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Research Article

Author Impact Metrics in Communication Sciences and Disorder Research

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Purpose: The purpose was to examine author-level impact metrics for faculty in the communication sciences and disorder research field across a variety of databases.
Method: Author-level impact metrics were collected for faculty from 257 accredited universities in the United States and Canada. Three databases (i.e., Google Scholar, ResearchGate, and Scopus) were utilized.
Results: Faculty expertise was in audiology (24.4%; n = 490) and speech-language pathology (75.6%; n = 1,520). Women comprised 68.1% of faculty, and men comprised 31.9% of faculty. The percentage of faculty in the field of communication sciences and disorders identified in each database was 10.5% (n = 212), 44.0% (n = 885), and 84.4% (n = 1,696) for Google Scholar, ResearchGate, and Scopus, respectively. In general, author-level impact metrics were positively skewed. Metric values increased significantly with increasing academic rank ($p < .05$), were greater for men versus women ($p < .05$), and were greater for those in audiology versus speech-language pathology ($p < .05$). There were statistically significant positive correlations between all author-level metrics ($p < .01$).
Conclusions: These author-level metrics may serve as a benchmark for scholarly production of those in the field of communication sciences and disorders and may assist with professional identity management, tenure and promotion review, grant applications, and employment.

Determining research impact is important for numerous reasons, including professional identity management, tenure review, promotion review, grant application, and employment. The impact of scholarly research can be examined on several levels. Journal-level metrics demonstrate a rank of a particular journal within its particular discipline, and they are used as an indirect means to evaluate the potential impact of particular articles. Primary journal-level metrics include the impact factor, Scimago journal rank, and source normalized impact per paper. Additional journal-level metrics are available; for example, Eigenfactor scores, Article Influence metrics, and Google Scholar Citation metrics.

Instead of showcasing only the journal-level metric, researchers may additionally examine article-level metrics (e.g., Altmetric or Plum Analytics) to examine article use information. These alternative metrics, or altmetrics, may include indices on how one's scholarly products are viewed/downloaded, any social media attention (e.g., Twitter, Google+, or Facebook), news coverage, dialogues on scholarly blogs, and/or usage by online reference managers (e.g., CiteULike or Mendeley).

What if one is interested in enumerating the collective impact or relevance of an individual's research output? The impact of the work of a scientist can also be estimated by author impact metrics. Measures of a scientific author's influence are called bibliometrics. Such quantification can be used for evaluation and comparison purposes. Author-level impact metrics are essential in assessing an individual's reputation and the impact of their career (Petersen, Wang, & Stanley, 2010; Petersen et al., 2014). These bibliometrics can be used for university faculty recruitment and advancement (Hirsch, 2005), awarding of fellowships (Bornmann & Daniel, 2006), providing grant funding (Council of Canadian Academies Expert Panel on Science Performance and Research Funding, 2012), predicting future achievement (Hirsch, 2007), and comparing scientific impact across disciplinary boundaries (Council of Canadian Academies Expert Panel on Science Performance and Research Funding, 2012; Kaur, Radicchi, & Menczer, 2013; Pan & Fortunato, 2014). Author impact has conventionally been measured by a simple count of an author's publications or publication citations. Over the past decade, there have been a proliferation of mathematical equations and scholarly impact metrics that can be used to quantify author impact.

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The most widely adopted author impact metric is the *h* index developed by Hirsch (2005, 2007). The *h* index is an indexed number that is based on the number of citations and number of published articles. For a given index *h*, the author impact metric is defined as the number of published articles with a citation number ≥ *h.* The value reflects an author's number of publications and the number of citations per publication. For example, an author with an *h* index of 10 has at least 10 publications that have each received at least 10 citations. Numerous variations of the *h* index and other author-level indices have since emerged (Bornmann & Daniel, 2009; Bornmann, Mutz, & Daniel, 2008). For example, the h_m index modifies the *h* index to account for manuscripts with multiple authors (Schreiber, 2008). The h_f index (Radicchi, Fortunato, & Castellano, 2008) is a generalized *h* index that generates an unbiased index for citations across disciplines and years. Kaur et al. (2013) proposed the h_s index as a normalized *h* index that allows comparisons of author impact across scientific disciplines. The i10-Index, introduced by Google Scholar, represents the number of publications an author has with at least 10 citations from other authors. Another is the *g* index proposed by Egghe (2006). It represents the global performance of a set of publications where the *g* index represents the highest number *g* of publications that together receive at least g^2 citations.

Author impact metrics can be easily gleaned from a number of databases (e.g., Thomson Institute for Scientific Information [ISI] Web of Science[1], Google Scholar, Scopus, and ResearchGate). Also, one can use subject-area databases and journal publisher resources to count citations. Examples of some subject-area databases are EBSCOhost databases (e.g., CINAHL and MLA Bibliography), ProQuest databases (e.g., ABI/INFORM and Earth Science Collection), and Medline (via PubMed or Ovid). Publisher platforms include Cambridge University Press's Cambridge Journals (https://www.cambridge.org/core/what-we-publish/journals), Elsevier's ScienceDirect (http://www.sciencedirect.com), Springer (http://www.springer.com/us/), and JSTOR (http://www.jstor.org).

Author-level impact metrics have been examined in a number of medical fields, including pediatric anesthesiology (O'Leary & Crawford, 2010), radiology (Chow, Ha, & Filippi, 2015), emergency medicine (DeLuca et al., 2013), laboratory medicine (Escobar, Nydegger, Risch, & Risch, 2012), urology (Kutikov et al., 2012), and neurology (Tinazzi et al., 2014). To date, however, there has been no report of author-level impact metrics in the field of communication sciences and disorders. The purpose of this study was to address this deficiency and undertake a comprehensive analysis of author-level impact metrics in the field of communication sciences and disorders. Three databases (i.e., Google Scholar, ResearchGate, and Scopus) were utilized.

[1]As of 2017, Web of Science is now maintained by Clarivate Analytics.

Google Scholar (https://scholar.google.com), which was launched in 2004, is a freely available web search engine. Google Scholar indexes journal manuscripts, conference papers, theses/dissertations, books, preprints, abstracts, technical reports, patents, etc., across disciplines. Google Scholar Citations is a service that Google Scholar provides to authors as a means to keep track of their article citations. "Author profiles" are created by first creating a Google account. Once created and signed in, an author then completes a "Citations sign-up form", confirming the spelling of their first and last names, and affiliation(s), etc. Google Scholar will then perform a search of articles with the author's name. The author confirms the articles are theirs, and they are added to their author profile. Google Scholar updates the profiles periodically, and new articles are added when identified. On occasion, Google Scholar may add an article by someone else, and the author must remove the errant entry. An author must approve their profile to be made public to be viewed; otherwise, it is not accessible.

ResearchGate (https://www.researchgate.net) is a social network service site, launched in 2008, for scientists. Membership is free to individuals that have an institutional email address or a published researcher authenticated by the site. Individuals who wish to use the site must create an account. Once an account is created, members can view other accounts, post questions, and communicate with other members. It has been reported that ResearchGate had 11 million members in 2016 (ResearchGate, n.d.). Most users are in the fields of medicine and biology; however, it also draws from a large community of scientists in engineering, computer sciences, chemistry, and agriculture (Gruzd, 2012).

Scopus (https://www.elsevier.com/solutions/scopus) is an abstract and citation database of peer-reviewed scientific journals, books, and conference proceedings. Scopus is owned by the publisher Elsevier and is available online with a subscription (since 2004). Scopus includes over 21,500 titles from more than 5,000 international publishers worldwide. Author searches can be conducted in Scopus by entering an author's Open Researcher and Contributor ID (ORCID) or the author's last name, initials or first name, and affiliation. Scopus uses an author identification algorithm that matches an author name on the basis of affiliation, address, subject area, source title, dates of publication, citations, and coauthors and assigns a single identifier number to each author. On occasion, Scopus will have multiple author profiles for the same person, and they should be merged.

