TODO

- Fix reference so they all use the asciifoc footnote functionality
  - Have at least 10 references in reference section
  - Convert all mentions/links to footnotes
- Move image out of appendix into results and discussion, and describe with a short paragraph
- Remove static images table and replace with asciidoc. When you describe the table, you can describe how to read the table.
- Make sure all tables and figures have a title and description as a short paragraph.

Automatic Employment Decision Technology Analysis with Focus on Bias Against Those with Disabilities

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Abstract

In this paper, we analyze if a lack of accommodations and accessibility features in AI/ML in HCM/TA is causing screen-out harm to candidates with disabilities. We collected and explored data for 30 AI organizations that offer HCM/TA products. Specifically, we looked at the information they made public regarding their accommodations and accessibility features related to their AI products. We also collected and categorized further information on the size of each organization, the specific products being offered, if they conduct bias testing, and if the organization has accessibility staff. We found a majority of organizations in our study do not offer accommodations in their AI products and are not actively addressing candidates with disabilities in the public eye which can lead to screen-outs and can harm candidates with disabilities even before the involvement of human bias.

Introduction

In 2021, persons aged 16 to 64 with a disability had more than double the rate of employment for typically abled people at 10.8%[1]. Persons with disabilities are the largest minority group in the United States, but often have the least representation.This has been an ongoing issue that disability activists feel has been exacerbated with the rapid growth of some technologies. In general AI systems are marketed as being objective and helping to reduce or eliminate bias, however traditional bias testing often ignores those with disabilities and related issues around screen-out, when organizations even attempt to tackle these issues. Many organizations do not even opt to perform bias testing, as will be explored herein.

There are two main types of Algorithmic Decision-Making Tools used in the HCM/TA industry; “Resume/Profile Screening” and “AI Video Screening.” Resume Screening uses Natural Language Process(NLP) algorithms to search for keywords and grammar which are used to pick to rank candidates. Previous studies like "Amazon scraps secret AI recruiting tool that showed bias against women", have already found gender based biases in AI systems, which indicated that these systems do not perform as advertised and fail to be objective along some vectors of discrimination. For example, if a resume contains keywords like "Women’s Honors Society" the algorithm could rank a candidate lower. This tends to be the fault of poor training data for these algorithms, the lack of a diverse dataset can lead to screen outs and poor representation. Some algorithms use current employees’ resumes as training data, which may only create an algorithm that reflects that built-in hiring biases the algorithm was built to subvert. Though organizations have attempted to address and solve this issue by removing these stop words[2] before running the text through the algorithm, there is little data or discussions on whether NLP algorithms are negatively impacting candidates with disabilities. Profile screening often uses recommendation systems with simpler and more transparent parameters, based on https://www.pnas.org/doi/10.1073/pnas.1915006117 ?. AI Video screening uses Convolutional Neural Networks (CNN) which are network architectures for deep learning to find patterns in images to recognize objects, faces, and scenes. Because CNNs can automatically identify the key features without the need for manual feature extraction, there is a lack of explainability with these models. Emotion recognition systems are particularly worrisome when it comes to CNNs, which attempt to determine a person’s emotions from their body language and facial expressions. "Developments in the biometrics and emotion AI market are immature. They may not work yet, or indeed ever." - NIST. This is concerning and should be alarming for typically able individuals but can be more overtly detrimental for individuals with disabilities.

WARNING	99% of Fortune 500 organizations had AI tools somewhere within their hiring plans

The Americans with Disabilities Act (ADA) states that "Screen out because of a disability is unlawful if the individual who is screened out is able to perform the essential functions of the job, with a reasonable accommodation if one is legally required". Some examples are Gamification, AI video interview software, and Chatbots without providing accommodations. These AI technologies affect candidates with different disabilities in various ways. Some “gamified” tests maybe present an advantage for some neurodivergent candidates but not for others candidates with physical disabilities. AI video interview software can negatively impact both neurodivergent and physical disabilities candidates. For example, an algorithm may not recognize a candidate with a speech impairment, or for neurodivergent candidates face reading software may score them low for not showing socially acceptable facial expressions. The lack of employees with disabilities in the technology industry contribute to the proliferation of these technologies and an increase in screen-outs. In 2020, the percentage of persons with a disability making $75k or more a year was 40.01% less than those without a disability[3]. There is a significant gap of representation among higher paying careers and screen-outs caused by AI hiring technology creates a larger gap.

