursschnittstellen mit besonderem Fokus auf Digitalisierung. Expertise für den Dritten Gleichstellungsbericht der Bundesregierung, 2020.

13 Noble, Safiya U.: Searching for Black girls: Old traditions in new media (PhD dissertation 2012).

14 Noble 2012.

15 Noble 2012.

98% for mobile search[16], it is necessary to analyse the agency and the potential social outcome of the information provider.

Several studies have discussed (gender) bias in search engines.[17] Kay, Matuszek and Munson (2015)[18], for instance, analysed gender bias in professions on behalf of Google image search results. The study found that individuals rated search results higher if they were in line with occupational stereotypes and that shifting the gender ratio for a variety of professions could influence the perception of gender distributions in the actual world. Thereby, the researchers showed that gender stereotyping in search engines can lead to wrong presumptions about the actual gender distribution in occupations. As the researcher found a systematic under representation of women in specific work professions, the displayed representation of gender in image search results could promote bias and discrimination in the real world.[19] In addition, Magno and colleagues[20] examined the influence of digital prejudices regarding female attractiveness on search engine platforms. This study found that search engines can be biased and indicate stereotypes that are very distinctive from the actual appearance of women within the examined country.[21] They also found strong similarities among countries with the same language, which is why the biased search engines do not reflect the demographics of the respective countries. In terms of 'beauty', a previous study[22] found that search engines reproduced a Eurocentric standard of beauty, with negative stereotypes for black and Asian women and positive stereotypes for white women in search engines such as Google and Bing. In both search engines the proportion of black women was much higher when searching 'ugly women'. Moreover, regarding physical attractiveness, negative stereotypes linked to

16 Statcounter: Search Engine Market Share Worldwide, https://gs.statcounter.com/search-engine-market-share

17 Araújo, Camila Souza; Meira, Wagner; Almeida, Virgilio: Identifying stereotypes in the online perception of physical attractiveness. In: Spiro, Emma; Ahn, Yong-Yeol (Eds): Social Informatics. SocInfo 2016. Lecture Notes in Computer Science 10046 (2016) / Baker, Paul; Potts, Amanda: Why do white people have thin lips? Google and the perpetuation of stereotypes via auto-complete search forms. In: Critical Discourse Studies 10(2) (2013), p. 187–204 / Epstein; Robertson 2015 / Kay; Matuszek; Munson 2015 / Magno; Araújo; Meira Jr.; Almeida 2016.

18 Kay; Matuszek; Munson 2015.

19 Ibid.

20 Magno; Araújo; Meira Jr.; Almeida 2016.

21 Ibid.

22 Araújo; Meira; Almeida 2016.

older women have been proven; since in the search engine queries 'beautiful women' were predominantly represented younger than the 'ugly women'.

Instead of questioning the binary nature of the mentioned studies themselves, a study by Baker and Potts[23] should be presented, which investigated discrimination in the auto-instant search offered by Google. The study demonstrated negative stereotyping and implicit value attributions for certain identity groups, such as LGBTQI identities. For example, when typing 'why do gay' into the instant search, Google offered the following search proposals: 'why do gay men have high voices'; 'why do gay men get aids'; 'why do gays exist'.[24] This work goes in line with the UN women ad series from 2013, who used genuine Google searches to alarm against sexism and discrimination.[25] While, at the time of writing this, different queries were suggested than described by Baker and Potts[26], who used Google.co.uk; the fact remains that search engines are (re)productive information platforms that are inherently part of the discourse itself. This opens up questions about the ethical responsibilities of online information providers that arise with the increasing democratization of these information platforms, but also the question how it is possible to combat the reproduction of inequalities.