The specific goals of this study were fourfold. The first was to collect and disseminate author-level impact metrics in the field of communication sciences and disorders. As noted above, there have been no previous reports of such bibliometrics. The data are of importance for university faculty recruitment and advancement, predicting future achievement, and comparing author impact across disciplinary boundaries. Second, it was of interest to examine author-level impact metrics within the field of communication sciences and disorders. That is, do an author's academic rank, gender, and/or field of study affect impact? Third, it was of interest to examine the association of author-level impact metrics in the field of communication sciences and disorders across databases. Last, it was of interest to examine scholarship longevity across faculty careers. That is, whereas author-level impact metrics can be assessed at a specific point in time, one may also inquire about metrics averaged across one's career. In particular, author-level impact metrics (e.g., publications, citations, *h* index, etc.) from the three databases (i.e., Google Scholar, ResearchGate, and Scopus) were examined as a function of faculty gender, academic rank, and area of expertise (i.e., audiology or speech-language pathology).

Method

Participants

Author-level impact metrics were collected for faculty from accredited universities in the United States and Canada. The lists of accredited programs were gathered from the Council on Academic Accreditation in Audiology and Speech-Language Pathology of the American Speech-Language-Hearing Association (2015) and the Council for Accreditation of Canadian University Programs in Audiology and Speech-Language Pathology (n.d.). All academic faculty listed in each program at each institution were included.[2]

Procedures

Beginning in February 2015 and ending in September 2015, demographic and personal data were collected from accredited universities program websites.[3] Information included institution location (i.e., state/province), gender, area of expertise (i.e., audiology or speech-language pathology), terminal degree, year of terminal degree, and academic rank.

Google Scholar, ResearchGate, and Scopus databases were utilized to gather author-level impact metrics. Identified programs were examined in a random order. With Google Scholar, author "user profiles" were first identified. Google Scholar automatically calculates and displays the individual's metrics once the author has been verified. The following six metrics were collected from public Google Scholar user profiles: total number of citations, number of citations in last 5 years, *h* index (i.e., total and in last 5 years), and i10-Index (i.e., total and in last 5 years). Three metrics were gathered from ResearchGate: number of publications, number of citations, and ResearchGate (RG) score. RG score is a number "calculated by ResearchGate using an algorithm that is not fully disclosed but which is based on contributions to members' ResearchGate profiles, interactions with other members, and reputation among other members" (Thelwall & Kousha, 2015, p. 880). That is, RG scores integrate both bibliometrics and altmetrics, where researcher publications, questions asked and answered, and number of followers are considered. Therefore, a researcher with *X* articles and *Z* citations with zero question and answer activity will have a lower RG score than a researcher with the same article and citation numbers who has question and answer activity. Author searches conducted in Scopus collected the following metrics: number of documents (i.e., total and in last 5 years), number of coauthors, number of citations (i.e., total and in last 5 years), number of citations excluding self-citations (i.e., total and in last 5 years), most cited (i.e., highest citation for a single publication), *h* index (i.e., total and in last 5 years), and *h* index excluding self-citations (i.e., total and in last 5 years).

Results

Institutions and Faculty

In total, we identified 257 accredited programs (see the Appendix). There were 246 programs in the United States and 11 in Canada. In the United States, programs were located in the following U.S. Census Bureau regions: South (35.8%; *n* = 88), Midwest (26.8%; *n* = 66), Northeast (22.4%; *n* = 55), and West (15.0%; *n* = 37). Of the 257 programs, 1.2% (*n* = 3), 71.6% (*n* = 184), and 27.2% (*n* = 70) offered training in audiology only, speech-language pathology only, and both audiology and speech-language pathology, respectively. With respect to 2015 Carnegie Classification of Institutions of Higher Education, programs in the United States were housed in research/doctoral universities (54.5%), master's colleges and universities (41.9%), and special focus institutions (3.6%; see Table 1).

Academic faculty totaled 2,010 individuals. Faculty expertise was in audiology (24.4%; *n* = 490) and speech-language pathology (75.6%; *n* = 1,520). Women comprised 68.1% (*n* = 1,368) of faculty, and men comprised 31.9% of faculty (*n* = 642). Terminal degrees held by faculty were overwhelmingly doctoral degrees (87.9%), followed by master's (5.5%), doctor of audiology (2.7%), and doctor of education (2.4%) degrees. Other degrees (e.g., doctor of speech-language pathology, doctor of communication sciences and disorders, medical doctor, master of education, and education specialist) totaled 1.5%. Rank was evenly distributed, with 35.1% (*n* = 705) assistant, 33.8% (*n* = 679) associate, and 31.1% (*n* = 626) full professorship. The average number of faculty per program was 7.9 (*SD* = 4.2). Gender, terminal degree, and rank, as a function of faculty expertise, are shown in Table 2. Box plots illustrating number of years since the terminal degree was completed, as a function of area of expertise and academic rank, are shown in Figure 1.

Online Presence

The percentage of faculty in the field of communication sciences and disorders identified in each database was 10.5% (*n* = 212), 44.0% (*n* = 885), and 84.4% (*n* = 1,696),

[2]Emeritus/retired faculty members were excluded.

[3]If complete information was not available on program websites, additional Internet searches were undertaken (e.g., Google Scholar, ProQuest Dissertations & Theses Global, and ResearchGate) in an effort to glean desired demographics.

Table 1. Number and percentage of U.S. institutions as a function of Carnegie classification.

Carnegie classification	*n*	%
Research universities (very high research activity)	53	20.6
Research universities (high research activity)	56	21.8
Doctoral/research universities	25	9.7
Master's colleges and universities (larger programs)	87	33.9
Master's colleges and universities (medium programs)	14	5.4
Master's colleges and universities (smaller programs)	2	.8
Special focus institutions (medical schools and medical centers)	6	2.3
Special focus institutions (other health professions schools)	2	.8
Baccalaureate colleges (arts & sciences)	1	.4

for Google Scholar, ResearchGate, and Scopus, respectively. Of all faculty members, 53.7% (n = 1,080) were not located in either Google Scholar or ResearchGate databases, which require active participation by the faculty. Of the remaining faculty members, 2.2% (n = 45) were found only in Google Scholar, 35.7% (n = 718) were found only in ResearchGate, and 8.3% (n = 167) were found in both Google Scholar and ResearchGate. Absolute count and percentage of faculty identified in each database as a function of rank are displayed in Table 3. There was no significant difference between the proportions of faculty absent as a function of rank for Google Scholar (χ^2 = 1.87, df = 2, p = .39), but there was for ResearchGate (χ^2 = 11.82, df = 2, p = .003) and Scopus (χ^2 = 78.46, df = 2, p < .001). Assistant professors had a higher proportion of absences in ResearchGate and Scopus. With regard to the proportion of faculty present by rank, the opposite was evidenced. There was a significant difference between the proportions of faculty present as a function of rank for Google Scholar (χ^2 = 10.68, df = 2, p = .005), but there was not for ResearchGate (χ^2 = 3.38, df = 2, p = .18) and Scopus (χ^2 = 4.30, df = 2, p = .12). Assistant professors had a higher proportion of presence in Google Scholar.

Table 2. Number and percentage of faculty as a function of expertise, gender, terminal degree, and academic rank.

	Area of expertise			
	Audiology		Speech-language pathology	
Parameter	*n*	%	*n*	%
Gender				
Female	263	53.7	1,106	72.7
Male	227	46.3	415	27.3
Terminal degree				
Ph.D.	420	85.9	1,346	88.5
Au.D.	55	11.2	—	—
Master's	6	1.2	104	6.8
Other	8	1.6	71	4.7
Rank				
Full	170	34.7	456	31.1
Associate	186	38.0	493	33.8
Assistant	134	27.3	571	35.1

Note. Ph.D. = doctor of philosophy; Au.D. = doctor of audiology.

Author-Level Impact Metrics

Google Scholar

The distribution of all Google Scholar indices did not differ significantly between the two categories of area of expertise (Mann–Whitney p > .05). All median values of Google Scholar indices were greater for men versus women. The differences were statistically significant for four of the measures: h index and i10-Index, both current and in the last 5 years (Mann–Whitney p < .05). The distribution of all Google Scholar indices differed significantly across academic rank (Kruskal–Wallis p < .001). With increasing rank, index values increased. Box plots of Google Scholar total number of citations, h index, and i10-Index, both current and in the last 5 years, as a

Figure 1. Box plots of years since terminal degree as a function of area of expertise and rank, where SLP is speech-language pathology. The top, bottom, and line through the middle of the box denote the 75th, 25th, and 50th percentile (median), respectively. Circles denote outliers (i.e., cases with values between 1.5 and 3 times the interquartile range). Asterisks denote extreme outliers (i.e., cases with values greater than 3 times the interquartile range).

