

UCLA

Recent Work

Title

Voice Assistant Data, Behavioral Profiling, and Targeted Advertising in the 21st Century

Permalink

<https://escholarship.org/uc/item/0tv6r3ck>

Author

Bahri, Roan

Publication Date

2026-03-16

Voice Assistant Data, Behavioral Profiling, and Targeted Advertising in the 21st Century

Roan Bahri¹

¹Affiliation (Undergraduate in Samueli School of Engineering, University of California, Los Angeles)

*mirbahri@g.ucla.edu

Abstract: Voice assistants store and parse data. This study analyzes how technology companies handling voice data contributes to targeted advertising systems and examines social implications leveraging standpoint theory and criticisms of racial capitalism.

INTRODUCTION

Voice assistants, such as Amazon Alexa, Apple Siri, and Google Assistant, have integrated into everyday digital environments, especially given the new generative AI capabilities of the 21st century. These systems enable users to perform tasks such as searching for information, controlling smart home devices, and purchasing products using spoken commands. While convenient, this technology also operates as powerful data collection tools. Each interaction generates behavioral information that can be used to infer user preferences, routines, and also consumption habits.

Technology companies increasingly rely on behavioral data to support targeted advertising systems. These systems analyze user activity across devices, applications, and platforms in order to construct predictive models of consumer behavior. To be more precise, voice assistant interactions uniquely add an additional layer of data collection because they occur in private domestic spaces and can reveal detailed aspects of users' lives. As a result, voice enabled technologies raise new questions about surveillance, privacy, and power within digital ecosystems.

Understanding these technologies requires examining how knowledge and data are produced within broader social systems. Epistemology—the study of how knowledge is created—play a critical role here in evaluating technological systems. Scientific and technological knowledge is often treated as objective or neutral, yet social theory demonstrates that knowledge production is also shaped by institutional power structures and social context [4]. Recognizing this dynamic allows researchers to question the specific assumption that technological systems operate independently of cultural, political, or economic influences. This underpinning assumption is challenged in this paper.

Several theoretical frameworks from critical science and technology studies help illuminate these issues. [4] Feminist standpoint theory argues that knowledge is socially situated and that marginalized perspectives often reveal structural biases within institutions. Similarly, theories of racial capitalism emphasize importantly how economic systems extract value from social inequalities, including through technological infrastructures. These perspectives suggest that voice agents in their digital platforms and algorithmic systems of processing personal information may reproduce existing power hierarchies rather than functioning as simply neutral tools. The analysis explores the technical processes through which voice data becomes part of advertising infrastructures while also investigating the broader social implications of this practice. Pointing out that particular attention is given to how these technologies may disproportionately affect marginalized groups such as non-native English speakers, individuals with speech differences, and communities with limited influence over technological design is of the chief importance as well.

"This work is in partial fulfillment of the ENGR184 course using the blueprint curriculum in Ref [1,2] and captured in a collection [3]"

METHODS

This study employs a research into voice assistant technologies and their relationship to targeted advertising systems. Rather than conducting experimental measurement, the research examines the technological architecture, economic incentives, and social impacts associated with voice-enabled digital platforms.

First, the method begins with evaluating the technical processes involved in voice assistant operation. Voice assistants function through several stages of data processing. Devices continuously monitor for wake words like "Alexa" or "Hey

Siri". Once activated, the system records the spoken command and transmits it to cloud-based servers where speech recognition algorithms convert audio signals into structured textual data. Machine learning systems then interpret the meaning of the command and generate an appropriate response.

Second, the research examines how information extracted from voice interactions can contribute to behavioral profiling systems. Voice commands frequently contain explicit signals about user interests. Requests for product information, restaurant recommendations, transportation services, or entertainment content can indicate consumer preferences. Technology companies may integrate these signals with other forms of behavioral data such as search history, location data, browsing activity, and purchase history.

To evaluate potential bias in speech technologies used by voice assistants, the study draws on prior empirical research analyzing speech recognition performance across demographic groups.

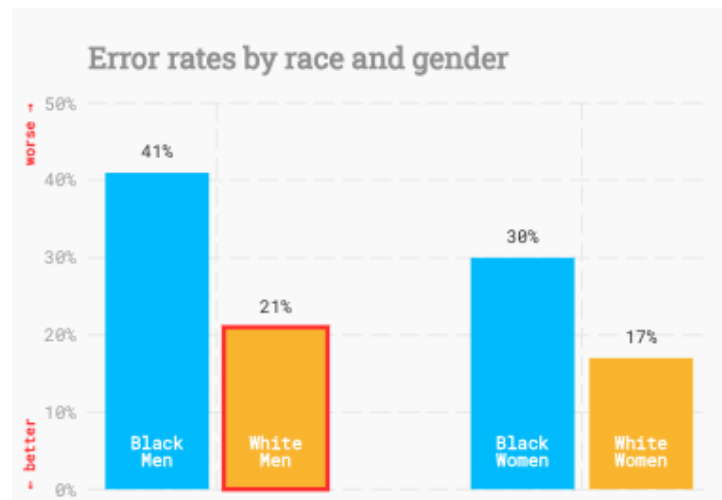


Fig 1.0. Linguistic Detection Error Rates Graph Based on Race and Gender

Word error rate disparities in commercial automatic speech recognition systems by demographic group. Speech recognition tools used in voice assistants produce higher transcription errors for Black speakers than for white speakers (Koencke et al., 2020) [1].