Given the scope and sovereignty of certain search engines, it must be emphasized that the biased search results can act as a catalyst for regressive (gender) stereotypes as well as discrimination in the digital and real world. However, it is important to note that these challenges do not only result from information intermediaries themselves, but also from the content that underlies their operational work. Ultimately, based on the usage of metrics, search engines decide which of the innumerable web pages are listed in the search results and, more importantly, how to rank them. As such, they are "determining any systematic inclusions and exclusions [as well as] the wide-ranging factors that dictate systematic prominence for some sites, dictating systematic invisibility for others".[27] An analysis found that of approximately 300 million clicks within one search engine 92% of those were on the first

23 Baker; Potts 2013.

24 Baker; Potts 2013.

25 UN Women: UN Women ad series reveals widespread sexism, https://www.unwomen.org/en/news/stories/2013/10/women-should-ads

26 Baker; Potts 2013.

27 Introna, Lucas D.; Nissenbaum, Helen: Shaping the Web: why the politics of search engines matters. In: The Information Society 16(3) (2000), p. 169–185.

page.[28] As search engine user trust higher-ranked results, the perception of social realities is also influenced in a political matter. Epstein and Robertson[29] conducted five experiments in order to analyse whether search rankings can manipulate voting preferences of undecided voters. They found that biased rankings could alter voting preferences by 20% or more, as this shift can be even higher in certain demographic groups. The researchers coined the neologism "search engine manipulation effect" (SEME) and set out the caveat that most of the search ranking bias is masked; which is why people are not aware of the manipulation. As such, SEME is a threat to democratic systems, especially in countries that are dominated by solely one search platform. At this point, it should be noted that Google covers 94% of the search engine market in Germany.[30]

The digitalisation does not only change the way we learn and live, but also has physiological and neural consequences. In 2008, a study found that the daily confrontation with search engines stimulates cell change and the release of neurotransmitters in the brain. As we are spending more time browsing websites than books, new nerve tracts in our brain are strengthened, while old ones are weakened. Specifically, experienced Google users showed a higher brain activity in the left frontal area, while beginners showed none or only minimal activity in that brain area.[31] Regardless of the Darwinian theories of media evolution,[32] it becomes clear that digitalisation has affected our society and daily life already. Even while now reading, if this occurs to be in a public room, the aftermath of the digital revolution should become evident. The transformation comes along with the rapid development of AI, which extends the cognitive as well as practical possibilities of human action by posthuman forms. This gives rise to the question whether the subject-object dualism needs to be dismantled in order to understand the way in which (non)human agency is entangled in the construction of the world. This article draws on Embirbayer and Misches' definition of agency as "the temporally constructed engagement by actors of different structural environments—the temporal-relational context of action—which through the in-

28 Chitika: Chitika Insights. The value of Google Result Positioning, 2013, http://info.chitika.com/uploads/4/9/2/1/49215843/chitikainsights-valueofgoogleresultspositioning.pdf

29 Epstein; Robertson 2015.

30 Statcounter.

31 Carr, Nicholas: Wer bin ich, wenn ich online bin … und was macht mein Gehirn solange? Wie das Internet unser Denken verändert, Munich 2010.

32 For an overview see Schröter, Jens (Ed.): Handbuch Medienwissenschaft, 2014, p. 405.

terplay of habit, imagination, and judgment, both reproduces and transforms those structures in interactive responses to the problems posed by changing historical situations".[33] In line with Barads' account of an agential realism as "one that incorporates important material and discursive, social and scientific, human and nonhuman, and natural and cultural factors"[34], this article aims to question these dichotomies, as to point out the posthuman mimesis of gender that goes beyond an anthropocentric understanding—to comprehend "how matter matters".[35]

The Question of (Posthuman) Agency

In the 1980s Langdon Winner published the essay "Do artifacts have politics?"[36], which emphasizes the social determination of technology. According to Winner[37], technology can be instrumentalized to increase authority and power; for example: the use of television to promote a political candidate during an election. (Epstein and Robertson[38] have shown how this strategy can also be implemented through search rankings). In his widely discussed essay, Winner[39] urges us to be vigilant, as technologies are methods to organize social order—especially as the systems play a pivotal role in daily life (deliberately or not).