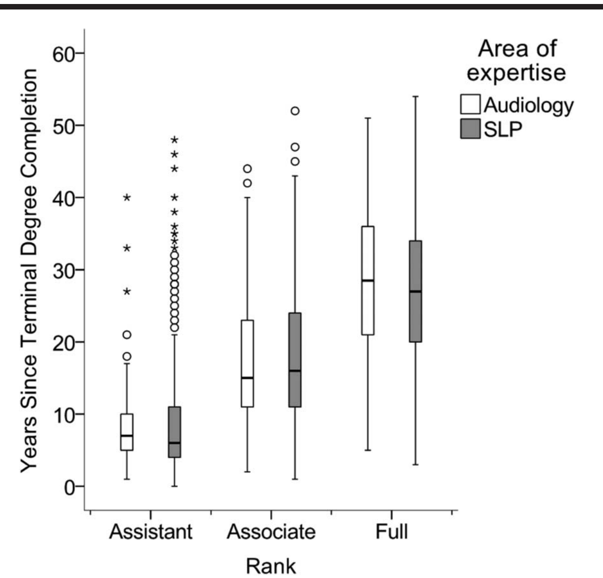


Table 3. Absolute count and percentage of faculty identified in each database as a function of rank.

Database	Rank			Total
	Full	Associate	Assistant	
Google Scholar				
Absent count	572	613	613	1,798
Absent (%)	31.8	34.1	34.1	100.0
Rank (%)	91.4	90.3	87.0	89.5
Total (%)	28.5	30.5	30.5	89.5
Present count	54	66	92	212
Present (%)	25.5	31.1	43.4	100.0
Rank (%)	8.6	9.7	13.0	10.5
Total (%)	2.7	3.3	4.6	10.5
Total count	626	679	705	2,010
Total (%)	31.1	33.8	35.1	100.0
Rank (%)	100.0	100.0	100.0	100.0
ResearchGate				
Absent count	338	359	428	1,125
Absent (%)	30.0	31.9	38.0	100.0
Rank (%)	54.0	52.9	60.7	56.0
Total (%)	16.8	17.9	21.3	56.0
Present count	288	320	277	885
Present (%)	32.5	36.2	31.3	100.0
Rank (%)	46.0	47.1	39.3	44.0
Total (%)	14.3	15.9	13.8	44.0
Total count	626	679	705	2,010
Total (%)	31.1	33.8	35.1	100.0
Rank (%)	100.0	100.0	100.0	100.0
Scopus				
Absent count	55	82	177	314
Absent (%)	17.5	26.1	56.4	100.0
Rank (%)	8.8	12.1	25.1	15.6
Total (%)	2.7	4.1	8.8	15.6
Present count	571	597	528	1,696
Present (%)	33.7	35.2	31.1	100.0
Rank (%)	91.2	87.9	74.9	84.4
Total (%)	28.4	29.7	26.3	84.4
Total count	626	679	705	2,010
Total (%)	31.1	33.8	35.1	100.0
Rank (%)	100.0	100.0	100.0	100.0

function of academic rank, are presented in Figure 2. The five number summaries of the Google Scholar box plot values, collapsed across area of expertise, are presented in Table 4.

ResearchGate

The distribution of all ResearchGate indices differed significantly between the two categories of area of expertise (Mann–Whitney $p < .001$). All median values were greater for those in audiology. Also, all median values of ResearchGate indices were greater for men versus women (Mann–Whitney $p < .001$). The distribution of all ResearchGate indices also differed significantly across academic rank (Kruskal–Wallis $p < .001$). With increasing rank, index values increased. Box plots of RG score, number of publications, and number of citations, as a function of area of expertise and academic rank, are presented in Figure 3. The five number summaries of the ResearchGate box plot values, as a function area of expertise and rank, are presented in Table 5.

Scopus

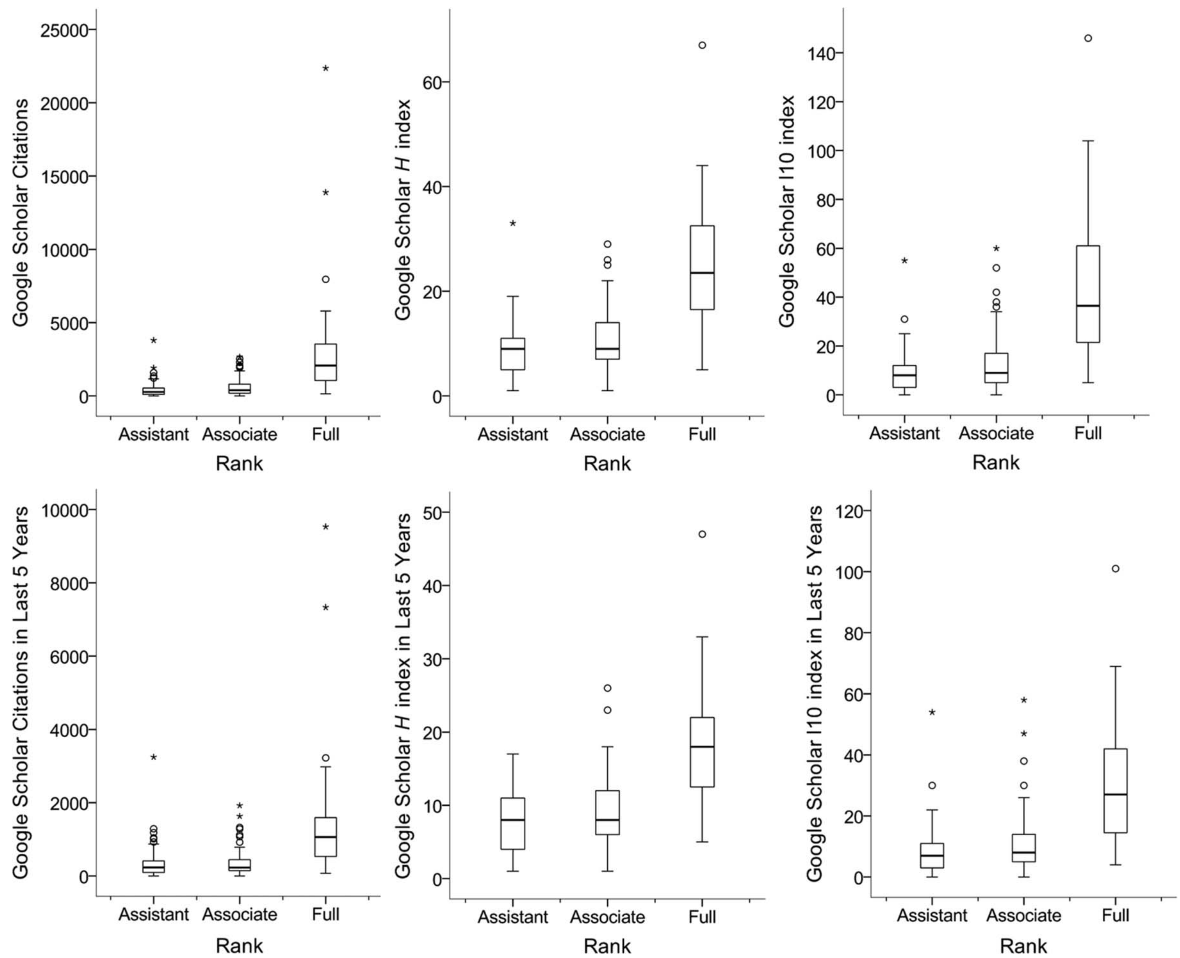
The distribution of all number of documents in Scopus differed significantly between the two categories of area of expertise (Mann–Whitney $p < .001$). All median values for number of documents were greater for those in audiology. Also, all median values for number of documents were greater for men versus women (Mann–Whitney $p < .001$). The distribution of Scopus number of documents also differed significantly across academic rank (Kruskal–Wallis $p < .001$). With increasing rank, the number of documents increased. Box plots of Scopus total number of documents and those in the last 5 years, as a function of area of expertise and academic rank, are presented in Figure 4. The five number summaries of the Scopus number of documents box plot values, as a function area of expertise and rank, are presented in Table 6.

