

## Research Article

# The Impact of Academic, Sociodemographic, and Program Growth Factors on Admission Offers to U.S. Graduate Education Programs in Communication Sciences and Disorders: National Trends in 2016–2020 Cycles

Christopher R. Watts,<sup>a</sup>  Anthony DiLollo,<sup>b</sup> and Yan Zhang<sup>a</sup><sup>a</sup>Harris College of Nursing & Health Sciences, Texas Christian University, Fort Worth <sup>b</sup>Davies School of Communication Sciences & Disorders, Texas Christian University, Fort Worth

## ARTICLE INFO

## Article History:

Received March 28, 2022

Revision received July 1, 2022

Accepted October 11, 2022

Editor-in-Chief: Erinn H. Finke

[https://doi.org/10.1044/2022\\_AJSLP-22-00094](https://doi.org/10.1044/2022_AJSLP-22-00094)

## ABSTRACT

**Purpose:** The purpose of this study was to investigate the impact of academic factors and sociodemographic factors on offers of admission to graduate education programs in communication sciences and disorders (speech-language pathology and audiology) in the United States.

**Method:** A retrospective analysis of extant data from undergraduate students applying to graduate education programs through the Communication Sciences and Disorders Centralized Application Service (CSDCAS) was conducted. Descriptive, parametric, nonparametric, and multivariate hierarchical logistic modeling analyses were applied to data from 38,625 unique applicants across four consecutive application cycles from 2016 to 2020 to assess relationships between admission offers, and academic and sociodemographic factors. The academic factors included Graduate Record Examination (GRE) and grade point average (GPA; cumulative undergraduate GPA and cumulative communication sciences and disorders [CSD] GPA), and sociodemographic factors included race/ethnicity, age, disadvantaged socioeconomic status, first-generation status, and multilingual status.

**Results:** The rate of receiving an offer of admission continuously increased from 59.4% in the 2016–2017 cycle to 75.4% in the 2019–2020 cycle ( $p < .001$ ). The significant predictors for admission offers across all four application cycles were GPA, GRE, and applicant age. While the odds ratios of GRE and age were relatively stable, the odds ratios of GPA had a decreasing trend. Bivariate analyses showed that students who were non-White, older, socioeconomically disadvantaged, first-generation, and nonmultilingual were significantly less likely to receive offers of admission than their counterparts, but the relationships between those sociodemographic factors, except for age, and admission offers diminished when all factors were considered in the logistic regression analyses.

**Conclusions:** Academic and sociodemographic factors significantly affected the likelihood of obtaining at least one offer of admission to a graduate program in CSD at different levels. While the effect sizes were variable, these findings provide evidence-based guidance for admission committees seeking to improve the inclusiveness of admission processes and the realization of greater diversity across multidimensional domains (e.g., race/ethnicity, socioeconomic status, age).

Correspondence to Christopher R. Watts: [c.watts@tcu.edu](mailto:c.watts@tcu.edu). **Disclosure:** The authors have declared that no competing financial or nonfinancial interests existed at the time of publication.

Independent practice as a speech-language pathologist or audiologist requires completion of a professional graduate program. As of May 2022, there were 309 accredited speech-language pathology (SLP) and 77 audiology (AuD) graduate education programs in the United States and associated territories (retrieved online on February 11, 2022, at <https://find.asha.org/>). Over the 4-year period of academic years (AYs) 2016/2017 through 2019/2020, admission capacity for graduate communication sciences and disorders (CSD) programs increased by 34%, representing 3,033 additional seats available for applicants (data based on median capacities across all accredited SLP and AuD programs; Council of Academic Programs in Communication Sciences and Disorders [CAPCSD] & American Speech-Language-Hearing Association [ASHA], 2022a, 2022b, 2022c, 2022d, 2022e). Over this same period, the number of undergraduate degrees conferred by CSD programs increased by less than 0.001%, representing a net of 28 additional students qualified to apply to graduate education programs (data from undergraduate degrees conferred based on 92.5% of all programs reporting; CAPCSD & ASHA, 2022e). These data suggest that opportunities for access to graduate education in CSD were substantially greater in 2019/2020 for the potential pool of applicants compared to the 2016/2017 admission cycle.

Greater opportunity for access to graduate education, based on gross numbers of seats available, would hopefully benefit students who traditionally experienced disparities in admissions to CSD programs. Data support this supposition to some degree. As an example, in AY 2015/2016, non-White students (i.e., those who identify as racial/ethnic minorities, or students of color) represented 23.57% of enrolment in undergraduate CSD programs, but only 16.56% of enrolment in graduate SLP programs and only 11.05% of enrolment in AuD programs (CAPCSD & ASHA, 2022a). By AY 2019/2020, non-White student representation in undergraduate education programs increased to 31.5% of enrolment while representation in graduate SLP and AuD programs increased to 23.3% and 18.6%, respectively. Thus, a proportional increase of non-White students in undergraduate CSD programs was accompanied by a proportional increase of non-White students in graduate CSD programs across this recent 4-year period.