> "Societies choose structures for technologies that influence how people are going to work, communicate, travel, consume, and so forth over a very long time. In the processes by which structuring decisions are made, different people are differently situated and possess unequal degrees of power as well as unequal levels of awareness".[40]

33 Emirbayer, Mustafa; Mische, Ann: What Is Agency?. In: American Journal of Sociology 103 (1998), p. 962–1023.

34 Barad, Karen: Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter. In: Signs 28(3) (2003), p. 801–331.

35 Barad 2003.

36 Winner, Langdon: Do Artifacts Have Politics? In: Daedalus 109(1) (1985), p. 121–136.

37 Winner 1985.

38 Epstein; Robertson 2015.

39 Winner 1985.

40 Winner 1985.

In line with this notion, Winner sets the striking example of a bridge as a technical artefact that can divide people within a society. He refers to the (low-hanging) bridge constructions by Robert Moses that allows to overpass New York and Long Island only with private cars.[41] Many of the overpasses between Long Island and New York were constructed with less than three meters of clearance at the curb.[42] This construction, Winner argued, was intended to keep those who could not afford a car (people from low-income groups and racial minorities) away from the "white" beaches. Winner concluded that Moses aimed to achieve a certain social effect by excluding (public) buses on these parkways; explicitly discriminating on the basis of social-class and race. However, due to the proof of public transportation connecting New York and Long Island, Winners' bridge example has been declared a myth.[43] Notwithstanding, the question can be left open whether the example was chosen (in)accurately, since the fact that Moses' constructions were focused on automobile owners, remains. Besides the strong doubts about the validity of Winners' bridge analogy, it can be held that Winners' essay about the underlying politics of technical objects initiated a debate in Science and Technology Studies (STS) about the notion that technology maintains and increases social injustice,[44] which is still valid today. According to the UNESCO report[45] for Digital Development the gap between industrial and developing countries is still widening:

> "In global terms, digital inequalities continue to be well-documented and, in many instances, divides across lines of geography, gender, age, physical abilities, socio-economic status, language, and educational attainment are growing. [...] Over half of the world's population (some 3.9 billion people) remain unable to connect regularly to the internet. Many of these people live in sub-Saharan Africa

41 Bath, Corinna: De-Gendering informatischer Artefakte. Grundlagen einer kritisch-feministischen Technikgestaltung (Dissertation 2009).

42 Winner 1985.

43 Joerges, Bernward: Do Politics Have Artefacts?. In: Social Studies of Science 29(3) (1999), p. 411–431 / Woolgar, Steve; Cooper, Goeff: Do Artefacts Have Ambilvalence? Moses' Bridges, Winner's Bridges and other Urban Legends in S&TS. In: Social Studies of Science 29(3) (1999), p. 433–449.

44 Bath 2009.

45 UNESCO: Working Group on Education: digital skills for life and work, 2017, https://unesdoc.unesco.org/ark:/48223/pf0000259013

> and South Asia, with six countries (India, China, Indonesia, Pakistan, Bangladesh and Nigeria) accounting for around half of the world's offline population."[46]

In most parts of the world the digital skills gender gap is growing simultaneously:

> "Today, women and girls are 25 per cent less likely than men to know how to leverage digital technology for basic purposes, 4 times less likely to know how to programme computers and 13 times less likely to file for technology patent. At a moment when every sector is becoming a technology sector, these gaps should make policy-makers, educators and everyday citizens 'blush' in alarm."[47]

The idea that technology should not be considered as neutral, but rather as socio-political is shared by STS research. Whereas Winner acknowledges the social injustice embedded in technological systems, he does not concentrate on the agency of technology itself. Although Bruno Latour[48] agrees with Winners' notion that the interaction with technology influences society; he pleads for a more open perspective regarding the subject-object dualism. Accordingly, Latour[49] regards artefacts not as neutral, but rather credits their ability to act.[50] Under the actor-network theory (ANT), the dichotomy of technology and the living is particularly avoided.[51] The revision of agency began to be discussed in the field of STS, as nonhuman entities are an active part in the domain. In 1985 Steve Woolgar asked "Why should sociology stop short when it comes to machines?"[52] and Latour[53] delivered a potential answer to this question. In his work "Mixing Humans and Non-Humans Together: The Sociology of a Door-Closer", Latour[54] uses the example of a door

46 UNESCO 2017.

47 UNESCO 2019.

48 Latour, Bruno: Which politics for which artifacts?. In: Domus 171 (2004), p. 50–51.

49 Latour 2004.

50 Bath 2009.

51 Ibid.

52 Woolgar, Steve: Why not a sociology of machines? The case of sociology and artificial intelligence. In: Sociology 19 (1985), p. 557–572.