The distribution of number of coauthors in Scopus differed significantly between the two categories of area of expertise (Mann–Whitney $p < .001$). All median values for number of coauthors were greater for those in audiology and were greater for men versus women (Mann–Whitney $p < .001$). The distribution of Scopus number of coauthors also differed significantly across academic rank (Kruskal–Wallis $p < .001$). With increasing rank, the number of coauthors increased. Box plots of Scopus total number of coauthors as a function of area of expertise and academic rank are also presented in Figure 4. The five number summaries of the Scopus number of coauthors box plot values, as a function area of expertise and rank, are also presented in Table 6.

The distribution of all Scopus citation indices differed significantly between the two categories of area of expertise (Mann–Whitney $p < .002$) and across gender (Mann–Whitney $p < .002$). All median values for citation indices were greater for those in audiology and greater for men. The distribution of all Scopus citations differed significantly across academic rank (Kruskal–Wallis $p < .001$). With increasing rank, the citation indices increased. Box plots of Scopus citation indices (i.e., number of citations and those in last 5 years, citations with no self-citations and those in the last 5 years, and most cited document), as a function of area of expertise and academic rank, are presented in Figure 5. The five number summaries of the Scopus citation box plot values, as a function of area of expertise and rank, are presented in Table 7.

The distribution of all Scopus *h* index values differed significantly between the two categories of area of expertise (Mann–Whitney $p < .001$) and across gender (Mann–Whitney $p < .001$). All median values for *h* indices were greater for those in audiology and greater for men. The distribution of all Scopus *h* indices differed significantly across academic rank (Kruskal–Wallis $p < .001$). With increasing rank, the *h* indices increased. Box plots of Scopus *h* index and *h* index with no self-citations and those in the last 5 years, as a function of area of expertise and academic rank, are presented in Figure 6. The five number summaries of the Scopus *h* indices box plot values, as a function area of expertise and rank, are presented in Table 8.

Figure 2. Box plots of Google Scholar indices as a function of area of expertise and rank. The top, bottom, and line through the middle of the box denote the 75th, 25th, and 50th percentile (median), respectively. Circles denote outliers (i.e., cases with values between 1.5 and 3 times the interquartile range). Asterisks denote extreme outliers (i.e., cases with values greater than 3 times the interquartile range).



Association of Google Scholar, ResearchGate, and Scopus Indices

Spearman rank-order correlation coefficients (r_s) were determined to examine the association between all 21 author-level metrics. There were statistically significant positive correlations between all author-level metrics ($p < .01$). Correlation coefficients ranged from .44 to .99, with a mean of .77.

Assessing Scholarship Longevity

It was of interest to examine scholarship longevity across faculty careers. Because the Scopus database identified the overwhelming majority of faculty in the field of communication sciences and disorders, examination was restricted to that database. Three indices were generated for this analysis. A Scopus average documents/year was calculated. This was calculated by dividing the total number of Scopus documents by the number of years since the terminal degree was completed. Also, a Scopus average citations/year was calculated by dividing the total number of Scopus citations by the number of years since the terminal degree was completed. A final value, Scopus "*m*," was calculated by dividing the *h* index by the number of years of activity (i.e., years since the terminal degree was completed). For example, a researcher with 20 years of activity with an *h* index of 20 has an *m* value of 1. Hirsch (2005) described this as the slope of the *h* index and suggested that it is "a useful yardstick to compare scientists of different seniority" (p. 16570). Hirsch noted that the *m* parameter is impractical if a scientist does not maintain productivity, whereas the *h* index remains a practical measure of collective accomplishment over time, even if the scientist has stopped publishing.

As with previous Scopus indices, these three indices differed significantly between the two categories of area of expertise (Mann–Whitney $p < .02$) and across gender (Mann–Whitney $p < .003$). All median values for were greater for those in audiology and greater for men. Box

Table 4. Five number summaries for box plots of Google Scholar indices as a function of area of rank collapsed across area of expertise.

Quartiles	Rank		
	Assistant	Associate	Full
Citations			
Minimum	2	1	143
25%	98	181	995
50%	274	387	2,068
75%	552	810	3,618
Maximum	3,800	2,667	22,360
Citations in last 5 years			
Minimum	2	1	74
25%	90	142	531
50%	234	229	1,063
75%	414	452	1,613
Maximum	3,246	1,925	9,531
h index			
Minimum	1	1	5
25%	4	7	16
50%	9	9	24
75%	11	15	33
Maximum	33	29	67
h index in last 5 years			
Minimum	1	1	5
25%	4	6	12
50%	8	8	18
75%	11	12	22
Maximum	17	26	47
i10-Index			
Minimum	0	0	5
25%	3	5	21
50%	8	9	36
75%	12	18	61
Maximum	55	60	146
i10-Index in last 5 years			
Minimum	0	0	4
25%	3	5	14
50%	7	8	27
75%	11	14	42
Maximum	54	58	101

plots of Scopus average documents/year, average citations/year, and *m*, as a function of area of expertise, are presented in Figure 7. The five number summaries of these Scopus indices, as a function area of expertise, are presented in Table 9.

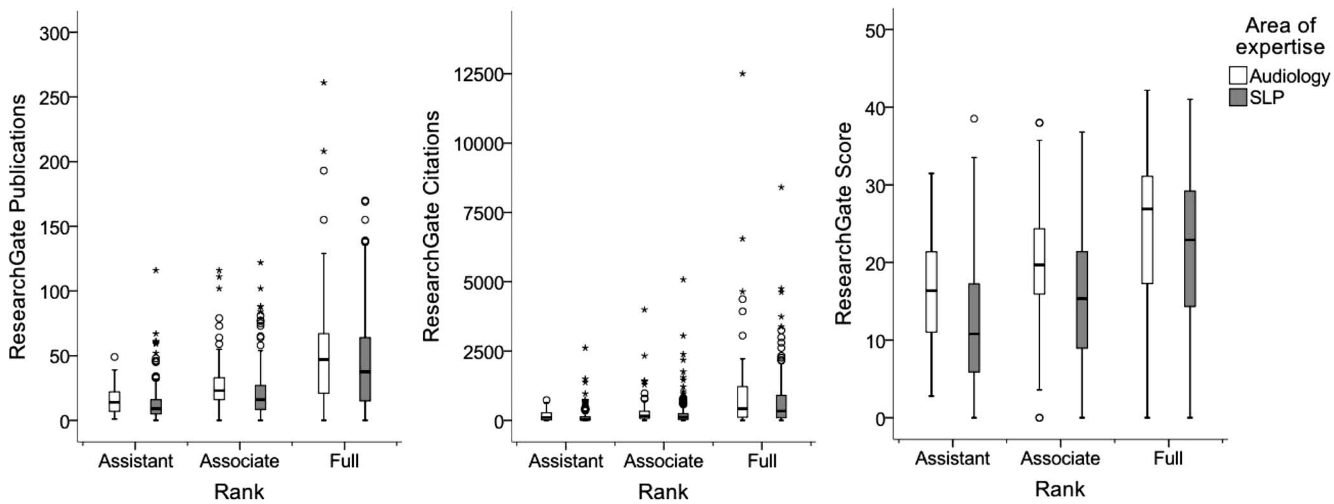
Discussion

These are the first reported author-level impact metrics in the field of communication sciences and disorders. Over 2,000 faculty members were surveyed from 257 accredited audiology and speech-language pathology programs in the United States and Canada. The majority of faculty members were housed in research/doctoral universities and master's colleges and universities. Approximately three quarters had an expertise in speech-language pathology. Academic rank was generally equally spread out. Although the majority of faculty members were women (68%), the distribution was widely different across area of expertise. Men comprised 46.3% of faculty in audiology and 27.3% of faculty in speech-language pathology. The faculty representation was not equal across the three databases. The majority of faculty members were identified in Scopus. This is not unexpected considering it represents those who have some peer-reviewed scholarship, and voluntary membership is not required. Faculty were identified the least in Google Scholar, where membership is required, and members must make their profiles public to be viewed. Interestingly, academic rank was not equally represented across databases. Assistant professors had a higher proportion of presence in Google Scholar and a higher proportion of absences in ResearchGate and Scopus. One could speculate that assistant professors may be more likely to be concerned with career advancement (i.e., tenure and promotion). As such, they would be more concerned with following author-level metrics on Google Scholar and less likely to be engaged with social networking in ResearchGate. On the contrary, older faculty may be less "tech savvy" and may not be familiar with Google Scholar profiles. It is not unexpected that assistant professors are less represented on Scopus because they may not have published yet, being early in their career. There may be some bias in the metrics found in Google Scholar and ResearchGate, where membership is voluntary. It may be that faculty members who are more productive are more likely to sign up and make their profile public. Less productive faculty members may shy away from these databases. In consequence, author metrics may be inflated in Google Scholar and ResearchGate.