Non-White student representation in undergraduate and graduate CSD programs remains disparate compared to racial/ethnic demographics of the United States, where, according to the 2020 U.S. Census data, non-White residents represent 42.2% of the population, although the percentage of the college-aged non-White population is even larger (Jensen et al., 2021). Non-White students are also disproportionately affected by academic factors considered in graduate CSD admissions when compared to White students. This phenomenon also occurs in other graduate

education health care disciplines such as dental school admissions (Curtis et al., 2007; Sedlacek, 2004). Kovacs (2022) recently found that while grade point average (GPA) and composite Graduate Record Examination (GRE) scores, previously referred to as cognitive factors (Baggs et al., 2015) or a type of academic factor (Curtis et al., 2007; M. B. Wilson et al., 2014), were significant predictors of admission to a single graduate SLP program, both metrics were lower for non-White students (thus presenting a barrier to admission) and the influence of GRE scores on admission was much greater for non-White compared to White students. Specifically, an increase in GRE scores elevated the chances of a White student getting an offer of admission to a much greater degree than the same increase in GRE score of a non-White student, with all other factors held constant.

One strategy for creating greater admissions success for non-White students is holistic admissions review (Guiberson & Vigil, 2021b, Wong et al., 2021). This has been defined as “a flexible, individualized way of assessing an applicant’s capabilities by which balanced consideration is given to experiences, attributes, and academic metrics and, when considered in combination, how the individual might contribute value as a student and future health professional” (Guiberson & Vigil, 2021a). Holistic admissions processes differ from traditional admissions by applying greater emphasis on the consideration of nonacademic factors (Curtis et al., 2007). A recent survey found that 60% of responding graduate education programs ( $n = 110$ ) utilized some level of holistic admission review, with 26% of those programs indicating a positive impact on admitted cohort diversity (Guiberson & Vigil, 2021b). In addition to biasing admission decisions, reliance on standardized admission factors such as GRE is associated with how comprehensively the curriculum of a program is inclusive and effective at achieving multicultural competencies associated with accreditation standards. Guiberson and Vigil (2021a) reported that programs utilizing a non-holistic “traditional” admissions process were not as successful in achieving student competencies in multicultural goals compared to programs with some degree of holistic admissions (59% vs. 90% of reporting programs, respectively). The reports of these authors suggest that admission practices influence cohort diversity, how multicultural competencies are embedded into the learning experience, and how well students obtain those competencies as they matriculate through a program.

Another strategy to create access for graduate education in SLP and AuD programs is to increase the seats available to applicants. This may be accomplished through accepting more applicants to a single program and/or the establishment of new programs. Both trends appear to be occurring. Across the 3-year admission cycle period of 2017–2020, the number of students accepted to

AuD programs increased by 7% (71.41% in the 2017–2018 cycle to 78.74% in the 2019–2020 cycle) with a corresponding increase in SLP programs by 12% (64.15%–75.21%). This increase in acceptance rates was associated with growth of four new AuD programs and 13 new SLP programs across the same 3-year period (CAPCSD, 2022; CAPCSD & ASHA, 2022e). Studies reporting outcomes of graduate education access for diverse students in these programs are lacking. One focus of this study was to analyze how recent growth in admission rates and graduate programs translated to the sociodemographic profiles of accepted students.

While a number of studies have investigated predictors of success once admitted to a graduate CSD program (see, e.g., Baggs et al., 2015; Boles, 2018; Forrest & Naremore, 1998; Halberstam & Redstone, 2005; Richardson et al., 2020; Ryan et al., 1998), the report of Kovacs (2022) is the only available peer-reviewed study investigating the impact of application components on resulting admission offers in graduate CSD programs. Recently, the centralized application system for graduate CSD programs (Communication Sciences and Disorders Centralized Application Service [CSDCAS]) has made available a comprehensive data set representing all CSDCAS applicants to SLP and AuD programs across four application cycles (AY 2016/2017 through AY 2019/2021). Access to these data presents an opportunity to investigate the impact of application components on graduate CSD admissions on a much larger and national representative data set than that of Kovacs (2022), whose data represented one graduate program at a single academic institution across three application cycles. Knowledge gained from a retrospective analysis of admission data is important, as Kovacs (2022) correctly identified, and knowledge gained from a national representative sample may elucidate universal trends that inform graduate program admission processes. Such information can help admission committees compare their consideration of admission components to national trends, can assess the value and weight of application components when deciding on offers of admission, and may also facilitate programs meeting goals of ASHA and their own institutions to elevate opportunities and inclusiveness for historically underrepresented groups (Fannin & Mandulak, 2021; Mandulak, 2022).

To address the existing knowledge gap, the purpose of this study was to investigate the impact of academic, sociodemographic, and program growth factors on offers of admission to graduate CSD programs. We were specifically interested in determining the influence of GPA and GRE scores as a function of race/ethnicity, economic status, multilingual status, first-generation college status, and the association of increasing seat availability due to program growth on the likelihood that an applicant would

receive at least one offer of admission to a graduate CSD program. Toward this aim, we addressed the following research questions: (a) Do sociodemographic and academic factors influence an applicant obtaining at least one offer of admission? (b) Do sociodemographic factors relate to scores from academic factors? (c) When considered together, which academic and sociodemographic factors best predict a student obtaining at least one offer of graduate admission and how are offers of admission associated with recent program growth and the availability of seats?