53 Latour, Bruno: Mixing Humans and Nonhumans Together: The Sociology of a Door-Closer. In: Social Problems 35(3) (1988), p. 298–310.

54 Latour 1988.

to elaborate that morality can be shifted into a medium.[55] Due to the door mechanism, individuals do not have to think about performing the social courtesy of closing a door behind them. Latour[56] emphasis that understanding our social world without the nonhuman is unreasonable, since morality, knowledge or sociability are not solely the possession of humans, but also of the delegates that build the social reality and their relations. In a Foucaultian manner, artefacts can be interpreted as a bio power that influences individuals without the mask of a subject.[57] Accordingly, Latour[58] offers a symmetric anthropology that regards human and non-human/ subjects and objects equally, also in terms of agency.

> "An 'actor' in ANT is a semiotic definition—an actant—, that is something that acts or to which activity is granted by others. It implies no special motivation of human individual actors, nor of humans in general. An actant can literally be anything provided it is granted to be the source of an action. Although this point has been made over and over again, anthropocentrism and sociocentrism are so strong in social sciences (as well as in the critiques of social explanations) that each use of ANT has been construed as if it talked of a few superhumans longing for power and stopping at nothing to achieve their ruthless goal."[59]

Another approach to (nonhuman) agency brings up new questions when analysing power differences and inequalities: If certain categories are in- or excluded, the implementation of technology can result in social shaping and vice versa; thus: "matter matters".[60] Judy Wajcman[61], who emphasizes that technology can be both a product but also a multiplicator of social constructions claims: "[...] gender relations can be thought of as materialized in technology, and masculinity and femininity in turn acquire their meaning

55 Braun, Holger: Soziologie der Hybriden. Über die Handlungsfähigkeit von technischen Agenten. In: TUTS Working Papers 4–2000, Berlin 2000.

56 Latour 1988.

57 Dreyfus, Hubert L.: Die Gefahren der modernen Technologie: Heidegger und Foucault. In: Honneth, Axel (Ed.): Pathologien des Sozialen. Die Aufgaben der Sozialphilosophie, Frankfurt/M. 1994, p. 107–120.

58 Latour, Bruno: On Actor-Network Theory. A Few Clarifications, Plus More Than a Few Complications. In: Philosophical Literary Journal Logos 27 (2017), p. 173–197.

59 Latour 2017.

60 Barad 2003.

61 Wajcman, Judy: TechnoFeminism, Cambridge 2004.

and character through their enrolment and embeddedness in working machines".[62] In line with Wajcman, Corinna Bath[63] calls for a co-construction of gender and technology. This article has taken this approach by presenting an onto-epistemological framework that does justice to the (non)human entanglements.

Agential Realism

Karen Barad, the feminist physicist, provides a theoretical alternative in order to capture the performativity of matter as an active contributor in the social becoming. In line with Haraways' idea of companion species[64], Barad[65] opens a concept of agential realism that incorporates discursive practices within the differential account of materialism; (dis)embodied or not.

> "Agential realism is an account of technoscientific and other practices that takes feminist, antiracist, poststructuralist, queer, Marxist, science studies and scientific insights seriously, building specifically on important insights from Niels Bohr, Judith Butler, Michel Foucault, Donna Haraway, Vicki Kirby, Joseph Rouse, and others."[66]

While each of the individual influences will not be addressed at this point, it should be emphasized that Niels Bohrs' interpretation of the quantum theory and his scepticism of a Cartesian epistemology have shaped Barads' differentiated understanding of materialism. Bohr refused atomistic metaphysics that regard things as ontologically-based entities with determinate boundaries, as he claimed that quantum physics needs to include observation as a process itself.[67] In particular, it is not possible to measure the

62 Wajcman 2004.

63 Bath 2009.

64 Haraway, Donna J.: The Companion Species Manifesto: Dogs, People, and Significant Otherness, Chicago 2003.

65 Barad, Karen: Agentieller Realismus. Über die Bedeutung materiell-diskursiver Praktiken. Übers. von Schröder, Jürgen. Berlin 2012.

