Media and Artificial Intelligence

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On March 17, 2014, a magnitude 4.4 earthquake shook southern California. The first story about the quake on the *LA Times'* website—a brief, factual account posted within minutes—was written entirely by an algorithm.[1] Since then, "robot reporters" have produced stories in major news outlets on topics ranging from minor league baseball games to corporate earnings announcements.[2] Some have speculated that future media will consist largely of content produced by artificial intelligence (AI).[3]

While AI and related technologies will indeed have a transformative impact on media markets, automated production of content—whether news or entertainment—is likely to be a minor part of this story for the foreseeable future. Unlike industries such as manufacturing and transportation, where thousands of jobs consist mainly of repetitive tasks that are well within the capability of current technologies, most of the value in media is in the production of complex content that heavily weights areas like judgment, interpretation, creativity, and communication, where humans continue to dominate algorithms and will do so for many years to come.

Instead, the major impact of AI has been and will continue to be on the *demand* side of media—not the production of content, but the process by which this content is matched to consumers. Future improvements in AI have the potential to profoundly alter this process for both good and for ill.

The basic economics of media mean demand-side matching plays a uniquely important role. News stories, social media posts, songs, and movies are all prototypical "experience goods" whose quality and fit with a consumer's tastes can only be judged once they have been consumed. Marginal costs are low, and the nature of demand varies greatly across consumers and time. Together, these factors mean that the market produces oceans of content of widely varying quality and appeal that must be sorted and filtered in order to produce social value. Effective matching, whether by traditional mechanisms such as human editing and well-known media brands, or by modern algorithms, is what converts this mass into a comprehensible, entertaining, and informative set of goods. It is a key factor determining the level of trust in

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[1] Oremus, Will, 2014, "The first news report on the L.A. earthquake was written by a robot," *Slate*, March 17.
[2] "Automated journalism," *Wikipedia*.
[3]See, e.g.: Bruno, Nicola, 2011, "Will machines replace journalists?" *Nieman Reports*; Carlson, Matt, 2015, "The robotic reporter," *Digital Journalism*, 3:3, 416-431.

media and the extent to which media can be manipulated by governments, advertisers, or other third parties seeking to persuade. It is what has been thoroughly upended by the advent of social media, which puts a decentralized, algorithm-driven process of matching in place of the centralized broadcasting model that has dominated media for centuries. And it is where we need to focus our attention if we are to address the current crisis of media and democracy.

There are three main dimensions along which this matching process can fail. First, quite simply, consumers may not be able to find what they want. Despite tremendous progress in search and related technologies, sifting through the mass of content to find the pieces that maximize a consumer's utility remains a formidable problem. Second, what consumers want may not be well aligned with what is best for society. Scholars have long pointed out that individual and social objectives are likely to diverge in media, as consumers do not fully account for the way their own decisions to be more or less informed about various issues spill over and affect others via the political process. Third, actors such as governments and firms may seek to capture media in order to shape the selection of content consumers see for their own ends.

AI has the potential to dramatically improve the efficiency with which the market matches content to consumers. However, the potential gains, and also the possible negative consequences, vary greatly across these three dimensions.

AI and Search

The most obvious gains from AI will come in making it easier for consumers to find the media content that they want. This "search" problem encompasses not only search technologies strictly defined, but also recommendations, reviews, and an array of other technologies that help consumers navigate content.

At first glance, search appears to be a prototypical application in which the gains to AI should be large. In general, AI will be effective in domains with (i) a tightly specified decision problem; (ii) measurable, clearly defined objectives; (iii) large volume of data on prior cases. Choosing a piece of content to satisfy a consumer's immediate demand clearly satisfies (i). Clicks, viewing time, and other easily captured metrics easily satisfy (ii). And online interactions produce vast amounts of data sufficient for (iii).

The gains to AI in search and recommendation problems have indeed been substantial. The "Netflix Challenge"—how to use prior data on individual consumers' movie ratings to predict future ratings—was a canonical application of machine learning. Google search, Amazon product recommendations, and the Facebook news feed all rely heavily on AI technologies.