Methodology of Study

Code implementation

First we created a 30 organizations list of the top AI organizations offering HCM/TA products

including both well-know Fortune 500 organizations and small start ups. Then we assessed what type of HCM/TA product(s) does the organization offer such as video screening, resume/profile screening, and/or Chatbots. Furthermore we invested if the organization's website marketed their product as "Bias-Free" or or used similar language which is very concerning. We looked if there is public evidence of accessibility staff on the organization's website or LinkedIn and has accommodations directly for the AI/ML software displays on their website including timeframe on those given accommodations. Investigating the compression of the organization's addressment of different types of disabilities.

Data Dictionary

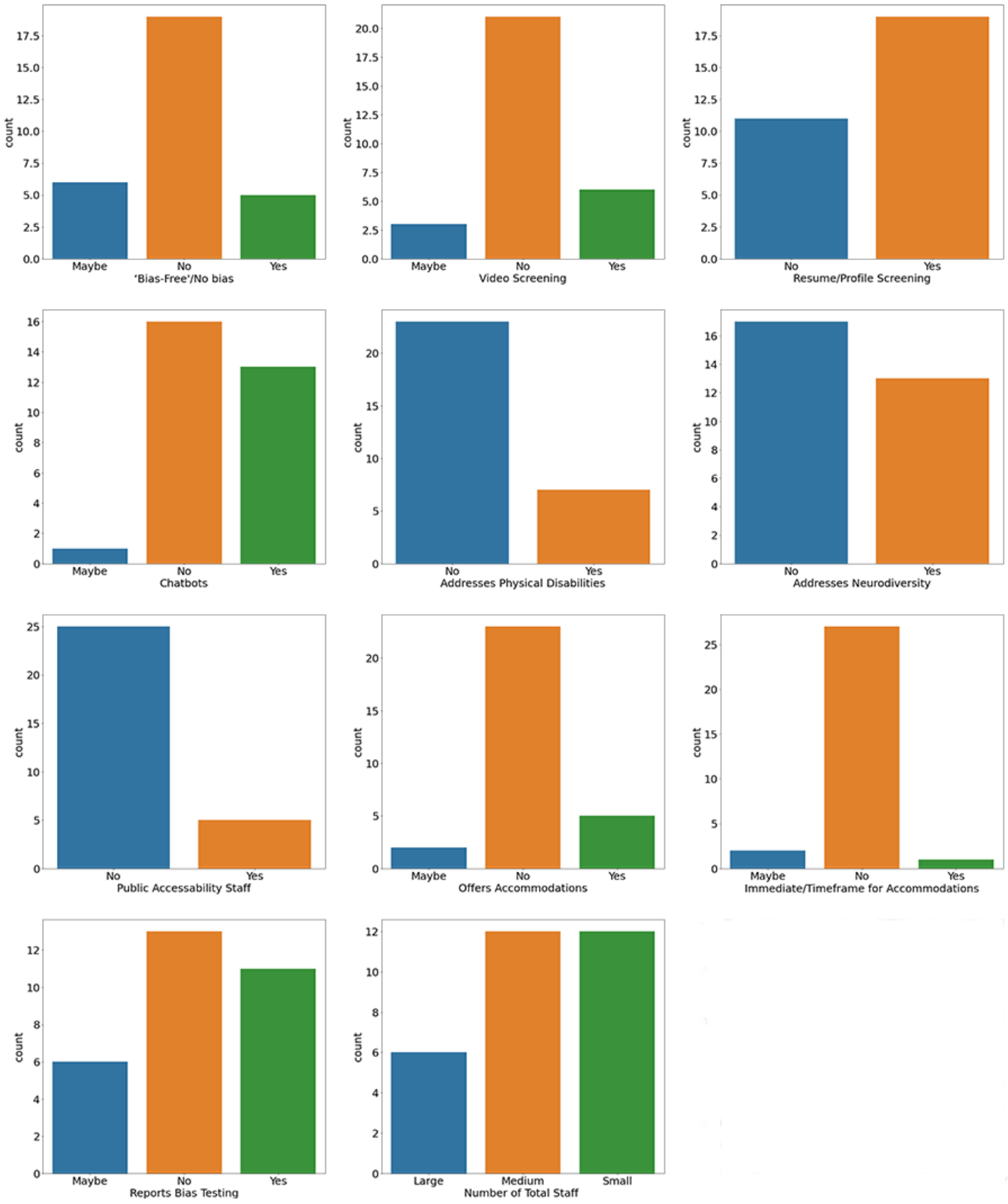
Features	Values	Description
"Bias-Free"/No bias	1 = yes, 0 = no, 2=maybe	If yes, organization's website displays the term "Bias-Free" or similar language, such as eliminates bias, in relation to organization's AI/ML technology or AI/ML technology in general.
Video Screening	1 = yes, 0 = no, 2=maybe	If yes, organization's website displays that organization integrates AI/ML screening algorithms in their TA/HR video software.
Resume/Profile Screening	1 = yes, 0 = no, 2=maybe	If yes, organization's website displays that organization integrates AI/ML screening algorithms on candidates resumes or profiles in their TA/HR software.
Chatbots	1 = yes, 0 = no, 2=maybe	If yes, organization's website displays that organization integrates Chatbots in their TA/HR software.
Addresses Physical Disabilities	1 = yes, 0 = no, 2=maybe	If yes, organization's website addresses ways to assist and/or the benefits of hiring candidates with physical disabilities.
Addresses Neurodiversity	1 = yes, 0 = no, 2=maybe	If yes, organization's website addresses ways to assist and/or the benefits of hiring neurodivergent candidates.
Public Accessibility Staff	1 = yes, 0 = no, 2=maybe	If yes, there is public evidence of accessibility staff on the organization's website or LinkedIn.
Offers Accommodations	1 = yes, 0 = no, 2=maybe	If yes, organization has accommodations directly for the AI/ML software
Immediate/Timeframe for Accommodations	1 = yes, 0 = no, 2=maybe	If yes, organization gives immediate or a timeframe for when accommodations would be to candidates for AI/ML software.