## Method

### Data Source

The design of this study was a retrospective analysis of extant graduate program application data provided by the CSDCAS Open Data Initiative (<https://www.capsd.org/csdcas-open-data-initiative/>), which aims to provide a mechanism for faculty and researchers at CAPCSD member institutions to conduct CSDCAS data-driven research. CSDCAS is a centralized online portal allowing students the opportunity to apply to graduate education programs in SLP or AuD. As of the AY 2021 application cycle, applications to 214 SLP programs and 54 AuD programs are available through CSDCAS, representing 71% and 68% of all programs, respectively. The most recent data (as of AY 2021) were provided to the investigators in one spreadsheet file after CSDCAS Data Subcommittee reviewed and approved the data usage application in January 2022. The data set provided de-identified individual applicant's information across four application cycles (AY 2016/2017, AY 2017/2018, AY 2018/2019, and AY 2019/2020) including admission outcome, academic, and sociodemographic variables. Individual applicants were separated into distinct rows (one row of data for each applicant) within the data set. To ensure transparency and anonymity, the CSDCAS data set provided the sociodemographic information in binned (e.g., age) or binary categories (e.g., disadvantage socioeconomic status [SES] = yes vs. no) instead of more expansive subcategories. The data set also combined applicants to SLP and AuD programs, such that applications could not be separated based on professional program type. As the secondary analysis of existing data does not fall within the regulatory definition of research involving human subjects, this study was classified as exempt via the university institutional review board policy.

Variables: Variables provided in the CSDCAS data set and used in the analysis are listed below.

- Admission outcome: binary, received at least one offer or received no offer.

- Academic factors:
  - Undergraduate GPA: cumulative 4-point scale GPA for all undergraduate courses
  - CSD GPA: cumulative 4-point scale GPA of undergraduate CSD courses only
  - Composite GRE: a Cronbach's alpha of .738 for GRE verbal, quantitative, and analytic percentiles were detected in the data, so we created a composite GRE score using the similar scoring method as of Kovacs's study (2022). A GRE composite score equal to an average percentile of verbal, quantitative, and analytic percentiles was used in the analysis.
  
- Sociodemographic factors (CSDCAS did not provide sex as a variable within the data set):
  - Age: three age groups: 17–22 years, 23–27 years, and 28–75 years
  - Disadvantaged SES: binary yes or no. "Yes" is defined by an affirmative response to any of the following: free or reduced-price school lunches, families receive public assistance, applicant holds GED or receives public assistant, and family income is economically disadvantaged.
  - Race/ethnicity: binary White or non-White. "White" is defined by a negative response to all non-White racial categories and all Hispanic ethnic categories.
  - First-generation status: binary yes or no. "Yes" indicates being the first generation of college in the family.
  - Multiple-language status: binary advanced (proficiency for at least one language in addition to the native language, e.g., multilingual) or not advanced.

## Statistical Analyses

Data were analyzed by SPSS (Version 27; IBM Corp.) in March 2022. Missing data were handled by pairwise deletion strategy unless otherwise stated. Sample characteristics including sociodemographic factors and academic scores (GRE and GPAs) were assessed using univariate analysis and included frequencies, percentage, means, and standard deviations for the four consecutive application cycles as a whole and by each cycle, respectively. A series of independent *t* and chi-square tests were used to assess the relationship between admission outcome (received at least one offer or no offer) versus each of the sociodemographic factors (age group, first-generation status, disadvantaged SES, race/ethnicity, multiple-language

status) and the academic scores (GRE and GPAs). Independent *t* and one-way analysis of variance tests were used to compare the differences of the academic scores (GRE and GPAs) among different sociodemographic factors. Robust Welch *t* or *f* tests were used when there were violations of assumptions of normality and homogeneity of variance. Effect sizes (Cramér's *V* for chi-square, Cohen's *d* for *t* test, and eta squared for *f* test) were calculated and interpreted using benchmarks outlined by Cohen (1988,1992).

A multivariate binary logistic analysis approach was employed to determine how academic and sociodemographic factors predict the binary outcome variable (i.e., whether or not a student obtaining at least one offer of graduate admission). Multicollinearity diagnostics revealed that the two GPA scores have collinearity; therefore, a composite GPA score was generated using the average of two GPA scores for the logistic regression. The logistic regression assumption of linearity of the continuous variables for the logit of the dependent variable was assessed via the Box–Tidwell procedure (Box & Tidwell, 1962). It has been recommended as a reasonable criterion to apply significance adjustment such as a Bonferroni correction based on all terms (including the intercept) in the model when assessing this linearity assumption (Tabachnick & Fidell, 2019). A Bonferroni correction was applied using all 10 terms (i.e., one intercept term, five categorical sociodemographic terms, two continuous academic terms, and two interaction terms of academic terms and their respective natural log-transformed variables) in the model resulting in a statistical significance level of .0001 (.001/10). Based on this assessment, all continuous independent variables (i.e., the academic factors) were found to be nonsignificant ( $p > .0001$ ) and therefore linearly related to the logit of the dependent variable, indicating the assumption of linearity was met.

Hierarchical forward stepwise binary logistic regression modeling was used to build the best-fit model to examine the main effects of the predictors in predicting obtaining at least one offer of admission versus obtaining no offer. The hierarchical blocks included academic factors being entered first and sociodemographic factors second for each application cycle and the whole sample. For the whole sample, the application cycle was entered as the last block to assess if the offer statuses differ in the application cycles. Within each block, individual predictors were entered using the stepwise forward selection method with entry testing based on the significance of the score statistic and removal testing based on the probability of the Wald statistic. The predictors were removed from the model when its Wald test was not significant ( $p < .05$ ). Adjusted odds ratios (*ORs*) were used to compare the odds of an applicant receiving at least one offer of admission versus obtaining no offer for each predictor. Due to multiple tests within one large sample, we chose to control



the Type I error probability by setting the level of significance (alpha) for all comparisons at .001.