Yet in another sense, the gains from AI have been surprisingly small. People have been predicting for decades that the defining feature of digital media will be the *personalization* of

search and matching—going beyond simply sorting web pages or movies to show those most relevant to a query, and instead using rich information about a consumer's prior choices and characteristics to select content uniquely suited to their individual tastes. Though people have been forecasting a revolution in the quality of personalization for as long as the internet has existed, this promise remains largely unrealized.

Google search today involves essentially no personalization.[4] The only major exception is the use of location data to define locally relevant results. Two users at the same location entering the same query will see the same results in the overwhelming majority of cases. While personalized recommendations are certainly prominent on sites like Netflix and Amazon, their quality remains by most accounts surprisingly poor. If I log in to Netflix today, four out of five of my "personalized recommendations" are for additional episodes of television series I have already watched. Amazon's "Recommendations for You" page offers mostly products I have already purchased, or products very similar to those I have already purchased—suggesting for example, that since I recently bought an electric toothbrush, I might like to buy another one. Even on Facebook, where personalization of content and advertising are at the core of the business, evidence suggests that much of what drives variation in users' newsfeeds is the set of items their friends share (combined with non-personalized predictions of the overall popularity of content) rather than finely tailored individual recommendations.[5]

What explains this *personalization paradox*? One possibility is that the predictions of a revolution in personalization have just been premature, and that AI technology is now reaching the point where the promise will finally be realized. There is certainly no doubt that progress will continue, and there will likely be domains where frontier technologies do produce large gains.

There may be a more fundamental answer to the paradox, however. Consider three different tasks that a search algorithm might perform. The first is providing an interface through which a consumer can *communicate* what they are looking for at a particular moment—e.g., parsing the text of a Google search like "Indonesia tsunami news" to determine its meaning. The second is ranking content in terms of its average quality or relevance—e.g., determining that a tsunami story on WSJ or CNN is on average preferred to a similar sounding story on an obscure political blog. The third is personalization—e.g., using consumer characteristics or past behavior to

[4] Hannak, Aniko, Piotr Sapiezynski, Arash Molavi Kakhki, Balachander Krishnamurthy, David Lazer, Alan Mislove, and Christo Wilson, 2013, "Measuring Personalization of Web Search," jin *Proceedings of the 22Nd International Conference on World Wide Web*, 527–38, WWW '13, New York, NY, USA: ACM.

[5] Bakshy, Eytan, Solomon Messing, and Lada A. Adamic, 2015, "Exposure to Ideologically Diverse News and Opinion on Facebook," *Science* 348 (6239): 1130–32.

determine that one consumer might prefer the WSJ story while another might prefer the CNN story.

The relative return to improving each of these tasks depends on the extent to which tastes are correlated between consumers and within consumers over time. Personalization will be most important in a world where the key dimension is *stable individual differences* in preferences—some consumers always like to read highbrow stories about tsunamis while others always like to read lowbrow stories, say. The other tasks become more important to the extent that what a given consumer is wants at one moment can be quite different from what she wants at another, and that for a given need consumers agree to a significant degree about what is most relevant.

A possible explanation for the personalization paradox, then, is that we have tended to over-estimate the importance of stable individual differences relative to the other kinds of variation. Figure 1 shows one example consistent with this hypothesis based on web browsing data from 2008. Each point in the plot is an online news or politics site. The x axis shows the average utility liberals get from the site and the y axis shows the average utility conservatives get from the site, where both are inferred from each group's likelihood of visiting the sites.

A world where stable individual differences were key would be one where this plot sloped downward—some sites give high utility to conservatives and low utility to liberals while others do the reverse. In that world, knowing the searcher's ideology and customizing content to it would be critical. In fact, the plot is clearly upward sloping with a high positive correlation. It is true that conservatives like foxnews.com relatively more and that liberals like nytimes.com relatively more, but this kind of variation is swamped by the fact that everyone likes both of these sites more than smaller sites and blogs.

There is no question that the quality of search and recommendation systems will continue to improve dramatically with advances in AI. It may well be, however, that these gains continue to be more about improved communication with users and overall ranking of content than about personalization.

