



Education

Swipe right for surgical residency: Exploring the unconscious bias in resident selection



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ABSTRACT

Background: Applicants provide a photo with their application through the Electronic Residency Application Service, which may introduce appearance-based bias. We evaluated whether an unconscious appearance bias exists in surgical resident selection.

Methods: After the match, applicant data from the 2018 to 2019 and 2019 to 2020 application cycles were examined. Reviewers were not provided the applicant photo or self-identified race during the second cycle. Photos provided by candidates were then rated by 4 surgical subspecialty residents who had no prior exposure to applications or interview status. Photos were rated on perceived fitness level, visual appearance, and photo professionalism. An overall photo score was then calculated.

Results: In the study, 422 applications were reviewed and 164 received interview invitations during the 2018 to 2019 cycle. Alpha Omega Alpha membership (odds ratio, 2.31; 95% confidence interval, 1.18–4.51), overall photo score (odds ratio, 2.29, 95% confidence interval, 1.43–3.66), research (odds ratio, 5.61, 95% confidence interval, 2.84–11.20), age (odds ratio, 0.86, 95% confidence interval, 0.76–0.99), and step 2 (odds ratio, 1.06, 95% confidence interval, 1.03–1.09) were predictors for receiving an interview. For the 2019 to 2020 cycle, 398 applications were reviewed, and 75 applicants received an invitation. Step 2 (odds ratio, 1.07, 95% confidence interval, 1.02–1.12), research (odds ratio, 2.78, 95% confidence interval, 1.40–5.55), age (odds ratio, 0.82, 95% confidence interval, 0.71–0.95), and overall photo score (odds ratio, 2.27; 95% confidence interval, 1.14–4.52) remained predictors despite reviewers being blinded to the photo during this cycle.

Conclusion: Although objective metrics remain critical in determining interview invitations, overall perceived applicant appearance may influence the selection process. Although visual appearance was associated with receiving an interview, the Electronic Residency Application Service photo does not ultimately affect selection. This may suggest that appearance may influence other objective and subjective aspects of the application.

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Introduction

The residency application process demands a significant amount of time and effort from medical students in addition to the already rigorous curriculum and abundance of academic requirements. Although there is a lack of standardization in the interview selection process, objective measures for evaluating

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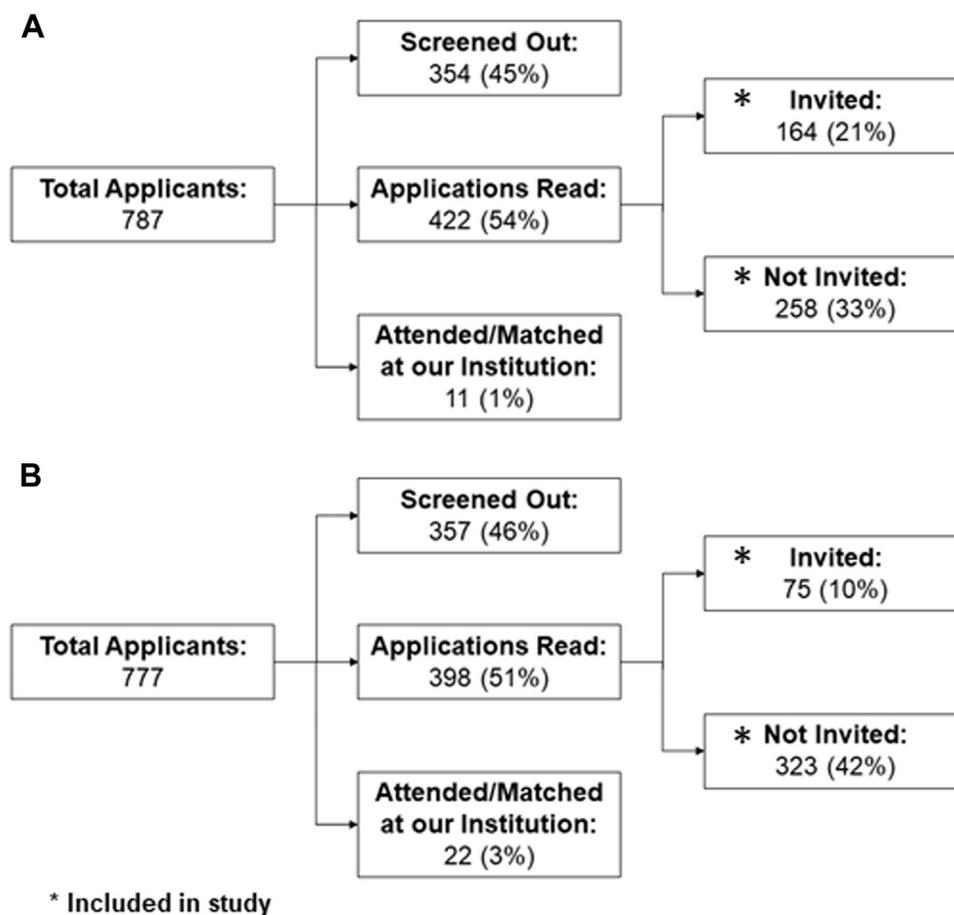