66 Barad 2003.

67 Barad, Karen: Meeting the Universe Halfway: Realism and Social Constructivism without Contradiction. In: Nelson, Lynn H./ Nelson, Jack (eds): Feminism, Science, and the Philosophy of Science, Dorfrecht/ Boston/ London 1996, p. 161–164.

position and momentum of a particle simultaneously, which is why measurements cannot be understood as neutral interactions.[68] Thus, Bohr avoided the presumed division of the observer/knower and the observed/known.[69] Bohrs' philosophical account of physics emphasizes that the observed phenomena can be interpreted as an embodiment of cultural practices; as a result of intra-activity. In contrast to the word "inter" that presupposes the pre-existence of independent entities; the notion of "intra" incorporates an agential cut that is situated within the phenomenon of the observation.[70] This perspective makes not only the observer apparent, but primarily the observation as an operation. The conceptual shift offers (re)elaborated conditions for causality, since the exteriority between the observer/knower and the observed/known within phenomena is changed.

> "On an agential realist account of technoscientific practices, the 'knower' does not stand in a relation of absolute externality to the natural world being investigated—there is no such exterior observational point. It is therefore not absolute exteriority that is the condition of possibility for objectivity but rather agential separability—exteriority within phenomena. 'We' are not outside observers of the world. Nor are we simply located at particular places in the world; rather, we are part of the world in its ongoing intraactivity. This is a point Niels Bohr tried to get at in his insistence that our epistemology must take account of the fact that we are a part of that nature we see to understand."[71]

Thus, Barad claims that neither the observer has total agency over the passive matter, nor vice versa; but rather matter and meaning has to be regarded as an agential intra-acting.[72] With her posthumanist account, Barad states that agency cannot be delegated as an element of subjects or objects; as it is rather the being in its intra-action—"matter comes to matter through the iterative intra-activity of the world in its becoming."[73] Accordingly, Barad[74] argues that responsibility is not the exclusive right of humans. In this regard, practices of knowledge cannot be traced back as (solely) human

68 Barad 2012.
69 Barad 2003.
70 Ibid.
71 Ibid.
72 Barad 1996 / Barad 2003.
73 Ibid.
74 Barad 2012.

operations, since first of all we use nonhuman elements for the acquisition, but also because they result from intra-actions that go beyond divisive hierarchical reasoning. Ultimately, also search engines must be considered as parts of reconfiguring the social—making it intelligible.

"If agency is the answer, kindly repeat the question!" This is the title from Willhelm Halffman's essay on positions on agency and the normativity of technology.[75] Halffman[76] regards agency not as a determined answer that is based on theoretical choices, but rather as an empirical toss of a coin. In line with this, this article requests to consider agency in its heterogenous and multi-faceted conditions, which includes components that go beyond human enactment. Agency is relational and agile—a result of the (non)human intra-actions. Hence, this article seeks to shift the anthropocentric position as to rethink and reconfigure the comprehension of agency and its undertaking; in order to question the loop of gendering emerging with digitalization. It must be emphasized that a posthumanist perspective of agency does not replicate the nonhuman for the human, but rather searches answers for the way of social order and its active entities. The onto-epistemological indeterminacy of agentive realism is subject to an openness that meets the causality of the appropriation processes of algorithmic bias.