AI and Bias

Many of the deepest problems in media today stem not from an inability to give consumers what they want, but from the fact that what they appear to want is not aligned with what is good for society. Some may demand celebrity news and puppy videos rather than information that would make them more informed citizens. Others may prefer misleading partisan content or outright misinformation rather than more balanced and accurate political news. A

substantial risk in an AI driven future is that algorithms become ever more expert at catering to these tastes, with disastrous consequences for society.

Can AI also be part of the solution? It certainly has a role to play. Facebook and others have devoted significant effort to training algorithms to identify misinformation. Google can in principle tune its algorithms to weight social objectives as well as the likelihood of clicks, for example by showing accurate information about the Holocaust rather than Holocaust denial sites in response to the query "did the Holocaust happen?"[6]

If we return to the criteria for what makes problems amenable to AI solutions, however, it is clear that we should expect AI to be far less effective in addressing bias than in improving search. Social objectives such as promoting truth and healthy democracy are much harder to define precisely than giving consumers what they want, and there are few cases in which they are easily quantifiable. Training data for search is generated automatically by consumer clicks; training data for identifying misinformation, in contrast, must typically be coded by human fact checkers. For other forms of bias, there are essentially no training cases because we lack hard measures of the broader social impact of most content.

Consistent with this prediction, most efforts to fight bias and misinformation to date have relied primarily on human judgment. While Facebook's efforts to fight misinformation certainly involve AI, most of the effective strategies have been things like downranking sites that consumers report trusting less, adding "article context" information with additional detail about sources, and filtering articles based on fact checking. These all involve far more human judgment than AI. Similarly, Google's adjustments to cases like Holocaust denial have relied to a significant degree on changing instructions to human raters rather than changing the objectives of AI algorithms.

We can hope that future developments in AI will make it more effective in aligning media content with social good. For the near future, however, most progress is likely to continue to come from human intelligence as curator, editor, and counterweight to the forces pulling more and more strongly toward satisfying short-run consumer demand.

AI and Capture

Probably the oldest, and possibly the most serious, concern is that media may be captured by third parties that shape or filter content to serve their own objectives. A leading case today is the massive censorship apparatus of the Chinese government. Other autocratic governments engage in similar activity on a smaller scale, and even democratic governments frequently

[6] Sullivan, Danny, 2016, "Google's top results for 'did the Holocaust happen' now expunged of denial sites," searchengineland.com (link).

intervene to try to suppress content they find objectionable. Governments not only try to affect what their own citizens see but what is seen abroad, as in the case of Russian interference in US and European elections. The advertising that fuels most digital markets is itself a form of third-party intervention.

How is AI likely to change the risk of media capture? Here, again, AI has the potential to both dramatically worsen the dangers and to be a key part of the solution.

On one hand, the Chinese government can use AI to more effectively screen objectionable content, monitor citizens to identify dissidents and impending protests, and target propaganda messages to maximize their effectiveness. Russian intelligence operatives can use AI to optimize their foreign influence campaigns, testing large volumes of content to determine what works best. Commercial advertisers can similarly use these tools to optimize and target content.

On the other hand, AI may also provide a robust defense against such manipulation. Consumers in autocratic countries can use AI to detect propaganda images and other content that has been manipulated from its original source. Better search technologies from international sources can help consumers evade domestic controls. Facebook and other social media companies can use AI to identify foreign interference in elections.

Again, the key question is to what extent the relevant objectives can be defined and measured at large scale. Identifying social media posts that mention sensitive topics such as Tibet or that comment critically on the government should be right in the sweet spot in this respect, given the ability of modern natural language processing tools to disambiguate meaning. Online surveillance to identify dissidents or impending protests is also well suited to AI, though in these cases the number of past examples that can be used for training is much smaller in scale. Optimizing for actual persuasive impact is a much harder task. While it is easy to observe the reach of propaganda or advertising, determining its effectiveness is much harder, particularly when the goal is to affect a long-run outcome like support for a regime rather than a short-run outcome like internet purchases.