## Results

### Descriptive Analysis of Sample Data

A total of 38,625 applications representing unique individuals within the four academic year cohorts were included in the data set. Of these, 9,213 applications were from the 2016–2017 cycle, 9,653 were from the 2017–2018 cycle, 9,928 were from the 2018–2019 cycle, and 9,831 were from the 2019–2020 cycle. In the 2016–2017 cycle, CSDCAS did not collect first-generation or disadvantaged SES information, so analyses related to those two variables were only performed for the remaining three cycles. Table 1 below depicts the sociodemographic and academic data for each application cycle. There was a statistically significant relationship between age and application cycles ( $\chi^2 = 28.28$ ,  $df = 6$ ,  $p < .001$ ). The older age group (28–75 years old) was the driving force of the significant relationship between age and application cycle in 2016–2017 (adjusted residuals =  $-3.8$ , indicating significantly less than

expected older applicants in this cycle, adjusted for sample size), whereas both the younger (17–22 years old) and older (28–75 years old) age groups contributed the significant relationship in 2018–2019 cycles (adjusted residuals =  $-3.4$  and  $3.5$ , respectively, indicating significantly less than expected younger applicants but more than expected older applicants in this cycle, adjusted for sample size). A small but statistically significant increasing trend was observed for the proportion of applicants representing disadvantaged SES, and non-White race/ethnicity in the two most recent cycles (2018–2019 and 2019–2020) compared to the previous cycle (2017–2018,  $p < .001$ ). The proportion of applicants being the first generation in college of the family or being multilingual were not found statistically significantly different in the application cycles ( $p > .001$ ). A statistically significant decreasing trend was observed for the composite GRE percentile, which decreased approximately two percentile points in each successive cycle (47.79, 45.61, 43.87, 41.35, respectively;  $p < .001$ ). However, both CSD GPA ( $\approx 3.62$ ) and undergraduate GPA ( $\approx 3.50$ ) remained relatively similar across all four cycles. The rate of receiving an offer of admission (number of applicants receiving at least one offer/the total number of applicants) continuously increased from 59.4% in the 2016–2017 cycle to 75.4% in the 2019–

**Table 1.** Sociodemographic and academic data across the four application cycles.

Sociodemographical factors	2016–2017	2017–2018	2018–2019	2019–2020	Whole sample	Effect size
	<i>N</i> = 9,213	<i>N</i> = 9,653	<i>N</i> = 9,928	<i>N</i> = 9,831	<i>N</i> = 38,625	Cramér's <i>V</i>
Age*		Valid <i>n</i> = 9,562			Valid <i>n</i> = 38,624	.019 <sup>a</sup>
17–22 years old	60.7%	60.4%	58.7%	60.6%	60.1%	
23–27 years old	28.8%	28.3%	28.8%	27.5%	28.3%	
28–75 years old	10.5%	11.3%	12.6%	11.9%	11.6%	
First generation						.019 <sup>b</sup>
No		84.0%	82.7%	82.4%	83.0%	
Yes		16.0%	17.3%	17.6%	17.0%	
Disadvantaged SES*						.047 <sup>b</sup>
No		78.6%	74.8%	73.9%	75.7%	
Yes		21.4%	25.2%	26.1%	24.3%	
Race/ethnicity*						.048 <sup>b</sup>
White	77.3%	75.6%	73.4%	71.7%	74.5%	
Non-White or Hispanic	22.7%	24.4%	26.6%	28.3%	25.5%	
Multilingual						.017 <sup>b</sup>
No	90.3%	90.1%	90.4%	89.1%	90.0%	
Yes	9.7%	9.9%	9.6%	10.9%	10.0%	
<b>Cognitive factors</b>	<b><i>M</i></b>	<b><i>M</i></b>	<b><i>M</i></b>	<b><i>M</i></b>	<b><i>M</i></b>	<b><math>\eta^2</math></b>
GRE composite*	47.79	45.61	43.87	41.35	44.33	.016 <sup>c</sup>
GPA CSD	3.63	3.63	3.62	3.62	3.62	.000
GPA undergraduate	3.50	3.50	3.49	3.50	3.50	.000
						<b>Cramér's <i>V</i></b>
Rate of receiving offer*	59.4%	64.1%	68.4%	75.4%	66.9%	.125 <sup>d</sup>

*Note.* SES = socioeconomic status; GRE = Graduate Record Examination; GPA = grade point average; CSD = communication sciences and disorders.

<sup>a</sup> $df = 6$ ; less than small (.04) effect size. <sup>b</sup> $df = 3$ ; less than small (.06) effect size. <sup>c</sup>Slightly greater than small (.01) effect size. <sup>d</sup> $df = 3$ ; between small (.06) and medium (.17) effect size.

\* $p < .001$  for individual factors using either chi-square or analysis of variance tests.

2020 cycle ( $p < .001$ ). This suggested that the likelihood of an applicant receiving an offer of admission was significantly greater over time.

### Research Question (A): Do Sociodemographic and Academic Factors Influence an Applicant Obtaining at Least One Offer of Admission?

Table 2 presents a detailed comparison of socio-demographic and academic factors stratified by those who received at least one offer and those who did not receive an offer. When comparing the sociodemographic and academic factors between the applicants who received at least one offer and those who did not receive any, all factors showed statistically significant differences ( $p < .001$ ). Compared to their counterparts who did not receive an offer, applicants who received at least one offer were disproportionately younger (17–22 years old: 67.2% vs. 45.6%, adjusted residual = 40.9), not first-generation (84.9% vs. 78.7%, adjusted residual = 13.1), in a nondisadvantaged SES category (77.6% vs. 71.5%, adjusted residual = 11.4), White (78.3% vs. 66.6%, adjusted residual = 24.8), and were not multilingual (90.6% vs. 88.5%, adjusted residual = 5.6). In another word, less than expected older (23–27 and 28–75 years old), first-generation, SES disadvantaged,

non-White, and multilingual applicants received an offer. However, the significance may simply be due to the large sample size of the chi-square, and it is noteworthy that the effect sizes of such discrepancies among the socio-demographic factors were either small (for first-generation, disadvantaged SES, race/ethnicity, multilingual) or close to medium (for age). As for the academic factors, compared to those who did not receive an offer, applicants who received at least one offer had statistically significant higher average composite GRE percentile (48.22 vs. 35.21), CSD GPA (3.73 vs. 3.40), and undergraduate GPA (3.61 vs. 3.28) scores ( $p < .001$ ), with all differences associated with large effect sizes.