Features	Values	Description
Reports Bias Testing	1 = yes, 0 = no, 2=maybe	If yes, organization states on the its website the organization preforms a third Party audits or its own audits for bias in their AI/ML models. Note: this might not include bias testing for disability
Number of Total Staff	Small < 100, Medium < 1000, Large > 1001	Estimate total employee count on LinkedIn or other website

After data collection, we performed data exploration with categorical descriptive statistics, such as counts and frequencies, and decision tree. This gave us the ability to find trends and draw conclusions about our dataset and evaluate our hypothesis.

- Columns used as targets in the final model: ‘Offers Accommodations_Yes'
- Type of models: Decision Tree Model
- Software used to implement the model: Python on colab, ‘sklearn', 'numpy', 'pandas', 'time', 'matplotlib.pyplot', and 'matplotlib.lines'.
- Version of the modeling software:’python 3.7.15’,'numpy 1.18.5', and 'pandas 1.0.5
- Code implementation

Results and Discussion



- Layout major questions as bullets
    - Q1: How do smaller organizations compare to the whole sample?

	'Bias-Free'/No bias	Video Screening	Chatbots	Resume/Profile Screening	Addresses Physical Disabilities	Addresses Neurodiversity	Public Accessability Staff	Offers Accommodations	Reports Bias Testing
Yes	-8.34	5.00	-1.66	-5.0	-15.0	-18.33	-16.67	-16.67	-28.34
No	11.67	-3.33	5	5	15	18.33	16.67	23.33	31.67
Maybe	-3.33	-1.67	nan	nan	nan	nan	nan	nan	-3.33

- In the pivot table above we can see in our dataset small organizations which have lees than 100 employees vary on performance. For example, smaller organizations tended to market their products as "Bias-Free" less than larger organizations, at a rate of 11.67% less. However, smaller organizations performed worse on the majority of categories, including "offering accommodations," "having accessibility staff," "reporting bias testing." This makes sense on its face, smaller organizations with access to less resources would not prioritize these accommodations, however this does not excuse such behavior.