Some of the most relevant research on this problem to date comes from work by Bei Qin, David Stromberg, and Yanhui Wu on the content of Chinese social media.[7] They show, on one hand, that Chinese social media is actually full of government criticism and discussion of sensitive topics, suggesting either that the regime prefers not to suppress these topics or that their technology does not yet allow them to do so comprehensively. (Which explanation is correct has important implications for the way we should expect censorship to evolve with better AI.)

[7] Qin, Bei, David Strömberg, and Yanhui Wu, 2017, "Why does China allow freer social media? Protests versus surveillance and propaganda," *Journal of Economic Perspectives*, 31(1).

At the same time, these authors show that machine learning applied to social media provides a potentially powerful surveillance tool, with even simple algorithms able to predict the occurrence of future protests or unrest with high fidelity.

Conclusion

There is no question that AI will have profound impacts on media markets. While automation of production may play some role, the unique properties of media goods mean the more important effects are likely to occur on the demand side. Here, there is great potential for social good, as AI can make it easier for consumers to navigate the bewildering mass of online content through search and personalized recommendations, and to identify cases where third parties are attempting to manipulate them. There is also cause for concern, as AI may tilt content more heavily toward consumer demand in domains where this is at odds with social good, and AI tools may be used to more effectively persuade and deceive.

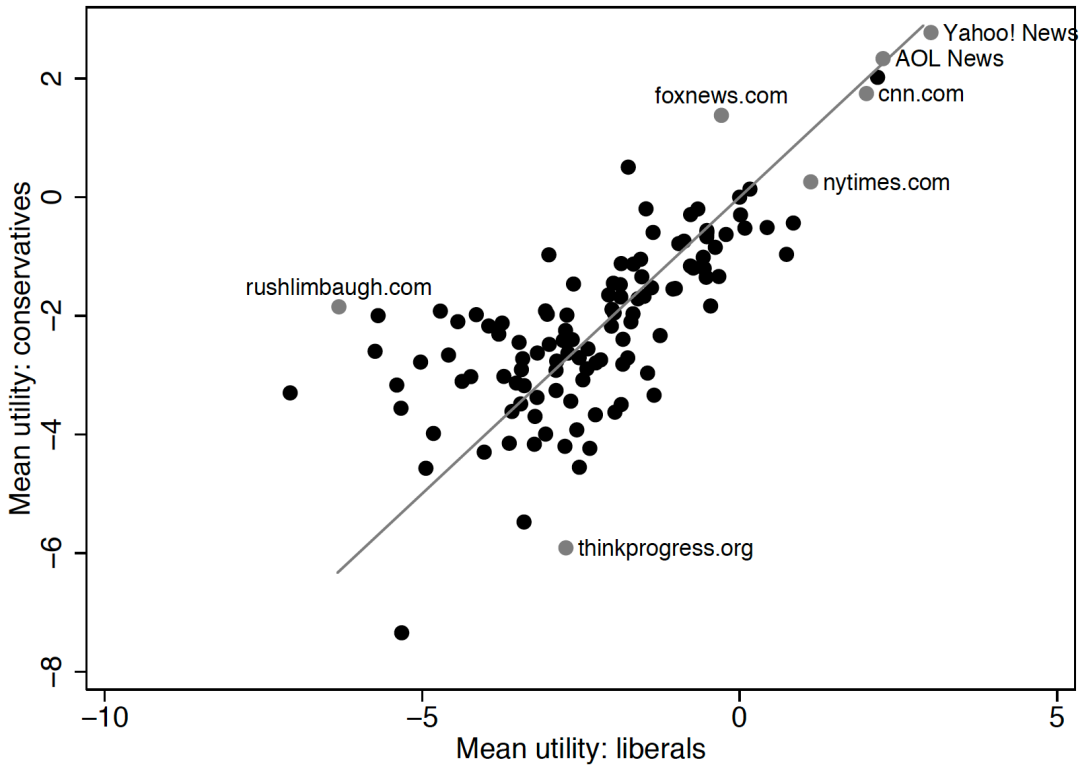

Figure 1: Average utility of news sites for conservatives and liberals

Source: Matthew Gentzkow and Jesse M. Shapiro, 2011, "Ideological segregation online and offline," *Quarterly Journal of Economics*, 126(4), Model Appendix.