### Research Question (B): Do Sociodemographic Factors Relate to Scores from Academic Factors?

Table 3 shows data for the academic scores (GRE and GPA) across the different sociodemographic factors. The results indicated that academic scores were significantly affected by each sociodemographic factor, although the effect sizes varied from small to large. The youngest applicants (17–22 years old) had significantly higher GRE composite scores ( $45.54 \pm 16.96$ ), CSD GPA ( $3.68 \pm$

**Table 2.** Comparison of social demographics and academic scores between those who received at least one offer and those who did not receive any offer.

Sociodemographical factors*	Received no offer		Received at least one offer		Effect size Cramér's V
	<i>n</i>	%	<i>n</i>	%	
Age					.209 <sup>a</sup>
17–22 years old	5,821	45.6%	17,386	67.2%	
23–27 years old	4,823	37.8%	6,121	23.7%	
28–75 years old	2,124	16.6%	2,349	9.1%	
First generation					.076 <sup>b</sup>
No	7,104	78.7%	17,317	84.9%	
Yes	1,920	21.3%	3,071	15.1%	
Disadvantaged SES					.066 <sup>b</sup>
No	6,448	71.5%	15,823	77.6%	
Yes	2,576	28.5%	4,565	22.4%	
Race/ethnicity					.126 <sup>b</sup>
White	8,505	66.6%	20,254	78.3%	
Non-White or Hispanic	4,263	33.4%	5,603	21.7%	
Multilingual					.028 <sup>b</sup>
No	11,333	88.8%	24,321	90.6%	
Yes	1,435	11.2%	2,436	9.4%	
Cognitive factors*	<i>n</i>	<i>M (SD)</i>	<i>n</i>	<i>M (SD)</i>	Cohen's <i>d</i>
Composite GRE	9,068	35.21 (16.36)	21,317	48.22 (17.19)	-.768 <sup>c</sup>
GPA CSD	11,792	3.40 (.40)	24,730	3.73 (.28)	-1.040 <sup>c</sup>
GPA undergraduate	12,590	3.28 (.36)	25,744	3.61 (.29)	-1.010 <sup>c</sup>

Note. SES = socioeconomic status; GRE = Graduate Record Examination; GPA = grade point average; CSD = communication sciences and disorders.

<sup>a</sup> $df = 2$ ; between small (.07) and medium (.21) effect size. <sup>b</sup> $df = 1$ ; around the small (.10) effect size. <sup>c</sup>Near or greater than large (.80) effect size.

\* $p < .001$  for all individual factors using either chi-square or *t* tests.

**Table 3.** Comparison of academic scores among sociodemographic statuses.

Sociodemographic factors	GRE composite	GPA CSD	GPA undergraduate
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Age*			
17–22 years old	45.45 (16.96)**	3.68 (0.32)***	3.61 (0.28)***
23–27 years old	41.71 (18.82)***	3.51 (0.39)***	3.34 (0.35)***
28–75 years old	44.45 (20.73)**	3.59 (0.41)***	3.26 (0.41)***
Effect size $\eta^2$ <sup>a</sup>	.008	.042	.171
First generation*			
No	44.65 (17.94)	3.63 (0.36)	3.52 (0.35)
Yes	37.78 (16.99)	3.56 (0.38)	3.40 (0.37)
Effect size $d$ <sup>b</sup>	.386	.194	.344
Disadvantaged SES*			
No	44.63 (17.86)	3.63 (0.35)	3.51 (0.35)
Yes	39.94 (17.85)	3.58 (0.38)	3.45 (0.37)
Effect size $d$ <sup>b</sup>	.263	.145	.193
Race/ethnicity*			
White	45.99 (17.37)	3.65 (0.34)	3.54 (0.33)
Non-White or Hispanic	39.23 (18.80)	3.53 (0.39)	3.36 (0.38)
Effect size $d$ <sup>b</sup>	.381	.348	.526
Multilingual*			
No	44.24 (17.64)	3.63 (0.35)	3.50 (0.35)
Yes	45.22 (20.70)	3.59 (0.38)	3.43 (0.38)
Effect size $d$ <sup>b</sup>	-.055	.106	.201

Note. GRE = Graduate Record Examination; GPA = grade point average; CSD = communication sciences and disorders; SES = socioeconomic status.

<sup>a</sup>Cohen's (1988) benchmarks: small ( $\eta^2 = .01$ ), medium ( $\eta^2 = .06$ ), and large ( $\eta^2 = .14$ ) effects. <sup>b</sup>Cohen's (1988) benchmark: small ( $d = 0.2$ ), medium ( $d = 0.5$ ), and large ( $d = 0.8$ ) effects.

\* $p < .001$  for all Welch or  $t$  tests. \*\* $p < .001$  for Bonferroni adjusted post hoc comparison with another age group. \*\*\* $p < .001$  for Bonferroni adjusted post hoc comparison with all other age groups.

