

Introduction

The personal statement (PS) and letters of recommendation (LORs) are essential components of the residency application process. However, their subjective nature may put them at risk for unconscious bias during their interpretation in the application process. This study evaluated general and linguistic differences in PSs and LORs between the applicant genders in a single otolaryngology residency program using deep learning techniques.

Methods

PSs and LORs for a subset of 2021-2022 and 2022-2023 applicants to a single otolaryngology residency program were reviewed. A natural language processing (NLP) package generated sentiment scores for each PS and LOR. A peer-reviewed tool, Empath, categorized words and phrases through a deep learning method of neural embedding over 1.8 billion words of modern fiction. Wilcoxon rank-sum compared between all groups.

Table 1. Characteristics of Otolaryngology residency LORs and PSs distributed by applicant gender

	Applicant gender	
	Male	Female
# LORs	46	10
# PSs	35	32
LOR word count average	429.9	451.4
PS word count average	625.7	625.6

Table 2. Comparing Empath scores for lexical categories relevant to Otolaryngology LORs and Wilcoxon rank-sum between male and female applicants

Category	Male applicants	Female applicants	P value
Achievement	0.0120	0.0119	0.694
Positive emotion	0.0068	0.0064	0.275
Negative emotion	0.0020	0.0024	0.052
Masculine	0.0021	0.0021	0.963
Feminine	0.0002	0.0005	0.008
Strength	0.0040	0.0043	0.402
Optimism	0.0081	0.0070	0.007
Work	0.0135	0.0130	0.301
Communication	0.0078	0.0077	0.625
Trust	0.0024	0.0030	0.011
Leader	0.0045	0.0047	0.597
Cheerfulness	0.0041	0.0035	0.019
Valuable	0.0015	0.0014	0.832
Help	0.0059	0.0060	0.864
Dominant personality	0.0010	0.0012	0.302

Results

Among the 617 LORs, 317 LORs were written for male applicants, and 300 LORs were written for female applicants. There was no significant difference in word count identified between LORs for male and female applicants to otolaryngology residency ($p=0.21$). On deep learning analysis using the Empath tool, LORs for female applicants had more feminine words ($p=0.01$) and words of trust ($p=0.01$). By contrast, male applicant LORs contained more words of optimism ($p=0.01$) and cheerfulness ($p=0.02$). For PSs, female applicants wrote statements with more positive emotions ($p=0.02$), while male applicants wrote more content about leadership ($p=0.03$).

Table 3. Comparing Empath scores for lexical categories relevant to Otolaryngology PSs and Wilcoxon rank-sum results between male and female applicants

Category	Male applicants	Female applicants	P value
Achievement	0.0064	0.0066	0.800
Positive emotion	0.0077	0.0107	0.017
Negative emotion	0.0047	0.0045	0.784
Masculine	0.0007	0.0009	0.512
Feminine	0.0004	0.0006	0.343
Strength	0.0033	0.0035	0.697
Optimism	0.0089	0.0099	0.349
Work	0.0069	0.0066	0.748
Communication	0.0040	0.0033	0.290
Trust	0.0039	0.0052	0.153
Leader	0.0029	0.0017	0.030
Cheerfulness	0.0015	0.0019	0.481
Valuable	0.0030	0.0022	0.160
Help	0.0077	0.0069	0.412
Dominant personality	0.0002	0.0005	0.131

Conclusions

Historically, otolaryngology has been a specialty primarily dominated by male practitioners. However, in this study, we found a noteworthy shift towards gender equality as the number of female applicants closely paralleled their male counterparts. This shift marks a significant trend in the field, underscoring the evolving landscape in the demographics of otolaryngology. Analysis of LORs provided insight into subtle yet distinct differences in how the genders were portrayed. In LORs, females were described with more words of trust, while males were described more optimistically and enthusiastically. Analysis of the PSs further illuminated the gender dynamics within otolaryngology applications. In PSs, male applicant discussed their leadership skills and experiences more often than female applicants. These disparities in self-presentation reflect the diverse strengths and unique qualities that individuals bring to the field, which help push and shape the field of otolaryngology.