Fig 1. Inclusion criteria for analysis of the (A) 2018 to 2019 application cycle and the (B) 2019 to 2020 application cycle.

students, such as the United States Medical Licensing Examination (USMLE) scores, grades, and class rank, may be useful predictors of an applicant successfully matching into their desired specialty.^{1–5} In addition to this objective data, the Electronic Residency Application Service (ERAS) also allows applicants to include their race and sex, as well as recommends submission of a recent photo. These more subjective aspects of the application may bias selection committees when choosing which applicants to invite for interview.^{6–9}

Although racial and sex biases in the interview process have previously been explored,^{10–12} few studies have examined the impact of the photo accompanying the residency application, and none in general surgery. A recent multi-institutional study used mock residency applications and stock photos to study radiology resident selection and found that reviewers were less likely to invite an applicant they viewed as unattractive or obese.¹³ Even more surprising was that facial attractiveness was a stronger predictor than grades, rank, and Alpha Omega Alpha (AOA) membership. This finding was not unique to this study.¹⁴ Analysis of the dermatology residency selection process found that applicants who smiled, wore suit jackets, or wore glasses in their photo were more likely to match into the field.¹⁵ These findings highlight the need for further understanding of the impact of the photo and perception of applicant physical appearance on residency interview selection. The objective of our study was to determine the impact of visual appearance, assessed by the applicant provided ERAS photo, on the likelihood of receiving an interview invitation at a single general surgery residency program.

Methods

Study population

This study was performed at a single academic general surgery residency program for 2 years. Applications were initially screened based on achieving a USMLE step 1 score greater than the median minus 2 standard errors of the mean. Students who attended our institution's medical school or who ultimately matched into our residency program were excluded to limit bias (Fig 1).

Application process pre- versus postintervention

During the 2018 to 2019 application cycle, we conducted our application screening process similarly to previous years. All information provided by applicants in their ERAS application, including the photo, was reviewed for interview selection. Review of applications and interview selection were performed by a designated group of residents and faculty assigned to the application review committee. Each application was screened by at least 3 independent reviewers. The study was repeated for the 2019 to 2020 application cycle. However, during this cycle, photos and race were removed from the printed and filtered online applications. Reviewers were blinded to the photo and race but were able to utilize all other aspects of the ERAS application to screen applicants for an interview.

Photo scoring

ERAS photos were evaluated through a review process independent from the afore-mentioned application process. This occurred after the match for the 2018 to 2019 cycle and after the rank list was created for the 2019 to 2020 cycle. To eliminate any potential bias from this process, 4 independent raters scored each photo based on appearance and the same 4 raters acted as reviewers for both years. These photo raters were surgical subspecialty residents (vascular, thoracic, plastics, and urology) who were not enrolled in the general surgery residency program. The raters were blinded to the applications and interview status of each applicant. Photo raters consisted of both males and females from various racial backgrounds. These raters represented a diverse group of individuals to reflect the diversity of our interview selection committees. Each photo was scored using a Likert scale for visual appearance (1 being extremely unattractive and 5 being extremely attractive), perceived fitness (1 being morbidly obese and 5 being extremely fit), and professionalism (1 being appears extremely unprofessional and 5 being appears extremely professional). The scoring system was developed based on criteria deemed significant in prior studies involving nonsurgical specialties.^{13,15} These 3 scores were averaged to generate a composite photo score.