◦ Q2: Do organizations that don't offer accommodations perform poorly across other categories/features?

'Bias-Free'/No bias	Video Screening	Offers Accommodations	Count
Maybe	Maybe	Yes	1
	No	No	5
No	Maybe	No	2
	No	Maybe	2
		No	9
		Yes	3
	Yes	No	2
		Yes	1
Yes	No	No	2
	Yes	No	3

- This shows a surprising trend of the highest count performing better across other categories/features specifically not marketing their product as 'Bias-Free'/No bias and conducting AI Video Screening.

◦ Q3: Does a disparity exist between organizations mentioning neurodiversity on their website versus physical disabilities? / Does a organization addressing neurodiversity make them more likely to offer disability accommodations versus when a organization addresses physical disability?

Addresses Physical Disabilities	Addresses Neurodiversity	Offers Accommodations	Count
No	No	No	15
	Yes	Maybe	2
		No	2
		Yes	4
Yes	No	No	2
	Yes	No	4
		Yes	1

- As shown in table 3, we can clearly observe that half of our organizations in the sample do not address physical disabilities or neurodiversity and do not offer accommodations of any kind. However, we can also see that for the organizations that do offer accommodations, they only address neurodiversity. There is only one organization out of the sample that addresses both physical disabilities and neurodiversity. Another interesting observation is that four organizations that do not offer accommodations address both physical disabilities and neurodiversity.
  - Q4: If a organization reports bias testing is it more likely that they offer accommodations?

	Offers Accommodations
Yes	27.27%
No	54.55%
Maybe	18.18%

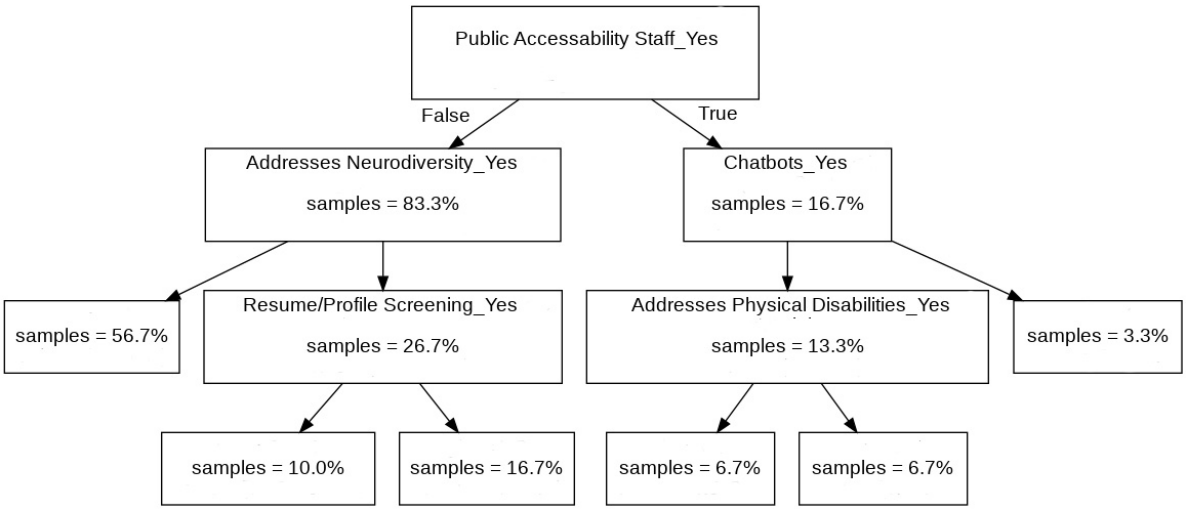
- In table 4 we see an interesting trend in organizations reporting bias testing and offering accommodations. Out of the organizations that do bias testing, the majority of those (54.55%) do not offer accommodations.
  - Q5: What percentage of organizations offer AI/ML video screening, without any accommodations?