The Mimetic Processes of Gendering

In 1950, Alan Turing introduced his work "Computing Machinery and Intelligence", in which he argued that learning machines work through imitation.[77] But what if these systems learn to discriminate? Gender bias in AI repetitively perpetuates and reinforces gender constraints that are reflected in social and practical discourses. Judith Butler[78] describes the (re)production of gender as "[t]his repetition is at once a re-enactment and re-experiencing of meanings already socially established". Judith Halberstam draws the parallel "Gender, we might argue, like computer intelligence, is a learned,

75 Halffman, Willem: If agency is the answer, kindly repeat the question. Essay review of Harbers et al., Inside the Politics of Technology. In: Science and public policy 33(6) (2006), p. 469–472.

76 Halffman 2006.

77 Collett, Celementine; Dillon, Sarah: AI and Gender: Four Proposals for Future Research, 2019.

78 Butler, Judith: Gender Trouble: feminism and the subversion of identity, New York 1990.

imitative behavior that can be processed so well that it comes to look natural"[79]—or automatic?

By addressing the technological appropriation processes, I plead that with raising (non)human entanglements, materiality needs to be seen as well as a multiplier for gender conditions on behalf of mimetic learning. Most recently, when search engines reconstitute gender arrangements by learning normative meanings of it. Technologies are always sociohistorically anchored and reflect social conditions[80], which is why historical attributions are manifested and perpetuated in mimetic appropriation practices; vice versa they (re)shape the world in their productive imitation.

Christoph Wulf[81] emphasizes the variety of meanings of the term mimesis, since it is not only used in the field of aesthetics but can also be constitutive for social studies. The articulation of mimesis as an imitation can be traced back to antiquity, such as in Plato's third book "Republic", which is extended to education.[82] According to Plato, due to its lasting effects, mimetic processes are very powerful and constitutive for human development.[83] As such, Wulf acknowledges that mimetic practices have to be set in relation to contemporary power relations, especially as they can be productive in its self-sufficiency:

> "Mimetic learning, learning by imitation, constitutes one of the most important forms of learning. Mimetic learning does not, however, just denote mere imitation or copying: Rather, it is a process by which the act of relating to other persons and worlds in a mimetic way leads to an en-hancement of one's own world view, action, and behaviour."[84]

79 Halberstam, Judith: Automating Gender: Postmodern Feminism in the Age of the Intelligent Machine. In: Feminist Studies 17(3) (1991), p. 439–460.

80 Schünemann, Isabel; Lebert, Yannick: Algorithmen & Gesellschaft. Zur Zukunft der sozialen Teilhabe in Deutschland. Vodafone Institut für Gesellschaft und Kommunikation, 2019.

81 Wulf, Christoph: Zur Genese des Sozialen: Mimesis, Performativität, Ritual, Bielefeld 2005.

82 Wulf, Christoph: Mimetic Learning. In: Designs for Learning 1(1) (2008), p. 56–57.

83 Wulf 2008 / Wulf, Christoph: Das Rätsel des Humanen. Eine Einführung in die historische Anthropologie, Paderborn 2013.

84 Wulf 2008

While Wulf[85] recognizes mimesis as an anthropological capacity by presupposing a plasticity of the body, this work implements a posthumanist perspective on mimesis as this condition seems obsolete under the sociotechnological implications of algorithmic bias. In the entanglements of (non) human intra-actions, intelligent systems also sustainably appropriate schemata as orientation structures. Thus, it should be emphasized that mimetic processes cannot be understood as mere reproduction and imitation, but rather have a performative character.[86] Following Butler's conceptualization of performativity as a practice of repetition[87], this reproduction affects and alters genderization—simultaneously as reinforcement and sustainably as stabilization and transmission. While the mimetic constructions result from the reproduction of the human, they can carry other (lasting) effects; as the presented examples show. Hence, technological performativity unfolds new impulses in these enrichments and can be regarded as a new way of looking at familiar phenomena, but also a different way of responding to them: "Mimesis resists a clear-cut split between subject and object; it resists any unequivocal distinction between what is and what should be."[88]

This work aims to point out that social action and responsibility should not be limited to humans[89]; rather it should be clarified that it is transmitted to technologies as to show opportunities of disobedience. Thus, I suggest that technologies acquire its own agency in mimetic processes, which manifest contemporary relations of inequality. The term posthuman mimesis refers to the (re)productive intervention in building social schemas that result from digital appropriation practices. The recognition of posthuman mimesis allows to (re)locate agency and responsibility in an intangibly complex world in which non-human actors also play their part. Within the mimetic practices, gender role beliefs and their bias can be (re)produced faster and are widely spread.