Interrater reliability

To assess interrater reliability, Kendall's coefficient of concordance for ordinal response was used. The Kendall coefficients (W) may vary between -1 and $+1$. A value of 0 represents no agreement, whereas a value of $+1$ represents perfect agreement.

Study variables and definitions

The primary outcome of interest was whether the applicant photo was a predictor of receiving an interview invitation. Additional predictor variables included age, sex, race, step 1 and step 2 scores, AOA membership, and research participation during medical school. Age was calculated based on the date of application submission. Race was determined by self-reported race on the ERAS application and defined as white, Asian, or underrepresented minority (URM) for applicants who identified as black, Hispanic, Native American, or other based on the definition from the Association of American Medical Colleges.¹⁶

Statistical analysis

Categorical variables are presented as a frequency and percentage of the population. Analysis was performed using logistic regression and a multivariate stepwise regression and presented as odds ratio with 95% confidence intervals. To avoid collinearity, only the composite photo score, not the individual component score, was utilized for multivariate analysis. All variables with a $P < .2$ on univariate analysis were included in the multivariate analysis. All analysis was completed with JMP Pro 14.0 (SAS Institute, Cary, NC). This study was approved by the University of Cincinnati Institutional Review Board (IRB #2019–0768).

Results

Application cycle: 2018 to 2019

For the intern class of 2019, 787 students applied to our program. After the initial screening based on step 1 score, 422 applications were considered for an interview (Fig 1A). 54% of applicants

Table 1
Applicant demographics

	2018–2019 cycle	2019–2020 cycle
	<i>n</i> (%) / median (IQR)	<i>n</i> (%) / median (IQR)
Applications Read	422	398
Sex		
Male	226 (53.6)	215 (54.0)
Female	196 (46.4)	183 (46.0)
Race		
White	241 (57.8)	243 (61.1)
Asian	124 (29.7)	90 (22.6)
URM	52 (12.3)	65 (16.3)
Age	27.0 (26.0–28.5)	26.9 (25.9–28.3)
Step 1	237.5 (231–246)	237 (230–246)
Step 2	251 (242–258)	249 (240–257)
AOA	88 (20.9)	68 (17.1)
Research	313 (74.2)	232 (58.3)

IQR, interquartile range.

were males while 58% were white (Table 1). Of these, 164 (38.9%) applicants received an invitation to interview.

Univariate analysis revealed that older applicants ($OR = 0.89$, $P = .01$) and those of Asian race ($OR = 0.56$, $P = .02$) were less likely to receive an interview invitation (Table II). Higher step 1 ($OR = 1.07$, $P < .01$) and step 2 ($OR = 1.09$, $P < .01$) scores were predictors of receiving an interview invitation, as were AOA status ($OR = 4.16$, $P < .01$) and research experience during medical school ($OR = 3.79$, $P < .01$). Additionally, applicants with higher perceived physical fitness ($OR = 1.81$, $P < .01$), visual appearance ($OR = 1.97$, $P < .01$), photo professionalism ($OR = 2.69$, $P < .01$), and composite photo scores ($OR = 2.63$, $P < .01$) were more likely to receive an interview invitation.

We next performed a multivariate analysis (Fig 2A). This demonstrated that older age ($OR = 0.86$, $P = .03$) was a significant negative predictor of receiving an invitation. Higher step 2 score ($OR = 1.06$, $P < .01$), AOA membership ($OR = 2.31$, $P = .01$), and research participation ($OR = 5.61$, $P < .01$) were positive predictors of receiving an invitation. The overall photo score was also a positive predictor ($OR = 2.29$, $P < .01$).

Application cycle: 2019 to 2020

After determining that appearance was associated with receiving an interview when the ERAS photo was part of the application, we implemented an intervention to control for our data. As noted in the Methods section, we repeated this study for the 2019 to 2020 application cycle; however, this time application reviewers were blinded to self-designated race and did not have access to the ERAS photo. For the intern class of 2020, 777 students applied for a position and 398 applications were read after the initial step 1 screen (Fig 1B). The overall demographics remained similar to the previous year and ultimately 75 (18.8%) invitations were extended (Table I).