	Offers Accommodations
Yes	16.67%
No	83.33%
Maybe	0%

- In table 5, organizations which offer AI/ML video screening 83.33% do not offer accommodations. This is particularly concerning because video screening is an AI technology that can severely impact candidates with disabilities. Relying so heavily on this one method can lead to screen outs.
  - Q6: What percentage of organizations that offer accommodations also offer them immediately or provide a timeframe? (leading to screen out)

	Immediate/Timeframe for Accommodations
Yes	40.00%
No	40.00%
Maybe	20.00%

- In table 6 we see that only 40% of organizations that offer accommodations offer these accommodations immediately or provide a timetable. Immediately providing accommodations or offering a timeframe can significantly reduce the chance of screen outs because the candidate is less likely to get passed by candidates that do not required accommodations.
  - Decision Tree



Conclusions and Recommendations

After our analysis, there is clear evidence that AI organizations who produce HCM/TA products have the capability to improve their accessibility features and shrink the gap of screen-outs for candidates with disabilities. It's important that organizations offer accessibility features and accommodations. However, issues go beyond accommodations. Only offering accommodations does not necessarily mean the risk of screen-out is significantly less. Specifically we recommend:

- Consideration of the timeframe of applicants receiving approval for accommodations. (Candidates need accommdations quickly.)
- Enabling information sharing could assist with accomodations. (By information sharing we mean the sharing of voluntarily given personal data between public entities or other organizations for a specific goal through the exchange, collection, use, or disclosure. Such information sharing may provide candidates with disabilities better opportunities to receive accomadations and do so in a timely manner, without having to request accomadations separately for each role.)
- Audits of AI/ML systems used in hiring for disparate treeatment, disparate impact, screenout and other types of discrimination, particularly for resume/profile screening and other systems that rely more on AI/ML processes, since accommodations are not as applicable in these circumstances.

- Avoiding false and misleading language such as “bias-free” when describing AI/ML systems used in hiring.
- organizations should collect demographically representative training data, sample and reweigh training data if necessary, and consider fairness metrics when selecting hyperparameters and cutoff threshold for employment decision making.
- organizations should also have opt-out options for selection methods based on AI/ML. (E.g., providing a live interview in place of algorithmic evaluation.)
- Inclusion of those who have disabilities in product design, implementation or testing. (This is especially important for organizations that do not have the resources for specific accessibility staff).
- Increased diversity in design teams. (This is important in producing a more inclusive and accurate products. Teams with employees who have disabilities have 72% more productivity and produce 30% higher profit margins.[4])
- organizations should apply external, independent standards to the design of AI/ML systems to mitigate bias, e.g., NIST’s Standard for Identifying and Managing Bias in Artificial Intelligence.

Over the course of this study we investigated if the lack of accommodation and accessibility features in AI/ML and HCM/TA is causing screen-out harm to candidates with disabilities. While AI/ML presents opportunities for reduced bias in HCM/TA applications, risk controls and mitigants, like those recommended here are required to deliver on that promise.

References

1. Issuing Authority This technical assistance document was issued upon approval of the Chair of the U.S. Equal Employment Opportunity Commission., and This technical assistance document was issued upon approval of the Chair of the U.S. Equal Employment Opportunity Commission. “The Americans with Disabilities Act and the Use of Software, Algorithms, and Artificial Intelligence to Assess Job Applicants and Employees.” US EEOC. Accessed November 28, 2022. https://www.eeoc.gov/laws/guidance/americans-disabilities-act-and-use-software-algorithms-and-artificial-intelligence.
2. Dastin, Jeffrey. "Amazon scraps secret AI recruiting tool that showed bias against women." In Ethics of Data and Analytics, pp. 296-299. Auerbach Publications, 2018.

Appendix

[1] https://www.bls.gov/news.release/disabl.a.htm

[2] Stop words are words that are filtered out of a stop list before or after natural language data processing because they are irrelevant.

[3] https://data.census.gov/table?q=Disability&tid=ACSST5Y2020.S1811

[4] https://www.accenture.com/_acnmedia/pdf-89/accenture-disability-inclusion-research-report.pdf