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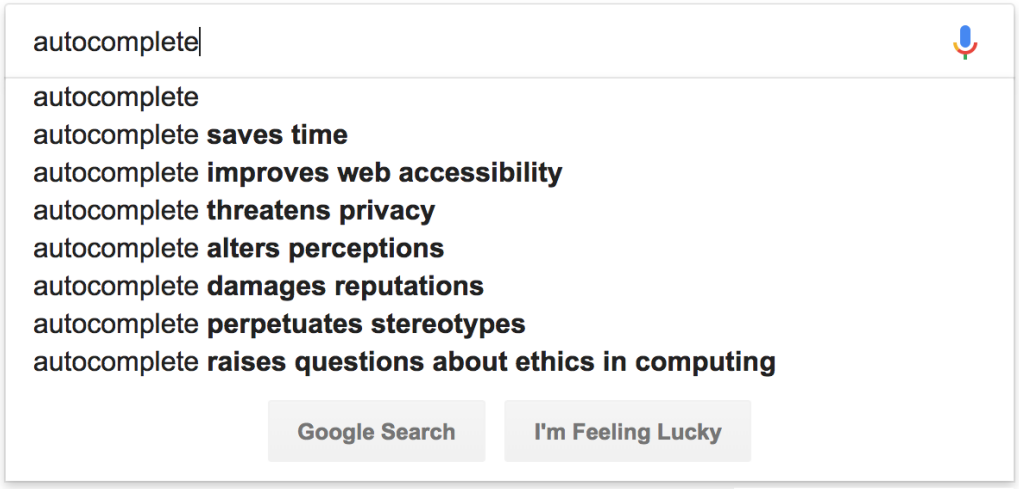
# Considering the Impact of Autocomplete on Users




"His first name is Richard and that's all I know," says Emma. "Here, let me help," says her friend, typing 'Richard' into Facebook's search bar. Richards populate the space beneath the search bar, and the girls select the first boy suggested. "That's him," Emma decides, only a matter of seconds since the challenge was proposed.

This is a case where an autocomplete feature helps saves time in finding the desired results. Nearly every implementation of autocomplete is useful, but it is important to understand that Google's autocomplete often impacts users in more ways than simply saving them time.

Autocomplete uses an algorithm to dynamically suggests words to complete the queries that users begin. The algorithm itself is not public, however some factors that often affect results are the search history of a user, popular searches, and location (Cache-22). The feature has saved users over 100 billion keystrokes, but there is more to this feature than simply its utility (Muñoz-Bates). Autocomplete impacts users in various ways ranging from benefiting those with disabilities, threatening privacy, altering their perception of search terms, defaming individuals, and amplifying stereotypes.

The purpose of this paper is to inform those who use Google of the ways autocomplete can influence users. Additionally, this paper will examine the costs of mitigating the detrimental effects by manually or algorithmically removing negative suggestions.

## IMPACT ON USERS

Even though providing search results is Google's primary function, the autocomplete feature has a significant and varying impact on its users. First, autocomplete can improve the accessibility of searching Google by aiding in query formulation. The feature is most helpful to users with dyslexia, but also can improve the searching experience of users with limited literacy or vision impairments. It is also important to understand how this feature affects the privacy of its users, since autocomplete stores significant information while searching. Third, the presented suggestions affect the way users view the search terms due to the psychological effects of presentation bias and the illusion of a choice. Additionally, autocomplete has the power to defame individuals if suggested terms implicate them in criminal or unsavory conduct. Lastly, autocomplete suggestions may perpetuate stereotypes by normalizing them in combination with providing validating search results. These impacts will be more carefully examined in this section.

## Accessibility

Autocomplete was originally intended to improve web accessibility by limiting the number of keystrokes necessary to form a query (Cache-22). The feature has since expanded to aid all users in query formulation, but the benefits of autocomplete for the disabled are still pertinent, especially for those with dyslexia. Searching can be challenging for dyslexics due to reduced rapid-naming and spelling abilities. Rapid-naming refers to connecting concepts to the appropriate terms for people, objects and ideas (Berget). Findings show that autocomplete reduces the effect of dyslexia by tolerating spelling errors and suggesting terms to make up for gaps in rapid-naming ability (Berget). Additionally, autocomplete searching is part of Microsoft's accessibility policy and included in Internet Explorer products (Carter). Autocomplete has also been found to improve the searching experience for low-literate and vision impaired individuals (Modesto, Beyene). However, autocomplete may not be for everyone and it is important to consider that accessible design is made difficult by diversity in the needs and preferences of users. One study found that some users with low vision found autocomplete suggestion helpful while others with the same impairment found the suggestions distracting (Beyene). Regardless, autocomplete is a useful tool that often improves the accessibility of query formulation for disabled users.