Univariate analysis again revealed that older age ($OR = 0.82$, $P < .01$), Asian race ($OR = 0.43$, $P < .01$), and being an URM ($OR = 0.21$, $P < .01$) were all negative predictors for receiving an interview (Table III). Female sex ($OR = 2.59$, $P < .01$) was a positive predictor of receiving an invitation, as were higher step 1 ($OR = 1.07$, $P < .01$) and step 2 scores ($OR = 1.11$, $P < .01$), AOA status ($OR = 2.55$, $P = .01$), and research experience ($OR = 2.04$, $P = .01$). Applicant ERAS photos were reviewed by the same group of independent raters. Although application reviewers were blinded to the photos during the actual interview selection process, higher scores from the

Table II
2018 to 2019 cycle univariate predictors of receiving interview invitation

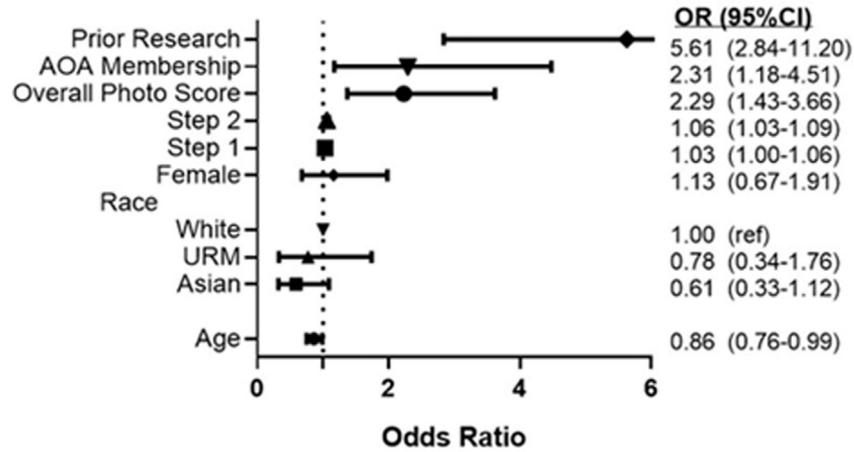
Predictors	OR	95% CI	P value
Age	.89	.91, .98	.01
Race			
White	1	ref.	
Asian	.56	.35, .88	0.02
URM	.61	.33, 1.15	0.13
Female	1.32	.89, 1.95	.17
Visual appearance Score	1.97	1.49, 2.59	<.01
Perceived fitness score	1.81	1.35, 2.44	<.01
Professionalism score	2.69	1.86, 3.90	<.01
Overall photo score	2.63	1.84, 3.76	<.01
Step 1	1.07	1.05, 1.09	<.01
Step 2	1.09	1.06, 1.12	<.01
AOA	4.16	2.53, 6.84	<.01
Research	3.79	2.22, 6.46	<.01

Table III
2019 to 2020 cycle univariate predictors of receiving interview invitation

Predictor	OR	95% CI	P value
Age	.82	.71, .95	<.01
Race			
White	1	ref.	
Asian	.43	.22, .87	<0.01
URM	.21	.07, .59	<0.01
Female	2.59	1.53, 4.37	<.01
Visual appearance Score	2.02	1.35, 3.02	<.01
Perceived fitness score	1.96	1.23, 3.12	<.01
Professionalism score	2.38	1.41, 4.01	<.01
Overall photo score	2.65	1.51, 4.65	<.01
Step 1	1.07	1.05, 1.10	<.01
Step 2	1.11	1.08, 1.15	<.01
AOA	2.55	1.24, 5.23	.01
Research	2.04	1.18, 3.55	.01