In addition, recent studies have also examined how language models and AI systems respond differently to dialect variation. These analyses demonstrate that linguistic patterns associated with African American English can influence how models evaluate meaning or generate predictions [3].

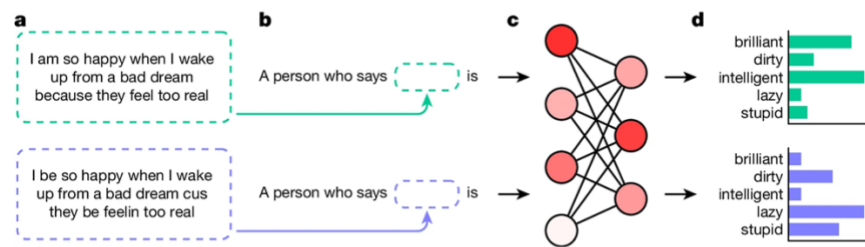


Figure 2.0. Illustration of Dialect Based Bias

When sentences are written in African American English, AI systems may generate more negative personality trait predictions compared to equivalent sentences written in standardized English [6].

Finally, the research applies theoretical frameworks including standpoint theory, racial capitalism, and critiques of the academic-industrial complex to interpret these technical and economic systems [3]. These frameworks help identify how power structures shape the design and operation of technological systems and how marginalized perspectives may reveal hidden biases within these infrastructures. Specifically, this study looks into people with linguistic patterns which deviate from average person purchasing an expensive product such as an iPhone or Amazon Alexa.

RESULTS AND INTERPRETATION

The analysis reveals several key dynamics connecting voice assistant technologies with systems of behavioral surveillance and targeted advertising.

First, voice assistant interactions generate detailed behavioral signals that reveal user interests, routines, and consumption patterns. Commands requesting product information, entertainment content, transportation services, or travel planning provide explicit indicators of consumer preferences. When aggregated over time and combined with other digital data sources, these signals allow technology companies to construct detailed behavioral profiles of individual users. These profiles enable targeted advertising systems to predict and influence consumer behavior. From a critical perspective, this process illustrates how everyday digital interactions become economically valuable forms of behavioral data within platform based economies.

Second, voice assistants operate within integrated technological ecosystems controlled by major technology companies such as Amazon, Apple, and [4]. These companies connect voice assistant devices with search engines, mobile operating systems, online marketplaces, and advertising networks. This infrastructure allow companies to combine both voice interaction data with other forms of behavioral data, significantly increasing the predictive power of advertising algorithms. As a result, voice assistant technologies function not only as tools of convenience but also as components of large-scale data infrastructures designed to extract behavioral information from users.

Third, research examining speech recognition technologies demonstrate that algorithmic systems may produce unequal outcomes across different demographic [1]. Studies of automatic speech recognition systems have shown important significant differences in transcription accuracy across dialects and accents, illustrating how technological systems can also reproduce broader social inequalities [6]. From a standpoint theory perspective, the experiences of marginalized users reveal limitations in technological design that may remain invisible to many developers working from dominant linguistic or cultural positions. These disparities highlight the importance of incorporating diverse perspectives into the development of AI technologies.

Finally, voice assistant technologies expand the scope of behavioral data collection into domestic environments. Because these systems operate inside homes, they blur the boundary between private spaces and commercial data extraction [2]. This shift reflects broader trends described as surveillance capitalism, in which everyday behaviors become sources of economic value for technology companies: As voice-enabled technologies become more widespread, questions about privacy, accountability, and power within digital infrastructures become increasingly significant.

CONCLUSIONS

Voice assistant technologies illustrate how contemporary digital systems combine technological innovation with large-scale behavioral data extraction. Although these systems are often marketed primarily as tools of convenience, they also function as components of complex data infrastructures that support targeted advertising and predictive consumer profiling.

This study highlights how voice interactions generate behavioral signals that technology companies can integrate with other forms of digital data in order to construct detailed consumer profiles. It's important to note that existing research demonstrate that speech recognition technologies may perform unevenly across different linguistic communities, potentially disadvantaging users whose dialects or speech patterns differ from those represented in training datasets.

From the perspective of critical science and technology studies, these findings challenge the core assumption that technological systems operate as neutral tools. Instead, the design and operation of voice assistant technologies are shaped by economic incentives, institutional power structures, and social inequalities. Recognizing these dynamics is very essential for developing more equitable and transparent technological systems.

Future research and policy efforts should focus on improving transparency in voice data collection, expanding the diversity of speech datasets used to train AI systems, and most importantly establishing stronger oversight mechanisms for algorithmic technologies deployed in commercial environments. Addressing these issues will be increasingly important as voice assistants and similar AI systems continue to expand their role in everyday digital life and improve in this new era of technology.

REFERENCES

1. Koenecke, A., Nam, A., Lake, E., et al. "Racial disparities in automated speech recognition." *PNAS* (2020). <https://www.pnas.org/doi/10.1073/pnas.1915768117>
2. Zuboff, S. *The Age of Surveillance Capitalism*. PublicAffairs (2019).
3. Binns, R. "Fairness in Machine Learning." ACM FAT Conference (2018).
4. Crawford, K. *Atlas of AI*. Yale University Press (2021).
5. Stanford Computational Policy Lab. "The Race Gap in Speech Recognition Technology." Stanford University. <https://fairspeech.stanford.edu/>
6. Lee, Tori. "AI is biased against speakers of African American English, study finds." *University of Chicago News*, Sept. 17, 2024. <https://news.uchicago.edu/story/ai-biased-against-speakers-african-american-english-study-finds>