## Privacy

Anyone who types "why does my…" into Google can see that users are surprisingly willing to give sensitive information to the search engine. These often embarrassing suggested searches reveal a disconnect in the way we think about privacy, or at least a preference for different forms of privacy. Many take questions to Google that they may not feel comfortable sharing with even close friends or family (Wittes). Users who ask Google their unfiltered

thoughts may not understand the potential privacy risks. In one study, surveyed autocomplete users consistently reported no concerns about the search engine's access to private information (Rader). One reason users may not consider privacy concerns while using autocomplete is due to a misunderstanding about what information is sent to a server. When using autocomplete, each keystroke is recorded and sent to Google, even if no queries are ever submitted (Rader). This is necessary in order to support real-time suggestions as queries are typed (Rader). Additionally, after submission, searches are not discarded. Instead, they are stored and organized according to other factors such as time and location (Thissen-Roe). Information on what personal data is recorded with each keystroke is important for users to understand, especially as it is not represented on the search page. This lack of understanding may lead users to disclose more than they would have elected otherwise.

### Psychology

Autocomplete has a powerful impact on the searches users make and their opinions regarding said searches. One factor relevant to autocomplete is the illusion of a choice - where a set of options presented to users appears extensive but in reality is not (Neyman). Autocomplete suggests a varying number of the top searches as you begin typing your query, however some results are not displayed due to the blacklisting of pornography, violence, hate speech, and copyright infringement (Baker, Ghatnekar). In cases where top queries are blacklisted, the autocomplete suggestions appear comprehensive to the user when, in fact, the results have been edited. Another important consideration is the existence of presentation bias - where individuals are influenced to prefer the first of presented options (Pan). This has been demonstrated for Google search results. In one study, users were found to be more likely to select the first of presented search results (Bar−Ilan). In a different study on college students,

users deemed higher ranked search results more trustworthy or credible (Pan). These factors are insidious if users are lead to believe that the listed queries are credible and that they represent all queries regarding the search terms (Pan). These factors will become especially relevant to later discussion of autocomplete results for stereotypes.

## Defamation

Autocomplete often reveals funny questions about celebrities or other public figures. There's even a web series by WIRED called the "Autocomplete Interview", where celebrities finally answer the suggested questions for their name (WIRED Autocomplete Interviews). However, for some, the suggested queries pose a threat to their public image. When autocomplete associates an individual's name with criminal, shameful, or unsavory conduct, it has the power to cause permanent damage to their reputation (Cache-22). This was the case for Germany's former first lady, Bettina Wulff. Autocomplete suggested the words "escort" and the German word for prostitute when her name was entered (Gaylord). These suggestions were damaging to Wulff's reputation so she took Google to court. However, Google was not found liable due to the fact that the algorithm had generated the results based solely on the most frequent searches (Gaylord). The court ruled in a similar fashion for Milorad "Michael" Trkulja, who's results suggested he was a hit-man (Duke). In these cases, Google was not found legally accountable, despite the damage to these individuals' reputations. For some queries, Google has removed the defamatory results anyway, along with suggestions that fall under the categories pornography, violence, hate speech, and copyright infringement (Gaylord, Ghatnekar). Censoring results is controversial, but it may be necessary when the algorithm infringes on the rights of the individual (Karapapa).

## Stereotyping

Often users are willing to share prejudiced thoughts with Google that they would not be willing to express out loud. For this reason, autocomplete can often reveal racist, sexist, or homophobic stereotypes still held by many (Clayborn). When these stereotypes are so visible as top suggestions for Google searches it can normalize and reinforce those thoughts (Tewell). The stereotypes were so damaging that UN Women released a series of ads featuring autocomplete suggestions over the faces of women to for changing the dialogue about women (UN). Additionally, results for discriminatory queries tend to validate whatever opinion is entered, regardless of its authenticity (Muñoz-Bates). This can lead to a circular knowledge economy that only amplifies the message and perpetuates existing systems of inequality (Cadwalladr, Tewell). This phenomenon is known as a “filter bubble”, where a user is exposed to results that only confirm their beliefs, due to the fact that the algorithm is aiming to provide results that the user is looking to find. When a user is exposed only to information that supports their views, their prejudices are again validated and amplified (Baker). Furthermore, Google presents intolerant autocomplete suggestions against their plain white backdrop.  The simple design makes the suggested terms seem accurate and obvious, when the reality is far messier than the interface conveys (Tewell). The ability to flag autocomplete suggestions was recently added, which had been advocated for by many social scientists (Swearingen, Tewell, Baker). Google has since removed many stereotyping suggestions and social scientists hope that Google will continue to actively remove commonly flagged and prejudiced suggestions (Baker).


Two advertisements from the UN Women campaign featuring autocomplete suggestions.

## MITIGATING IMPACT

Investigating the effects of autocomplete on its users leads many to consider if more should be done to mitigate some of its negative effects. Two strategies to do this are to remove certain suggestions in a manual fashion and to algorithmically account for the biases exposed by the algorithm. The strategy of removing suggestions pertains most to cases of defamation while the algorithmic reduction of biases deals with suggestions that amplify stereotypes and prejudices. In both cases, implementing the strategy yields repercussions. To remove suggestions would amplify the illusion of a choice and lead to ethical questions about which suggestions are right to remove. Algorithmically reducing bias must deal with the fact that all

search engines are inherently biased and that doing so would come at a cost for the accuracy of the search results. These strategies will be examined more thoroughly in this section.

