Detecting Bias in Plastic Surgery Residency Application Letters of Recommendation Using Natural Language Processing

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Background

Context: Recent shift to pass/fail grading in medical schools and USMLE Step 1 has led to increased reliance on subjective evaluation methods like Letters of Recommendation (LoRs).

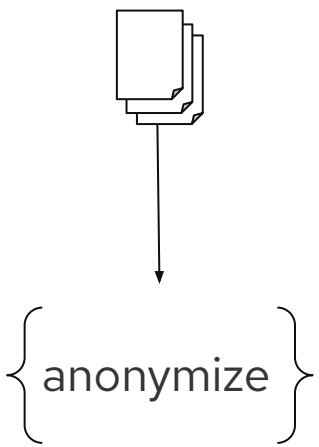
Problem: LoRs may contain implicit biases that affect how applicants are perceived.

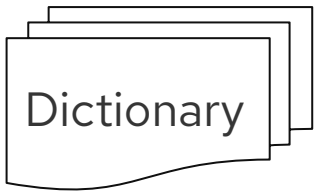
Opportunity: Advances in Natural Language Processing (NLP) allow systematic investigation of bias in written evaluations.

Research Objective

Our Goal: To identify linguistic patterns that indicate bias in LoRs for plastic surgery residency applicants based on gender and race/ethnicity.

Methods - Data





- **Dataset**: 5,679 plastic surgery residency applications (2017-2022) submitted via ERAS to a Midwestern academic medical center.
- **Data Processing**:
  - Anonymization using Part-of-Speech tagging and Named Entity Recognition.
- **Dictionary**
  - Custom 400-word dictionary designed to detect bias-sensitive descriptors.
  - Analysis via Linguistic Inquiry and Word Count (LIWC) software.

Methods – Analysis

- **Statistical Method**:
  - Applied two-way MANOVA to analyze linguistic differences in LoRs based on *gender and race/ethnicity*.
  - This method enables the simultaneous examination of multiple language patterns, identifying subtle but significant variations.
- **Dependent Variables**:
  - **Frequency of bias-relevant word categories** in LoRs.
  - Examined descriptors across categories such as *personality traits, technical skills, and leadership qualities*.

Results – Key Findings

- **Univariate Findings**:
  - Men of multiple races: More likely to be described with "Activity" words and "Inventive/Curious" traits.
  - Women of multiple races: More likely to be described as "Sensitive/Nervous" and "Solitary/Reserved."

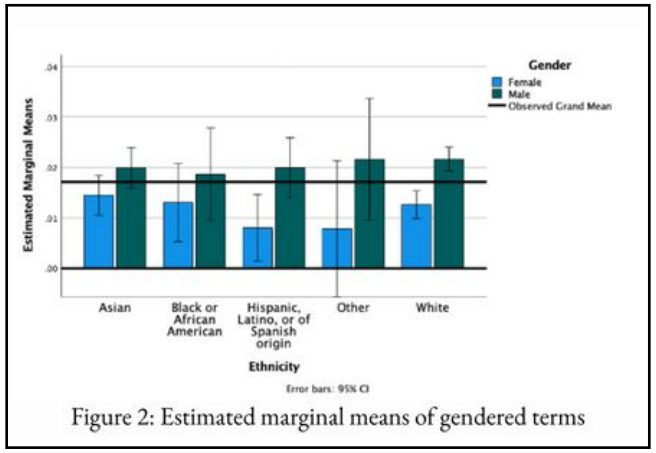
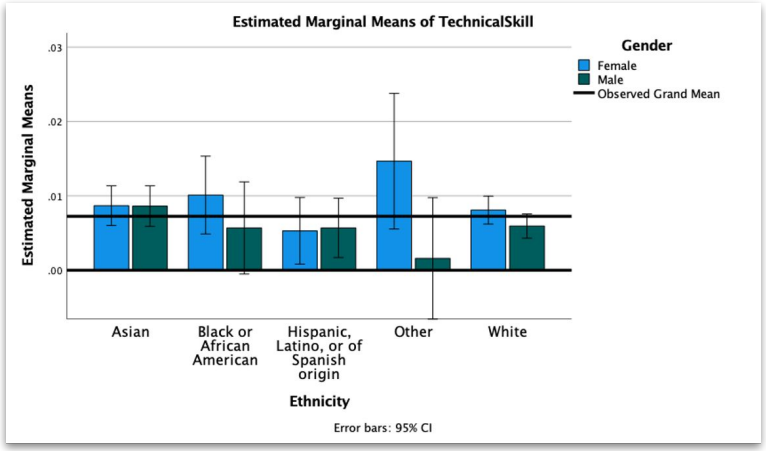
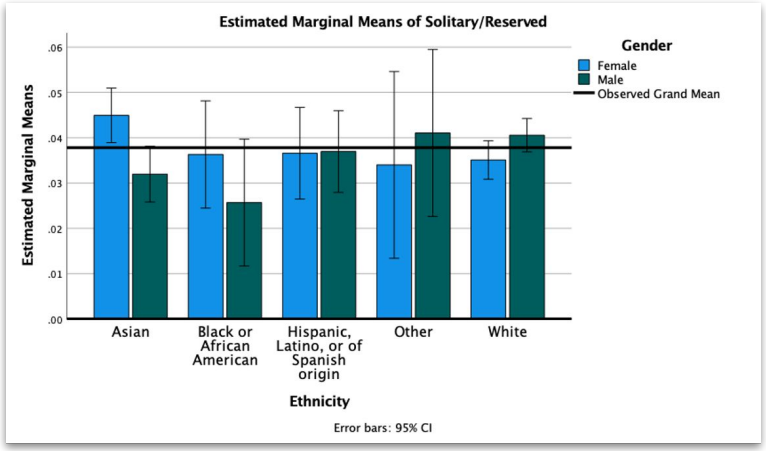


Figure 2: Estimated marginal means of gendered terms





Implications

- **Intersectionality matters**: Bias in LoRs is not just based on gender or race but their combination.
- **Impact on Residency Selection**: Bias in written recommendations can influence applicant evaluations and opportunities.
- **Future Research**:
  - Investigate how bias in LoRs affects applicant outcomes.
  - Develop automated bias detection tools to improve equity in residency selection.

Conclusion and Next Steps

- **Summary**: This study provides evidence of bias in LoRs and highlights the need for more equitable evaluation methods in residency selection.
- **Next Steps**:
  - Expand research to other medical specialties.
  - Collaborate with residency programs to develop fairer evaluation frameworks.
  - Advocate for bias-awareness training in LoR writing.

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