0.32), and undergraduate GPA ( $3.61 \pm 0.28$ ) compared to their older counterparts. Specifically, post hoc tests with Bonferroni's adjustment showed that the 23- to 27-year-old age group had almost 3 points lower GRE composite scores than the 17- to 22-year-old (mean difference =  $-3.73$ ,  $p < .001$ ) and 28- to 75-year-old (mean difference =  $-2.74$ ,  $p < .001$ ) age groups, whereas the 28- to 75-year-old age group only scored about one unit lower than the 12- to 22-year-old age group (mean difference =  $-1.00$ ,  $p = .01$ ). As for the CSD GPA, the 17- to 22-year-old age group had higher scores than the 23- to 27-year-old (mean difference =  $0.16$ ,  $p < .001$ ) and 28- to 75-year-old (mean difference =  $0.09$ ,  $p < .001$ ) age groups, whereas the 23- to 27-year-old age group also scored lower than the 28- to 75-year-old age group (mean difference =  $-0.08$ ,  $p < .001$ ). In terms of undergraduate GPA, the 17- to 22-year-old age group had higher scores than the 23- to 27-year-old (mean difference =  $0.27$ ,  $p < .001$ ) and 28- to 75-year-old (mean difference =  $0.35$ ,  $p < .001$ ) age groups, whereas the 28- to 75-year-old age group also scored lower than the 23- to 27-year-old age group (mean difference =  $-0.08$ ,  $p < .001$ ). The effect size associated with age was large for undergraduate GPA but small for composite GRE and CSD GPA. Composite GRE scores and both GPA measures were significantly lower for applicants who identified as first-generation, disadvantaged SES, and

non-White, again with effect sizes ranging from small to medium. Applicants who identified as multilingual had significantly lower GPAs but higher GRE scores compared to their nonmultilingual counterparts. Effect sizes associated with language status findings were all in the small range.

### Research Question (C): Which Academic and Sociodemographic Factors Best Predict an Applicant Obtaining at Least One Offer of Graduate Admission?

Five multivariate logistic regression models were run for each application cycle and for the whole sample with data collapsed across the 4-year cycle, respectively. Table 4 shows the OR of the predictors remaining in each of the final models after nonsignificant factors were being removed (Wald test,  $p < .05$ ). In general, all final models demonstrated statistically significant improvement over the constant-only model and the previous model (model  $\chi^2$ ,  $p > .001$ ; Nagelkerke's pseudo- $R^2$  range:  $.27 \sim 0.34$ ). The nonsignificant Hosmer–Lemeshow test ( $p > .001$ ) provided further evidence of well-fitting models. Composite GRE, composite GPA (the average of CSD and undergraduate GPAs), and age were significant predictors for all five models. The retaining of the significant predictors

**Table 4.** Multivariate binary logistic regression models predicting offer status by application.

Variable	2016–2017			2017–2018			2018–2019			2019–2020			Whole sample		
	OR	99% CI <sup>a</sup>		OR	99% CI		OR	99% CI		OR	99% CI		OR	99% CI	
		L	U		L	U		L	U		L	U		L	U
Composite GRE*	<b>1.04</b>	1.03	1.04	<b>1.04</b>	1.03	1.04	<b>1.03</b>	1.03	1.04	<b>1.03</b>	1.03	1.04	<b>1.03</b>	1.03	1.04
Composite GPA* <sup>b</sup>	<b>38.72</b>	26.8	55.94	<b>26.27</b>	19.42	35.54	<b>18.4</b>	14.0	24.17	<b>9.37</b>	7.21	12.18	<b>16.01</b>	13.65	18.78
Age* (17–22 years old = reference)															
23–27 years old	<b>0.79</b>	0.65	0.97	<b>0.83</b>	0.69	0.99	<b>0.82</b>	0.69	0.97	<b>0.68</b>	0.57	0.81	<b>0.77</b>	0.7	0.85
28–75 years old	<b>0.65</b>	0.48	0.89	<b>0.61</b>	0.47	0.79	<b>0.53</b>	0.41	0.68	<b>0.57</b>	0.45	0.73	<b>0.57</b>	0.5	0.66
Race/ethnicity <sup>c</sup> (White = reference)															
Non-White	0.83	0.67	1.03												
Disadvantaged SES (no = reference)										0.85	0.72	1.01			
Yes															
Application cycle <sup>c</sup> (2017–2018 = reference)															
2018–2019													<b>1.51</b>	1.35	1.67
2019–2020													<b>2.65</b>	2.37	2.96
<b>Constant</b>															
Final model parameters															
$R^2$ (Nagelkerke)	0.39			0.38			0.34			0.27			0.34		
Model $\chi^2$	1,830.59, $df = 5$ , $p < .001$			2,223.94, $df = 4$ , $p < .001$			2,191.99, $df = 4$ , $p < .001$			1,567.32, $df = 5$ , $p < .001$			6,202.97, $df = 6$ , $p < .001$		
Hosmer–Lemeshow $\chi^2$	13.89, $df = 8$ , $p = .085$			9.68, $df = 8$ , $p = .29$			7.11, $df = 8$ , $p = .53$			19.58, $df = 8$ , $p = .01$			16.29, $df = 8$ , $p = .038$		

*Note.* Only significant predictors at  $p < .01$ , highlighted in bold, for the model are included. OR = odds ratio; GRE = Graduate Record Examination; GPA = grade point average; SES = socioeconomic status.