There were statistically significant associations among author-level impact metrics in the three databases. This was not unexpected. Although the three databases differ in the means by which they collected data, some measures reflected the same author-level impact metric. The number of citations was an index in all three databases. Document counts were found in both ResearchGate and Scopus. The *h* index was found in both Google Scholar and Scopus. The Google Scholar i10-Index is a similar publication/citation metric to the *h* index. The RG score and impact points are global metrics that consider publication and citation metrics. Previous reports have also noted a significant correlation among author-level metrics (e.g., *h* index) across citation databases (Meho & Rogers, 2008; Sanderson, 2008). Google Scholar citations have been reported to correlate well with traditional bibliometric data citation sources (Harzing & van der Wal, 2008). Citation counts have been reported, however, to be different across databases in some fields (e.g., Arora & Eden, 2011; Bakkalbasi, Bauer, Glover, & Wang, 2006; Kulkarni, Aziz, Shams, & Busse, 2009). ResearchGate publication counts have also been demonstrated to positively correlate with traditional bibliometric data document sources (Thelwall & Kousha, 2015; Yu, Wu, Alhalabi, Kao, & Wu, 2016).

Six general trends were evidenced across all author-level impact metrics. First, most of the indices were positively skewed. Second, not surprisingly, the examination of Google Scholar and Scopus indices (i.e., number of citations, documents, *h* index, and i10-Index) in the last 5 years revealed values that are lower relative to an author's full

Figure 3. Box plots of ResearchGate indices as a function of area of expertise and rank, where SLP is speech-language pathology. The top, bottom, and line through the middle of the box denote the 75th, 25th, and 50th percentile (median), respectively. Circles denote outliers (i.e., cases with values between 1.5 and 3 times the interquartile range). Asterisks denote extreme outliers (i.e., cases with values greater than 3 times the interquartile range).



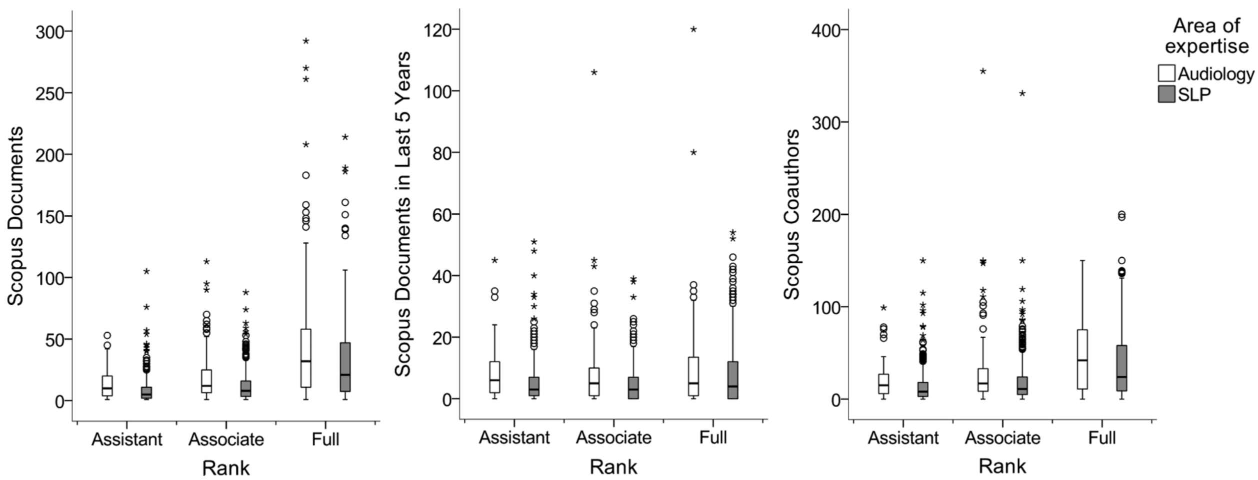
career indices. Third, removing self-citations lowered Scopus indices (i.e., number of citations and *h* index). Fourth, there was a significant effect of academic rank. With increasing rank, all index values increased. Considering that academic promotion comes with increased scholarly productivity over time, this would be expected. In addition, with increasing rank across one's career, the number of collaborations would increase, and hence the number of coauthors would likely increase. Fifth, all median values for author-level metrics were greater for men versus women, with the exception of Google Scholar's total number of citations and citations in the last 5 years. Last, the distribution of all author metric indices, with the exception of Google Scholar metrics, differed significantly between the two categories of area of expertise. All values were greater for those in audiology versus speech-language pathology. The reason for the exception with Google Scholar may be the small representation of faculty in the

Table 5. Five number summaries for box plots of ResearchGate indices as a function of area of expertise and rank.

	Rank					
	Assistant		Associate		Full	
Quartiles	Audiology	SLP	Audiology	SLP	Audiology	SLP
RG score						
Minimum	2.8	0	0	0	0	0
25%	10.5	5.8	15.7	8.9	17.0	14.3
50%	16.4	10.8	19.7	15.3	26.9	22.9
75%	21.8	17.4	24.5	21.5	31.1	29.2
Maximum	31.5	38.5	38.0	36.8	42.2	41.2
Number of publications						
Minimum	1	0	0	0	0	0
25%	7	5	15	8	21	15
50%	14	9	23	16	47	38
75%	22	16	33	27	68	64
Maximum	49	116	116	122	261	170
Number of citations						
Minimum	0	0	0	0	0	0
25%	14	8	75	34	109	96
50%	103	32	159	116	419	336
75%	276	134	345	250	1226	907
Maximum	732	2,614	3,993	5,080	12,506	8,410

Note. SLP = speech-language pathology; RG = ResearchGate.

Figure 4. Box plots of Scopus number of document indices and number of coauthors as a function of area of expertise and rank, where SLP is speech-language pathology. The top, bottom, and line through the middle of the box denote the 75th, 25th, and 50th percentile (median), respectively. Circles denote outliers (i.e., cases with values between 1.5 and 3 times the interquartile range). Asterisks denote extreme outliers (i.e., cases with values greater than 3 times the interquartile range).



field of communication sciences and disorders in that database (i.e., only 10.5%).

Removing self-citations in Scopus lowered total citations by 8.8%, citations in the last 5 years by 16.7%, *h* index by 7.0%, and *h* index in the last 5 years by 10.5%, collapsed across rank and area of expertise. These values are comparable to those in clinical medicine, computer science, and engineering (Dehghani, Basirian, & Ganjoo, 2011). High rates of self-citation, as much as 36%, have been reported in the field of communication sciences and disorders (e.g., Aksnes, 2003). Fowler and Aksnes (2007) argued that even a small amount of self-citation affects total citations across a career. They reported that each self-citation yields an additional 3.65 citations from others after 10 years. Taken cumulatively, "it means an additional 40% of total citations may be generated indirectly by self-citations. Adding these effects together, self-citation may therefore account directly or indirectly for more than half of all citations after 10 years" (Fowler and Aksnes, 2007, p. 434). They concluded that this is important to consider

Table 6. Five number summaries for Scopus number of documents as a function of area of expertise and rank.

	Rank					
	Assistant		Associate		Full	
Quartiles	**Audiology**	**SLP**	**Audiology**	**SLP**	**Audiology**	**SLP**
Number of documents						
Minimum		1	1	1	1	1
25%	4	2	6	3	11	7
50%	10	5	12	8	32	21
75%	20	11	25	16	58	47
Maximum	53	105	113	88	292	214
Number of documents in last 5 years						
Minimum	0	0	0	0	0	0
25%	2	1	1	0	1	0
50%	6	3	5	3	5	4
75%	12	7	10	7	14	12
Maximum	45	51	106	39	120	54
Number of coauthors						
Minimum	0	0	0	0	0	0
25%	6	3	8	5	11	9
50%	15	8	17	11	42	24
75%	27	18	33	24	76	58
Maximum	99	150	355	331	150	200

Note. SLP = speech-language pathology.