### Removing suggestions

Despite Google's claim that autocomplete results are generated entirely by an algorithm, many suggestions are already censored by the search engine. Removed results typically fall in the categories of pornography, violence, hate speech, and copyright infringement (Ghatnekar). Additionally, Google's removal of autocomplete suggestions varies from country to country. In China, autocomplete suggestions comply with the country's internet censorship and in Germany, results denying the Holocaust are removed (Ghatnekar, Gaylord). These differences among countries demonstrate that Google has the ability to police autocomplete results beyond their current standard, however their uninvolved policy is what protects them from lawsuits like that of Bettina Wulff (Ghatnekar, Gaylord).

Still many believe more should be done to remove harmful suggestions (Miller). However, doing so leads to concerns regarding the algorithm's neutrality and ethics. When autocomplete results are censored, it creates the potential for manipulation by the allegedly-neutral algorithm (Quinn). This is especially pertinent when considering again the idea of the illusion of a choice. If autocomplete results are further limited to exclude a degree of harmful information, then the queries presented will not accurately represent the top searches and will still appear comprehensive to the user (Neyman).

Further moral complications appear if we acknowledge that the harmful queries are suggested because they are the most requested results by users. If these suggestions are eliminated, then the search engine is deciding that it is in the best interest of the user that they not be pointed towards the queries in which they are most interested. Moreover, if autocomplete

results are being eliminated, how is the decision to censor a suggestion made? Where is the line between removing a result that is damaging and censoring results to obscure the reality from users? These ethical questions make any intention to protect individuals from harmful suggestions a more problematic decision (Baker).

### Algorithmically reducing biases

The biases exposed by autocomplete result from the algorithm's operation on a real world dataset. It reveals the stereotypes and opinions held by individuals frequently searching the suggested queries (Quinn). Prejudiced opinions suggested by autocomplete do not reflect a bias of the algorithm itself towards racist, sexist, or homophobic queries, instead all search engines are necessarily biased to produce optimal results. This is a phenomenon known as search engine bias, where each search engines is biased towards the assumptions inherent in its algorithm (Lewandowski). This does not mean that the algorithm is deliberately manipulative, rather that results are ordered by an algorithm that relies on assumptions about what makes a search result relevant or not (Lewandowski). Given this definition, there is no search engine that does not contain search engine bias (Lewandowski).

Nonetheless, if Google has an interest in providing "fair" autocomplete suggestions, that attempt to mitigate biases exposed by the algorithm, there are different complications to consider. To provide fair results, the algorithm would have to optimize results over both the fairness and relevancy of the suggestions. The dual optimization, however, would likely decrease the quality of queries generated. Recent work on fair algorithms has shown that there is a tradeoff between fairness and accuracy. Optimizing for fairness, in addition to relevancy, would mean minimizing the weight of variables that lead to optimal results and thus reducing the utility of the autocomplete feature (Osoba)

## CONCLUSION

Autocomplete affects its users in various ways beyond saving them time in query formulation. The feature has the power to improve accessibility, increase privacy risks, alter perception of search terms, defame individuals, and perpetuate stereotypes. These effects are important to consider, especially those that negatively impact users. Given these risks, some have called for changes to the autocomplete feature. Two strategies are to remove specific suggestions and to programmatically mitigate biased results. Both strategies come at cost. Removing suggestions can amplify the illusion of choice and lead to questions regarding which results would be considered damaging enough to censor. For the strategy of algorithmically removing bias, one must consider that all search engines are inherently biased and that doing so would reduce the accuracy of search suggestions.

After investigating this topic thoroughly, it is clear that considering how autocomplete affects users is a challenging undertaking. The programmer must make difficult decisions about the balance between accuracy and ethics in coding the algorithm. This challenge is not limited to the autocomplete algorithm alone. It is easy to extrapolate how similar decisions must be made when considering Google's PageRank algorithm for ordering its search results. Further, algorithms used to set bail amounts have been shown to be correlated with race. Removing the factors that tie in race, such as address, could help to make the algorithms less biased. However, if by removing those factors the algorithm becomes less accurate, the programmer is faced with a tough ethical decision.

Ethical considerations are significant when designing virtually any algorithm that deals with people. The influence of code often reaches beyond the intended functionality. Programmers must examine all possible outcomes, especially those that impact their users.

This investigation of autocomplete and its impacts has demonstrated that Google must carefully evaluate programming decisions with users in mind, as is the case with any algorithm or software that affects or is used by people.

Emma might not know it, but a lot more went into finding the Richard in her English class than a few keystrokes and a few seconds saved in the search bar.

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