<sup>a</sup>L = lower end of 99% CI; U = upper end of 99% CI. <sup>b</sup>Composite GPA is the average of CSD and undergraduate GPAs. As composite GPA is a 4-point scale, and the differences between GPAs are often less than 1, interpreting the OR in the unit of 0.1 point instead of 1 point is more sensible. <sup>c</sup>Race/ethnicity was only included in the 2016–2017 application cycle with  $p = .024$ . Adding first generation and disadvantaged SES did not improve the models and, therefore, were not included.

\*Both academic predictors and age group were significant at  $p < .001$  for all models.



is corresponding to the results reported above for Research Questions 1 and 2: Only those factors showing medium or large effect size association with offering status remained significant in the logistic regression models after controlling for other variables. For the whole sample, the *OR* of composite GRE and composite GPA in terms of offer status were 1.03, 99% CI [1.03, 1.04], and 16.01, 99% CI [13.65, 18.78], respectively. This can be interpreted as for every GRE percentile increase in the whole sample, the odds of receiving any offer increased by 1.03. As composite GPA is a 4-point scale, and the differences between GPAs are often less than 1, interpreting the *OR* in the unit of 0.1 point instead of 1 point is more sensible. For every 0.1 point undergraduate GPA increase, the odds of receiving any offer increased by 1.6 in the whole sample. Interestingly, while the *ORs* of GRE remained stable (1.03 ~ 1.04) in all four cycles, the *ORs* of composite GPA demonstrated substantial decreases from 3.87 in 2016–2017, to 2.63 in 2017–2018, to 1.84 in 2018–2019 to 0.94 in 2019–2020. Applicants in older age groups had lower odds of receiving any offer compared to the youngest counterparts across all five models. The application cycle is also a predictor of receiving an offer. Applicants in a later cycle had higher odds of receiving an offer compared to those who were in early application cycles. Other sociodemographic factors such as first-generation, disadvantaged SES, race/ethnicity, or being multilingual were not found to be significant predictors in any of the five models.

## Discussion

The purpose of this study was to investigate the effect of academic and sociodemographic factors on offers of admission to graduate CSD programs. Our findings confirmed and extended the findings from the only other peer-reviewed study investigating the impact of application components on resulting admission offers in graduate CSD programs (Kovacs, 2022). We utilized a large data set (38,625 unique applications) representing four consecutive application cycles to answer three research questions. For context, across the four application cycles, the total number of unique applicants increased by just over 600 individuals (9,213 applicants in the 2016–2017 cycle and 9,831 in the 2019–2020 cycle). Over this same period, the total number of programs participating in CSDCAS from which the data set was generated increased by 55 programs (159 total programs in 2016–2017 representing 126 SLP and 33 AuD; 214 total programs in 2019–2020 representing 167 SLP and 47 AuD). Based on mean capacities for SLP and AuD programs from the 2016–2017 and 2019–2020 CSD Education Surveys (CAPCSD & ASHA, 2022b, 2022e), there was an increase of 2,845 admission slots in CSDCAS programs available between 2016–2017

and 2019–2020. Thus, across the application cycles studied, the growth in graduate program capacity far outpaced the growth in undergraduate applications to SLP and AuD programs. Our finding that applicants in a later cycle had higher odds of receiving an offer compared to those who were in earlier application cycles corresponds with such capacity change.

The first question asked whether sociodemographic factors (age, first-generation status, disadvantaged SES, race/ethnicity, and multilingual status) and academic factors (composite GRE, CSD GPA, and undergraduate GPA) influenced offers of admission. When assessing the question in a simple bivariate way, our results demonstrated that every sociodemographic and academic factor had an effect on whether or not an applicant was offered admission to at least one program. Specifically, for sociodemographic factors, the applicants were more likely to obtain an offer of admission if they were younger (17–22 years old), not a first-generation student, not in the disadvantaged SES category, White, and not multilingual. However, this result needs to be interpreted with caution due to the large sample size. For academic variables, applicants were more likely to obtain an offer of admission if they had larger composite GRE scores and larger GPAs (both CSD and undergraduate).

The findings of this study are consistent with those from research in both COSD and other health care graduate education fields (Curtis et al., 2007; Kovacs, 2022; Sedlacek, 2004). More specifically, results corroborated that students who are non-White, older, socioeconomically disadvantaged, first-generation, and nonmultilingual were significantly less likely to receive at least one offer of admission than their counterparts. This may suggest that admission committees in many graduate education programs place substantial weight on admission factors biased against certain sociodemographic groups (M. B. Wilson et al., 2014; Wong et al., 2021). A number of authors have pointed to the adoption of holistic admission processes as a means of balancing equity in the admissions process (Guiberson & Vigil, 2021b; M. A. Wilson et al., 2019). This admissions approach assigns greater weight to nonacademic factors, addressing the reality of a disparate impact of academic factors on graduate admissions of non-White students supported by prior research (Curtis et al., 2007; Sedlacek, 2004). The process and transition from traditional to holistic admission practices in graduate COSD education programs has been recently reported in tutorial form by Wong et al. (2021), with specific considerations for programs considering the adoption of this strategy.

When considering the findings above, one must also consider the context of effect size associated with each difference. As shown in Table 2, both measures of GPA manifested large effect sizes, as did GRE scores. This

contrasted with sociodemographic variables, which had significant effects on admission but only the age factor had a medium effect size, the remaining effect sizes varying within the small range. Collectively this suggests that the largest practical impact on offers of admission for the applicants in the data set were provided by GPA and GRE. This is an important finding, as Kovacs (2022) has reported a disparate impact of GRE on admissions for overrepresented populations compared to underrepresented populations, and has suggested that programs may want to consider whether they use a single cutoff GRE score for different groups of applicants.