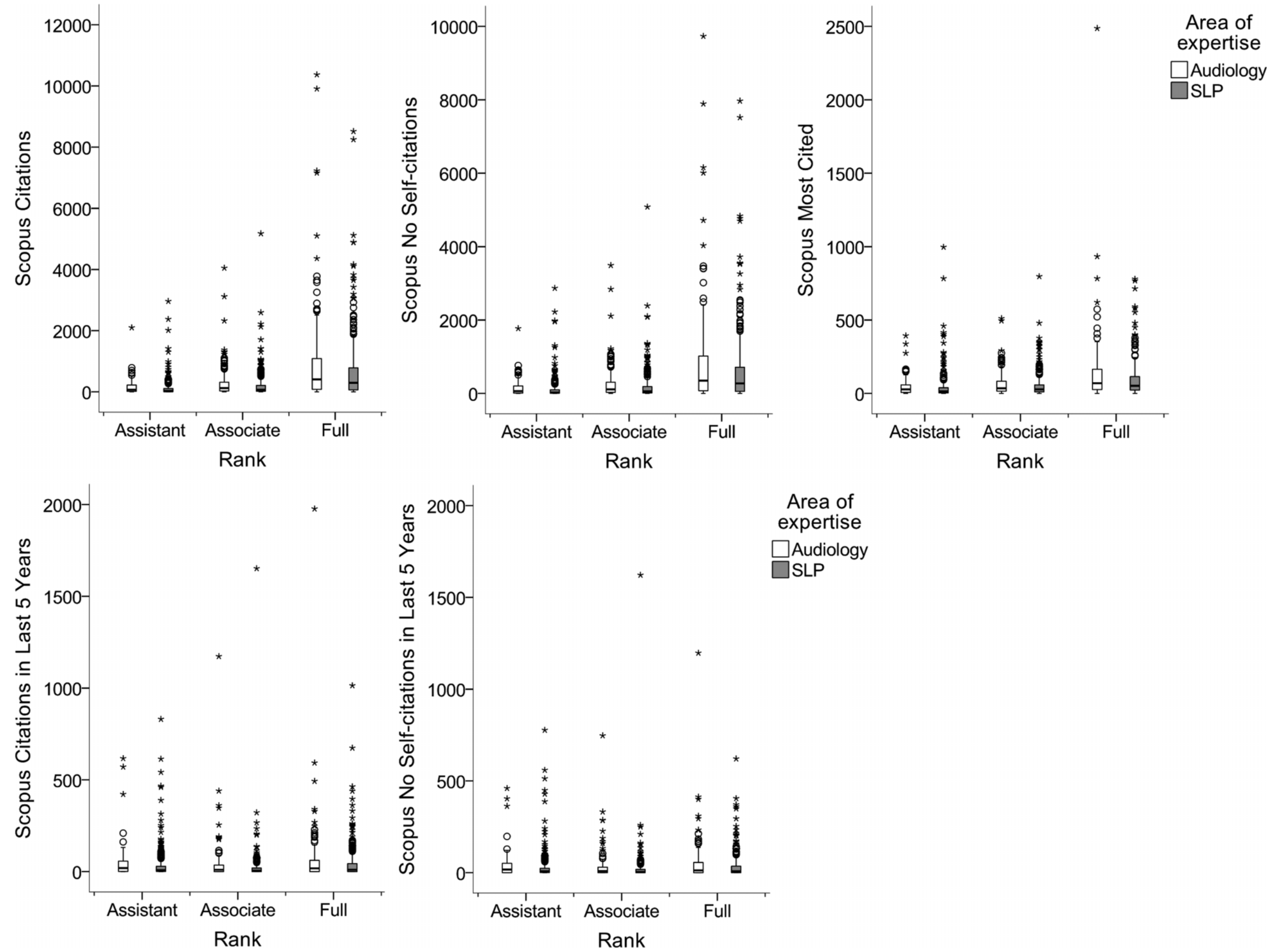


Figure 5. Box plots of Scopus number of citation indices as a function of area of expertise and rank, where SLP is speech-language pathology. The top, bottom, and line through the middle of the box denote the 75th, 25th, and 50th percentile (median), respectively. Circles denote outliers (i.e., cases with values between 1.5 and 3 times the interquartile range). Asterisks denote extreme outliers (i.e., cases with values greater than 3 times the interquartile range).

when evaluating an average researcher who has a relatively few number of publications and citations, because "a few self-citations could easily tip the balance for funding and promotion decisions" (Fowler and Aksnes, 2007, p. 434).

The gender effect seen on author-level impact metrics is consistent with previously reported gender effects in scholarly productivity. For example, a gender effect has been observed with *h* index in the fields of psychology (Geraci, Balsis, & Busch, 2015; Nosek et al., 2010) and ecology/evolutionary biology (Kelly & Jennions, 2006; Symonds, Gemmell, Braisher, Gorringe, & Elgar, 2006). In addition, men have been shown to publish more manuscripts than women across scientific disciplines (Cole & Zuckerman, 1984; Kelly & Jennions, 2006; Sax, Serra Hagedorn, Arredondo, & Dicrisi, 2002; Symonds et al., 2006; Xie & Shauman, 1998). The cause of the difference is difficult to identify and has been deemed the "productivity puzzle" (Cole & Zuckerman, 1984; Xie & Shauman, 1998). Several social factors have been suggested. For example, it has been argued that women bear a disproportionate amount of domestic responsibility that affects scholarship (Cole & Zuckerman, 1984; Kelly & Jennions, 2006; Symonds et al., 2006). Women are particularly more affected than men, in terms of publication productivity, if they have young (i.e., less than 10 years of age) children (Hunter, 2010; Kyvik, 1990; Kyvik & Teigen 1996). Knapp (2005) suggested that women are more greatly burdened with additional nonresearch obligations as a result of their scarcity and the appeal of having a balance of the genders on administrative committees. There is evidence that at least at the level of associate professor, the larger service responsibility imposed on women affects research productivity and career advancement (Misra, Hicke Lundquist, Holmes, & Agiomavritis, 2011; Xie & Shauman, 1998). Differences in research funding have been also attributed differences in scholarly production. Duch et al. (2012) examined 437,787 science, technology, engineering, and mathematics publications authored by 4,292 faculty members in U.S. research

Table 7. Five number summaries for box plots of Scopus citation indices as a function of area of expertise and rank.

	Rank					
	Assistant		Associate		Full	
Quartiles	Audiology	SLP	Audiology	SLP	Audiology	SLP
Citations						
Minimum	0	0	0	0	0	0
25%	12	5	30	19	78	64
50%	70	29	124	70	408	296
75%	227	110	319	213	1,102	786
Maximum	2,101	2,962	4,049	5,176	10,370	8,517
Citations in last 5 years						
Minimum	0	0	0	0	0	0
25%	1	1	0	0	0	0
50%	19	8	10	5	18	10
75%	58	29	36	20	62	44
Maximum	617	831	1,173	1,652	1,977	1,014
No self-citations						
Minimum	0	0	0	0	0	0
25%	10	5	28	15	74	56
50%	63	26	112	59	351	271
75%	208	101	306	187	1,021	716
Maximum	1,771	2,869	3,492	5,082	9,733	7,969
No self-citations in last 5 years						
Minimum	0	0	0	0	0	0
25%	0	1	0	0	0	0
50%	17	8	9	4	13	8
75%	51	25	30	18	56	36
Maximum	460	777	747	1,622	1,197	621
Most cited						
Minimum	0	0	0	0	0	0
25%	7	4	16	11	26	23
50%	28	14	35	28	70	52
75%	61	39	83	58	163	115
Maximum	394	997	511	797	2,487	780