Predictors of Receiving an Interview Invitation

A 2018 to 2019 Cycle



B 2019 to 2020 Cycle

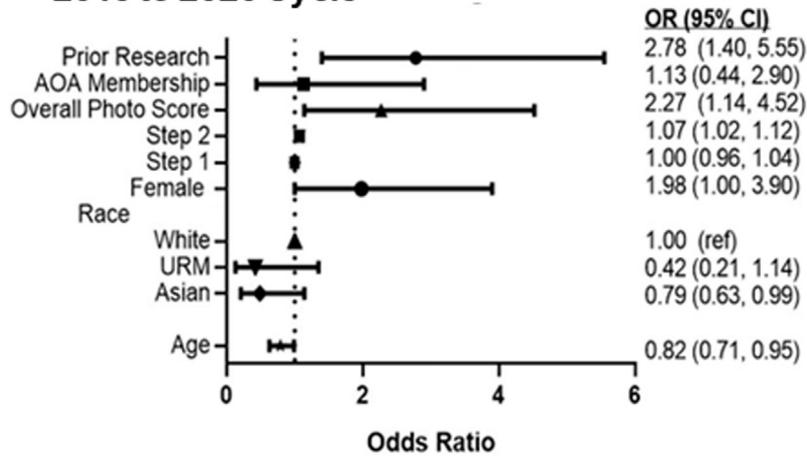


Fig 2. Multivariate analysis for the (A) 2018 to 2019 application cycle and the (B) 2019 to 2020 application cycle.

independent photo raters were associated with receiving an interview invitation (visual appearance OR= 2.02, perceived fitness OR = 1.96, professionalism OR = 2.38, $P < .01$ for all).

Multivariate analysis confirmed that older age (OR = 0.79, $P = .04$) remained a negative predictor, and step 2 score (OR = 1.07, $P < .01$), research participation (OR = 2.78, $P < .01$), and the overall

photo score (OR = 2.27, $P = .02$) were all positive predictors for receiving an interview invitation (Fig 2B).

Interrater reliability

Interrater reliability was then measured for the visual appearance, perceived fitness, and professionalism scores. Reliability was assessed both across raters in a given year and between the same rater for 2 years. Agreement was significant across all 3 categories with the highest level of agreement in perceived fitness level (Kendall's $W = 0.56$) followed by visual appearance ($W = 0.54$) and professionalism ($W = 0.41$; $P < .01$ for each).

Discussion

In this study, we investigated factors associated with receiving an interview for a categorical general surgery residency position. In doing so, we developed an appearance scoring system based on an applicant's photo to quantify appearance and determine its impact on interview selection. Our multivariate analysis demonstrated that overall appearance was associated with receiving an interview invitation, suggesting potential bias in the interview selection process. However, the association between applicant appearance and interview invitation remained significant even when reviewers were blinded to the ERAS photo. This suggests that the ERAS photo itself may not have a direct implication on resident interview selection but may be subjectively used as a component of the evaluation process as the challenge of choosing applicants to interview increases.

Although the impact of appearance has been explored in the field of business,¹⁷ few studies have assessed this in health care, and none in general surgery. Psychologists have previously associated attractiveness with a perception of trustworthiness, intelligence, professionalism, and productivity.¹⁷ However, attractiveness is generally gauged in-person, allowing an interviewer to see other facets of an applicant, including their personal and professional qualities. Residency applications and letters of recommendation attempt to highlight an applicant's personality and address professionalism, but the photo has been criticized for benefiting applicants viewed as attractive and creating a disadvantage for those perceived as unattractive or obese. In our study, appearance remained a positive predictor of receiving an interview despite the ERAS photo being excluded from the review process. This may suggest that applicants who are rated as attractive may have more positive letters of recommendations or received better grades. These perceptions of appearance have been studied in young and older adults and showed that the "halo effect" stereotype, or the positivity toward a person's attributes based on appearance rather than qualities, not only exists, but also is exacerbated when assessing a person in the same age demographic.¹⁸ This affects applicants, given that many interview selection committees include residents and programs should be aware of this bias.