The second research question asked whether sociodemographic factors influenced academic factor scores. Findings revealed that all three academic factors were significantly affected by every sociodemographic factor. In general, GRE and both of the GPA scores were higher when applicants were younger (17–22 years old), not a first-generation student, not in the disadvantaged SES category, and were White. Interestingly, while multilingual speakers manifested significantly lower GPA scores than nonmultilingual speakers, the GRE scores of multilingual speakers were higher. It should also be emphasized that effect sizes in this analysis also varied between small and medium, as noted in Table 3.

The last research question looked at, when assessed together, which academic and sociodemographic factors best predicted an applicant obtaining at least one offer of graduate admission. We applied modeling to the separate admission cycles (four different models) and an omnibus model incorporating the entire data set (one additional model). Modeling revealed that GRE scores, composite GPA, and age were significant predictors for all five models, whereas the small effect of first-generation status, disadvantaged SES, race/ethnicity, and multilingual status were mostly eliminated while all sociodemographic factors and academic factors were considered in the same model. The odds of obtaining an offer of admission were greater with each percentile increase of GRE scores and with the younger age group. The strongest predictor of admission offers was composite GPA, with an *OR* of 1.6 in the omnibus model. However, the *OR* trend of composite GPA across the four admission cycles was not uniform (unlike GRE scores, which remained stable). At each subsequent admission cycle, the odds of obtaining an offer of admission given a higher composite GPA actually decreased, from an *OR* of 3.87 in the 2016–2017 cycle to 0.94 in the 2019–2020 cycle. This decline was expected given the ratio of total admission slots to applicants, which increased substantially across the four application cycles (e.g., admission slots grew by thousands, while applicants grew by only hundreds). This can be understood as the odds of students with lower GPAs obtaining at least one offer of admission was much greater in the 2019–2020 cycle

compared to the 2016–2017 cycle. Even with this decline, however, as of the 2019–2020 admission cycle, students with a GPA of 0.1 points higher (e.g., 3.6 vs. 3.5) increased their odds of getting at least one offer of admission by 10× (10 times more likely).

When considering GRE scores, the *ORs* reported in this study were stable across application cycles but small (cumulative *OR* = 1.03). However, the scale we utilized to calculate *ORs* was based on 1% changes. If one considers larger separations in GRE percentile scores between any two students, the reality is that across the four application cycles, students scoring 10 percentiles higher were also 10× more likely to receive at least one offer of admission. This may provide insight into programmatic decisions regarding the use of GRE scores within the admission process, as there are ongoing concerns regarding biases in standardized testing. As an example, M. A. Wilson et al. (2019) reported that triaging applications based on GRE scores influenced underrepresentation of admitted students to a graduate program in categories of race and sex (non-White students and female students were penalized to a greater extent). However, it is also important to consider that recent reports have emphasized that eliminating requirements for GRE scores as a unitary approach to realize program diversity is likely ineffective for enrolments in allied health programs, while a multitiered holistic review process may be more successful (Cahn, 2015; M. A. Wilson et al., 2019).

Although the effect sizes associated with sociodemographic factors were small to medium, admission committees should consider that race/ethnicity, socioeconomic status, first-generation status, and age significantly influenced the likelihood that a student would receive at least one offer of admission. Of these factors, the greatest impact was age of the applicant, with older applicants less likely to receive offers of admission compared to younger applicants. Reasons for this disadvantage in CSD admissions need further exploration, as it is not clear if older age at admission is a risk factor for successful matriculation through a graduate CSD program. As admission committees continue to pursue greater representation from underrepresented groups within their graduate cohorts, these findings may inform how application portfolio reviews are considered.

## Study Limitations

This study was limited by the factors available in the CSDCAS data set. Most substantial was that we had no way of separating SLP program applicants from AuD program applicants. Whether study findings hold true for both types of professional programs will be a task for future research, if such data are made available. Due to this, generalizations taken from the findings of this study

should be guarded. Another substantial limitation was the lack of sex as an included factor, which restricted our ability to assess gender difference in our analysis. We also did not have access to applicant undergraduate institution, grades in specific CSD courses, or international student status. As such, the impact of these and many other factors on offers of admission to graduate CSD programs remains less clear.

## Conclusions

This study has found that both academic and socio-demographic factors significantly affected the likelihood of obtaining at least one offer of admission to a graduate program in CSD. Students who are non-White, older, socioeconomically disadvantaged, first-generation, and nonmultilingual were significantly less likely to receive at least one offer of admission than their counterparts. These findings support the supposition that traditional admission practices reliant on strong weighting of academic factors may be biased against some sociodemographic groups. The greatest predictors of admission offers were undergraduate GPA, GRE scores, and applicant age. While the effect sizes across all factors were variable ranging from low to high, the findings may be informative for admission committees when developing applicant review processes. As previous research suggests that unitary approaches to admission factors (i.e., changing criteria for GRE scores without altering criteria for other factors that can influence admission) are less impactful for achieving diversity of enrolled cohorts, this study provides evidence to inform admission practices for programs and institutions seeking to improve the inclusiveness of admission processes and the realization of greater diversity across multidimensional domains (e.g., race/ethnicity, socioeconomic status, age).

## Data Availability Statement

All data utilized in this study are available via request through the CSDCAS Open Data Initiative (<https://www.capcsd.org/csdcas-open-data-initiative/>).

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