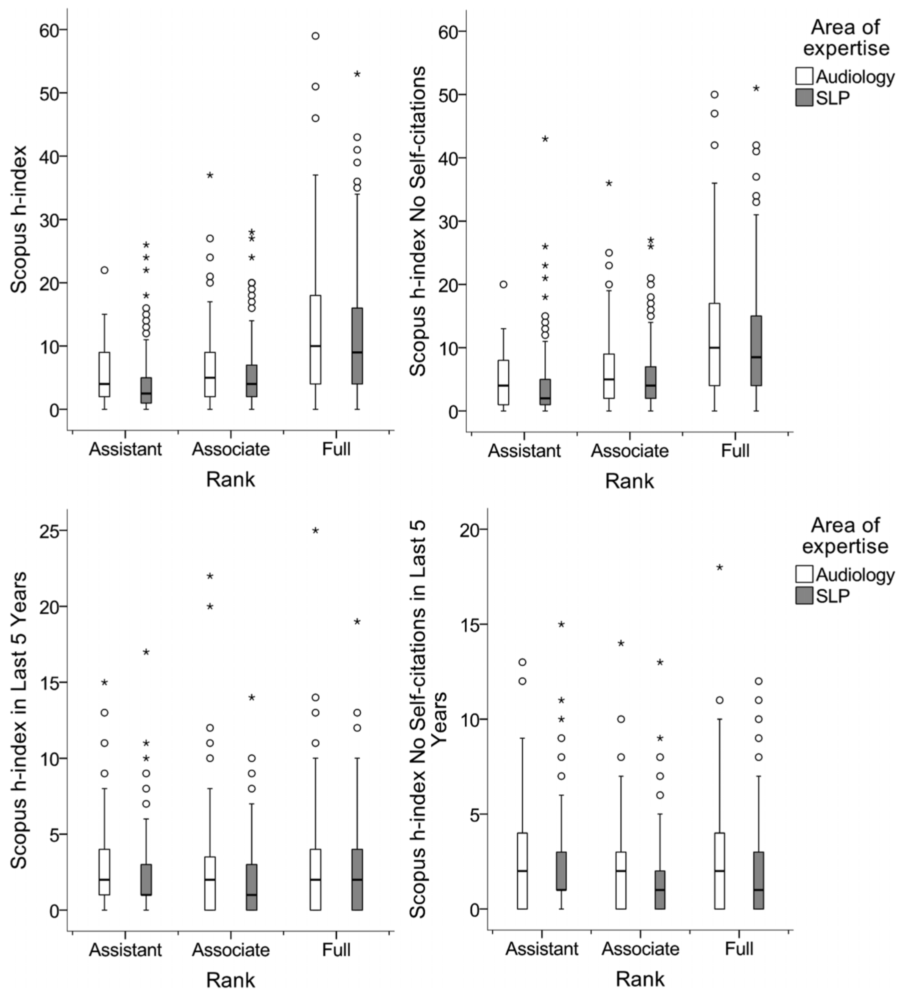
Note. SLP = speech-language pathology.

universities. They found that lower publication rates by women were significantly correlated with the amount of research resources typically needed. Last, the lack of professional networks involving women has been identified as a possible detriment to scholarly productivity (Durbin, 2011; Kyvik & Teigen, 1996; Villanueva-Felez, 2015). Indeed, women had fewer coauthors than men (see Figure 4 and Table 6), a pattern that may have contributed to fewer research collaborations and hence scholarly production.

The fact that significant differences were found across all author-level impact metrics in ResearchGate and Scopus across area of expertise is puzzling, considering approximately three quarters of faculty work in speech-language pathology. However, considering the effect of gender discussed above, one cannot discount the interpretation that the disparity seen across area of expertise may just reflect the gender disparity across audiology and speech-language pathology faculty membership. From Table 2, one can see that the majority of faculty in audiology (53.7%) and speech-language pathology (72.7%) are female researchers. To examine this possible confounding factor, we reanalyzed the ResearchGate and Scopus author-level impact metrics as a function of area of expertise excluding female faculty. On all Scopus indices and two of four ResearchGate indices (i.e., number of publications and citations), there was no statistically significant effect of area of expertise (Mann–Whitney $p > .05$). This strongly suggests that differences in author-level metrics across audiology and speech-language pathology faculty membership are related to gender. Another contributing effect to differences across area of expertise is the significant difference in number of coauthors. Recall, faculty in audiology had a higher coauthor count. Having more coauthors can lead to more collaborations and a concomitant increase in scholarly production. Also, it has been demonstrated that that there is a positive association between the number of coauthors and coauthor citation (Costas, Van Leeuwen, & Bordons, 2010; Davarpanah & Amel, 2009; Dehghani et al., 2011).

An obvious question is: How can one use these author-level metrics in the field of communication sciences and disorders? Comparing some metrics across disciplines is not recommended (Hirsch, 2005). For example, *h* index values are determined “by the average number of references in a paper in the field, the average number of papers produced by each scientist in the field, and the size (number of scientists) of the field” (Hirsch, 2005, p. 16571), and

Figure 6. Box plots of Scopus *h* indices as a function of area of expertise and rank, where SLP is speech-language pathology. The top, bottom, and line through the middle of the box denote the 75th, 25th, and 50th percentile (median), respectively. Circles denote outliers (i.e., cases with values between 1.5 and 3 times the interquartile range). Asterisks denote extreme outliers (i.e., cases with values greater than 3 times the interquartile range).



so one would expect varying values across disciplines. In fact, varying *h* index values are generally higher in the sciences, followed by engineering, health sciences, business, and humanities (e.g., Batista, Campiteli, Kinouchi, & Martinez, 2006; Harzing & Alakangas, 2016; Jarvey, Usher, & McElroy, 2012; Podlubny, 2005). Nonetheless, comparisons across disciplines are necessary, for example, with grant funding (Council of Canadian Academies Expert Panel on Science Performance and Research Funding, 2012). In these cases, the use of normalized indices (e.g., whereby raw numbers of citations are divided by a discipline-dependent factor) is suggested to control discrepancies across scientific domains (e.g., Kaur et al., 2013; Li, Radicchi, Castellano, & Ruiz-Castillo, 2013; Lundberg, 2007; Radicchi & Castellano, 2012) and allow comparisons of author impact across scientific disciplines.

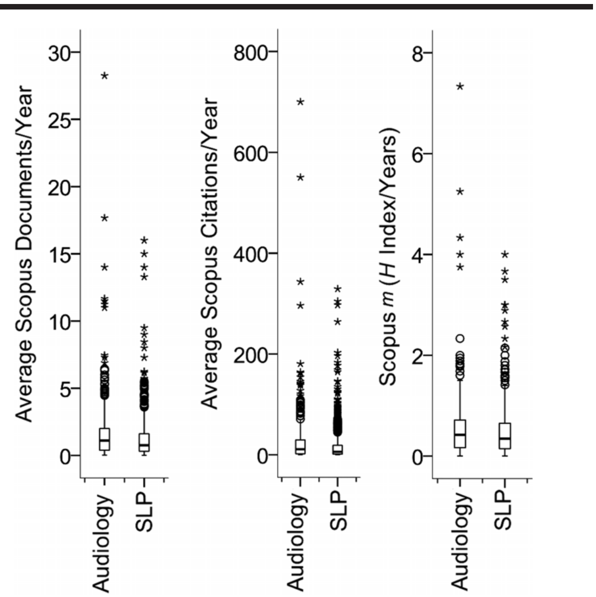
Hirsch (2005) suggested that the *h* index could be used for advancement evaluation for tenure and promotion. The *m* parameter can also be used to identify successful, outstanding, and truly unique individuals in a field. The values found in Tables 8 and 9 could be used in the field of communication sciences and disorders by assigning quartile values to certain benchmarks. For example, an *h* index above the 25%, 50%, and 75% quartiles could be benchmarks for promotion to associate professor, awarding tenure, and promotion to full professor, respectively. Likewise, an *m* above the 25% quartile could be the standard for tenure, and an *m* above the 75% quartile could be the standard for promotion to full professor. Hirsch (2007) also suggested that the *h* index is superior in predicting future scientific achievement as compared with other indices such as total citation count, citations per document, and total document count. Hence, administrators could use these indices (e.g., *h* index) for decisions for tenure and promotion and when hiring mid-level and senior faculty. It should be cautioned, however, that bibliometrics alone do not capture the full range of scholarly

Table 8. Five number summaries for box plots of Scopus *h* indices as a function of area of expertise and rank.

	Rank					
	Assistant		Associate		Full	
Quartiles	Audiology	SLP	Audiology	SLP	Audiology	SLP
h index						
Minimum	0	0	0	0	0	0
25%	2	1	2	2	4	4
50%	4	2	5	4	10	9
75%	9	5	9	7	18	16
Maximum	22	26	37	28	59	53
h index in last 5 years						
Minimum	0	0	0	0	0	0
25%	1	1	0	0	0	0
50%	2	1	2	1	2	2
75%	4	3	4	3	4	4
Maximum	15	17	22	14	25	19
h index no self-citations						
Minimum	0	0	0	0	0	0
25%	1	1	2	2	4	4
50%	4	2	5	4	10	8
75%	8	5	9	7	17	15
Maximum	20	43	36	27	50	51
h index no self-citations in last 5 years						
Minimum	0	0	0	0	0	0
25%	0	1	0	0	0	0
50%	2	1	2	1	2	1
75%	4	3	3	2	4	3
Maximum	13	15	14	13	18	12

Note. SLP = speech-language pathology.