"Such gender role beliefs, shared within a society, promote socialization practices that encourage children to gain the skills, traits, and preferences

85 Wulf 2013.

86 Wulf 2005 / Wulf, Christoph: Produktive Nachahmung. Weiterbildung. In: Zeitschrift für Grundlagen, Praxis und Trends 5 (2012), p. 12–15.

87 Butler 1990.

88 Gebauer, Gunter/ Wulf, Christoph/ Reneau, Don: Mimesis: Culture—Art—Society, 1996.

89 Bath 2009 / Braidotti, Rosi: Nomadic Subjects. Embodiment and Sexual Difference in Contemporary Feminist Theory, New York 2011 / Barad 2012.

that support their society's division of labour."[90] If the division of labour is widening the gender gap in AI, it could be assumed that the loop will continue to perpetuate bias. The Global Gender Report[91] found that 78 % of AI professionals are male. There are several examples of man-based machines or/and data.[92] Coming back to the initial question: How can we overcome algorithmic biases? An answer could be built on Hardings' standpoint theory[93], which indicates that epistemology and conceptual frameworks result from the dominant groups of hierarchical societies, who establish social power. Thus, the man-machine reconfigurations call for a critical transformation of the social and technology—to tackle the principles of homophily—a concept introduced by Wendy Chun for describing sources for pattern discrimination[94]. Yet, besides reaching out for more diverse development teams, another way to subversively change the mimetic pattern will be introduced at last.

Concluding Remarks

"The claim that a machine cannot be the subject of its own thought can of course only be answered if it can be shown that the machine has some thought with some subject matter. Nevertheless, ´the subject matter of a machine's operations´ does seem to mean something, at least to people who deal with it. [...] By observing the results of its own behaviour it can modify its own programmes as to achieve some purpose more effectively. These are possibilities of the near future, rather than Utopian dreams."[95]

90 Eagly, Alice H./ Wood, Wendy: Biosocial Construction of Sex Differences and Similarities in Behavior. In: Advances in Experimental Social Psychology 46 (2012), p. 55–123.

91 The Global Gender Report (2018) World Economic Forum, http://www3.weforum.org/docs/WEF_GGGR_2018.pdf

92 Criado-Perez, Caroline: Unsichtbare Frauen. Wie eine von Daten beherrschte Welt die Hälfte der Bevölkerung ignoriert, Munich 2020.

93 Harding, Sandra: Standpoint methodologies and epistemologies: a logic of scientific inquiry for people. In: World Social Science Report 2010, p. 173–175.

94 Chun, Wendy H. K.: Queering Homophily. In: Apprich, Clemens/ Chun, Wendy H. K.; Cramer, Florian; Steyerl, Hito. Pattern Discrimination, Minneapolis 2018, p. 59–97.

95 Turing 1950.

Coming back to Turing's work[96] it should be noted that technological systems imitating human decisions can reify and reinforce biases. Algorithms are performative and vice versa they unfold in a state of uninterrupted negotiations and are thus in a continuous intermediate stage of building power and knowledge.[97] Even if the posthuman does not have the mask of a subject and implements bias unintentionally, algorithmic bias repetitively perpetuate categorizations in social and practical discourses. The presented studies show that biased search engines can lead to discrimination, but who is being held responsible? With the continuing (non)human entanglements these questions need to be approached. Due to technological developments, the objective of this contribution was to reconceptualize the relationship between humans and non-humans and to rethink the categories of agency and responsibility. If these technologies determine (in)equalities, it seems vital to assume that they are part of the social becoming. In efforts to discuss the implications of the agential realism the example of biasing technologies was chosen in order to illustrate that Barad's relational framework functions as a critical tool to approach mimetic appropriation processes as it takes (non)human on-going intra-actions into account. If nonhuman entities have an impact on our lives, it seems rather necessary to set an onto-epistemology offset; especially for responsibility ascriptions "not only for what we know, how we know, and what we do but, in part, for what exists".[98] The concept of agential realism proposes the inseparability between ontology and epistemology as the social is in a constate state of becoming. Thus, agential realism offers a perspective that enables to address the empirical implications when analyzing mimetic processes of technologies. By linking ontology and epistemology, Barads' theory contributes to the theories of situated knowledge[99] by offering a more comprehensive understanding of the relationship between humans and non-humans and