Similar to previous studies, all 3 components of the photo score in this study were positive predictors of receiving an interview invitation. Although no studies have looked at appearance in the general surgery resident population, this has been explored in other fields of medicine. Maxfield et al evaluated more than 5,000 applications for radiology residency and found that after USMLE step 1 scores, applicant facial attractiveness was the next strongest predictor of a reviewer favorably rating the application.¹³ Similarly, we found that attractiveness was strongly associated with receiving an invitation to interview; however, this finding persisted after blinding the interview selection committee to the ERAS photo. This postintervention arm of our study may suggest that the photograph

is a surrogate for other subjective personal qualities, such as professionalism or work ethic, which may be ascertained from other aspects of the application, such as the personal statement, activities, or letters of recommendation. That is, although the photo may explicitly demonstrate one's appearance, appearance itself still manifests within the application even without a photo. This notion is also supported by univariate data from our study, which demonstrated that photo professionalism most significantly correlated with receiving a residency interview. With this possibility in mind, we looked at correlation coefficients and found that no association was present with step scores or research, but an association was present between AOA membership and both visual appearance and professionalism. This finding may also highlight the inequities in selecting candidates for these professional societies that prior studies have shown, and this may confound the association between appearance and receiving an interview.¹⁹

Beyond objective measures, removal of the applicant photo may shift predictors of receiving an interview invitation. In our study, after removal of the photo, URM and Asian applicants were less likely to receive an interview invitation and females were more likely to receive one. These may be due to reviewer unconscious biases, where race may be inferred by the applicant's name or membership in certain societies, and addressing these biases may help improve racial diversity when selecting applicants.²⁰ In our study, we removed self-identified race from the application, in addition to the photo, during the second cycle, which may have confounded our results. However, the findings from the present study may suggest that the applicant provided photo can enhance diversity, perhaps by drawing more obvious attention to race. Additional implicit bias testing before the start of the application season may raise self-awareness of these biases and help mitigate discrimination in applicant selection.²¹ Striving to create more equitable methods to evaluate students should be the highest priority as the evaluation criteria for selection continues to narrow.

Removing photos from the ERAS application has been proposed for the future based on prior studies.^{13–15} However, our findings suggest that this may not be necessary. Although individual bias toward a photo may offer some advantage, the multifactor application process and use of multiple reviewers, at least at our institution, likely offsets overvaluing a single item or individual bias. With the potential removal of the ERAS photo and the recent announcement that the USMLE step 1 exam will move to pass or fail,²² there will be fewer aspects of the application to help differentiate students. USMLE step 1 has previously been found to be predictive of academic success in residency and has been seen as a predictor of receiving an interview.^{3,4,13} Although our study did not find that step 1 was associated with receiving an interview, this is likely because our selection process screens out applicants with below-median scores on the examination. Despite this lack of step 1 association, we found a repeated association with step 2 scores and receiving an interview invitation. With the transition to a pass or fail step 1 examination, this may shift the importance of the step 2 score and it may become a stronger predictor of interview invitation.

Our study has limitations. First, this is a single institution study. Additionally, our program is a 7-year program where residents take 2 years for professional development and research. This may place an overemphasis on the research experience to receive an interview invitation. Second, letters of recommendation and personal statements were used by the interview selection committee to grant an interview but were not included in the analysis given the inability to create an objective scoring system. Next, we interviewed a lower number of applicants during the second year of the study due to the increased number of applicants applying from our own institution and applicants who completed an away rotation at

our institution. A larger number of applicants turned down interviews during the first cycle, as well, increasing the overall number of invitations extended. However, the demographics of the groups analyzed remained similar across both years. Our institution protocol is to download and review applications that meet the step 1 cutoff, limiting our ability to evaluate applicants who applied but did not meet the screening cutoff. Future studies should be aimed to include these applicants. Additionally, we created a scale to evaluate appearance, which has not previously been validated. However, the scale was created based on significant findings from previous studies in nonsurgical specialties. Next, applicants' names, professional society memberships, and extracurricular activities were not removed, which may have allowed for inference of race and influenced perception of physical fitness. Finally, the photo appearance score and attractiveness are subjective measures and vary considerably. However, we attempted to control for this by using 4 raters consisting of both males and females and from various racial backgrounds. Furthermore, we confirmed concordance using interrater reliability.

In conclusion, this study evaluated the impact of the ERAS photo on general surgery residency interview selection. We found that more favorable applicant appearance was associated with receiving an interview; however, this was independent of the student-provided ERAS photo. This may suggest that appearance may influence other objective and subjective aspects of the application. Future studies should be conducted on a multi-institutional level to determine whether these findings persist in other programs and specialties, as well as the impact of appearance on evaluations, recommendations, and societal membership.

Conflict of interest/Disclosure

No authors have any conflicts to disclose.

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