96 Ibid.

97 Roberge, Jonathan; Seyfert, Robert: Was sind Algorithmuskulturen? In: Ead. (Eds.): *Algorithmuskulturen. Über die rechnerische Konstruktion der Wirklichkeit, Bielefeld 2017, p. 7–40.

98 Barad 2003.

99 Haraway, Donna: Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspectives. In: Feminist Studies 14(3) (1988), p. 575–599 / Harding, Sandra: Whose Science? Whose Knowledge? Thinking from Women's Lives, Ithaca 1991.

by re-conceptualizing the categories: subjectivity, agency and causality.[100] The entelechy of the rapidly progressing technologies and the (non)human intra-actions call for a methodological re-thinking: With the radical indeterminacy of objectivity and subjectivity, the onto-epistemological framework provides an approach that is better suited to capture the complexities of the entangled responsibilities.[101] Thus, I plead for an onto-epistemology that goes beyond anthropocentric paradigms as to enable to conceive responsibilities as continuous entangled relations; especially if these set (un) visibility, inclusion and representation in relation to resources, power and opportunities. Finally in order to square the circle, a constructive dialogue between and beyond the disciplines is needed. Concurrently, research is working on different data obfuscation techniques to ensure digital privacy protection[102]. One self-defense method is informational resistance, disobedience or protest "by producing misleading, false, or ambiguous data with the intention of confusing an adversary or simply adding to the time or cost of separating bad data from good".[103] Regarding the trade-off between usability and privacy, a pertinent daily method of disobedience is to change the pattern by covering one's track of data—data disobedience through depersonalization and irritation. To do this, demographic data, including (gender) identities, need to be varied throughout the web[104]. Thereby, the digital self but also the society can be multiplied in interesting ways, which can lead to positive side effects, such as building fluid identities and mi-

100 Rouse, Joseph: Barad's Feminist Naturalism. In: Hypatia 19(1) (2004), p. 142–161 / Hinton, Perta: Situated Knowledges' and New Materialism(s). Rethinking a Politics of Location. In: Woman: A Cultural Review 25(1) (2014), p. 99–113 / Hoppe, Katharina; Lemke, Thomas: Die Macht der Materie. In: Soziale Welt 66 (2015), p. 261–280.

101 Kayumova, Shakhnoza; Mcguire, Chad J.; Cardello, Suzanne: From empowerment to response-ability: rethinking socio-spatial, environmental justice, and nature-culture binaries in the context of STEM education: In: Cultural Studies of Science Education 14(1) (2019), p. 205–229.

102 Bakken, David E.; Parameswaran, Rupa; Blough, Douglas M.; Franz, Andy A.; Palmer, Ty J.: Data obfuscation: Anonymity and desensitization of usable data sets. In: IEEE Security and Privacy 2(6) (2004), p. 34–41.

103 Brunton, Finn; Nissenbaum, Helen: Vernacular resistance to data collection and analysis: A political theory of obfuscation. In: First Monday 16(5) (2011), np.

104 Kausch, Julia: Wie digitale Netzwerke analoges Leben formen—und was das Problem ist. Das Filter (2 February 2018), http://dasfilter.com/kultur/wie-digitale-netzwerke-analoges-leben-formen-und-was-das-problem-ist-medienwissenschaftlerin-wendy-chun-im-interview

metizing pluralities towards a (digital) world in which demographics do not automatically implicit societal (dis)advantages.

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