Figure 7. Box plots of Scopus average documents/year, average citations/year, and *m* (i.e., slope of *h* index/years since terminal degree) as a function of area of expertise, where SLP is speech-language pathology. The top, bottom, and line through the middle of the box denote the 75th, 25th, and 50th percentile (median), respectively. Circles denote outliers (i.e., cases with values between 1.5 and 3 times the interquartile range). Asterisks denote extreme outliers (i.e., cases with values greater than 3 times the interquartile range).



activity (Hirsch, 2005; Jarvey et al., 2012). For example, the true quality of the research output may be misrepresented by the citation count. Consider Martin Fleischmann and Stanley Pons's (1989) ill-fated report of "cold fusion" in the *Journal of Electroanalytical Chemistry and Interfacial Electrochemistry* and the resulting positive and negative citations in the following months (Anonymous, 1990). In addition, teaching ability is not considered. Last, other means of assessing faculty should be used. Aksnes and Taxt (2004), for example, suggested bibliometrics and expert peer review are stronger when used in combination.

We agree with the notion that "science is a gift economy; value is defined as the degree to which one's ideas have freely contributed to knowledge and impacted the thinking of others" (Bollen, Van de Sompel, Hagberg, & Chute, 2009, p. 1). As such, it is our opinion that examining quantitative measures of scientific impact at the author level in the field of communication sciences and disorders is justified. The motivation may vary depending whether one is an individual faculty member examining one's own or someone else's scholarship; an administrator making a decision regarding hiring or tenure and/or promotion; or a granting agency making decisions about grant application funding. We suggest that an open database (e.g., Scopus), where voluntary membership is not required, be utilized. In our opinion, the following metrics are of the most value: number of documents (i.e., total and in last 5 years), number of citations excluding self-citations (i.e., total and in last 5

Table 9. Five number summaries for box plots of average Scopus indices as a function of area of expertise.

Quartiles	Area of expertise	
	Audiology	Speech-language pathology
Document average/year		
Minimum	0.0	0.0
25%	0.4	0.3
50%	1.1	0.8
75%	2.0	1.6
Maximum	28.2	16.0
Citations average/year		
Minimum	0.0	0.0
25%	2.1	1.4
50%	11.0	6.0
75%	29.7	18.8
Maximum	700.3	329.1
m (*h* index/years since terminal degree)		
Minimum	0.0	0.0
25%	0.2	0.1
50%	0.4	0.3
75%	0.7	0.7
Maximum	7.3	4.0

years), and *h* index excluding self-citations (i.e., total and in last 5 years). Longevity metrics (i.e., Scopus average documents/year, Scopus average citations/year, and Scopus *m*) are also recommended for evaluation for tenure and/or promotion, post-tenure review, and grant funding. For any examination of an individual faculty member's impact, we suggest some consideration of a faculty member's research workload and their institution's Carnegie classification.

In conclusion, this is the first report of author-level metrics in the field of communication sciences and disorders. Over 2,000 faculty members were surveyed from 257 accredited audiology and speech-language pathology programs in the United States and Canada. The overwhelming majority of faculty was represented in Scopus, followed by ResearchGate and Google Scholar databases. In general, author-level impact metrics were positively skewed; metric values increased significantly with increasing academic rank; author-level metrics were greater for men versus women; and values were greater for those in audiology versus speech-language pathology. Self-citation inflated total citations and *h* index values by approximately 10%. These author-level metrics may serve as a benchmark for scholarly production of academic research faculty in the field of communication sciences and disorders. The data can assist faculty with professional identity management, tenure review, promotion review, grant applications, and future employment opportunities.

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References

Aksnes, D. W. (2003). A macro study of self-citation. *Scientometrics, 56,* 235–246.

Aksnes, D. W., & Taxt, R. E. (2004). Evaluation correlation. *Research Evaluation, 13*(1), 33–41.

Anonymous. (1990). Citations track the fate of cold fusion. *New Scientist, 1713*. Retrieved from: https://www.newscientist.com/article/mg12617131-800-citations-track-the-fate-of-cold-fusion/

Arora, R. S., & Eden, T. O. (2011). Assessing the impact of paediatric oncology publications using three citation databases. *Pediatric Blood and Cancer, 56,* 152–153.

American Speech-Language-Hearing Association. (2015, February 1). CAA accredited program listing. Retrieved from: http://www.asha.org/uploadedFiles/CAAAccreditedPrograms.pdf

Bakkalbasi, N., Bauer, K., Glover, J., & Wang, L. (2006). Three options for citation tracking: Google Scholar, Scopus and Web of Science. *Biomedical Digital Libraries, 3,* 7.

Batista, P. D., Campiteli, M. G., Kinouchi, O., & Martinez, A. S. (2006). Is it possible to compare researchers with different scientific interests? *Scientometrics, 68,* 179–189.

Bollen, J., & Van de Sompel, H., Hagberg, A. & Chute, R. (2009). A principal component analysis of 39 scientific impact measures. *PLoS ONE, 4,* e6022.

Bornmann, L., & Daniel, H. D. (2006). Selecting scientific excellence through committee peer review—A citation analysis of publications previously published to approval or rejection of post-doctoral research fellowship applicants. *Scientometrics, 68,* 427–440.

Bornmann, L., & Daniel, H. D. (2009). The state of *h* index research. *EMBO Reports, 10,* 2–6.

Bornmann, L., Mutz, R., & Daniel, H. D. (2008). Are there better indices for evaluation purposes than the *h* index? A comparison of nine different variants of the *h* index using data from biomedicine. *Journal of the American Society for Information Science and Technology, 59,* 830–837.

Chow, D. S., Ha, R., & Filippi, C. G. (2015). Increased rates of authorship in radiology publications: A bibliometric analysis of 142,576 articles published worldwide by radiologists between 1991 and 2012. *American Journal of Roentgenology, 204,* W52–7.

Cole, J. R., & Zuckerman, H. (1984). The productivity puzzle: Persistence and changes in patterns of publication of men and women scientists. *Advances in Motivation and Achievement, 2,* 217–258.

Costas, R., Van Leeuwen, T. N., & Bordons, M. (2010). Self-citations at the meso and individual levels: Effects of different calculation methods. *Scientometrics, 82,* 517–537.

Council for Accreditation of Canadian University Programs in Audiology and Speech-Language Pathology. (n.d). Accreditation status of university programs. Retrieved from: https://www.cacup-aslp.ca/English/accreditedProgram.html

Council of Canadian Academies Expert Panel on Science Performance and Research Funding. (2012). *Informing research choices: Indicators and judgment*. Retrieved from: http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/science%20performance/scienceperformance_fullreport_en_web.pdf

Davarpanah, M. R., & Amel, F. (2009). Author self-citation pattern in science. *Library Review, 58,* 301–309.

Dehghani, L., Basirian, J. R., & Ganjoo, M. (2011). Citations to highly-cited researchers by their co-authors and their self-citations: How these factors affect highly-cited researchers' *h*-index in Scopus. *Webology, 8*(2), Article 91. Retrieved from: http://www.webology.org/2011/v8n2/a91.html

DeLuca, L. A., Jr., St. John, A., Stolz, U., Matheson, L., Simpson, A., & Denninghoff, K. R. (2013). The distribution of the *h*-index among academic emergency physicians in the United States. *Academic Emergency Medicine, 20,* 997–1003.

Duch, J., Zeng, X. H. T., Sales-Pardo, M., Radicchi, F., Otis, S., & Woodruff, T. (2012). The possible role of resources requirements and academic career-choice risk on gender differences in publication rate and impact. *PLoS ONE, 7,* e51332.

Durbin, S. (2011). Creating knowledge through networks: A gender perspective. *Gender, Work and Organization, 18*(1), 90–112.

Egghe, L. (2006). Theory and practise of the *g*-index. *Scientometrics, 69,* 131–152.

Escobar, P. M., Nydegger, U., Risch, M., & Risch, L. (2012). The intellectual contribution of laboratory medicine professionals to research papers on laboratory medicine topics published in high-impact general medicine journals. *Clinical Chemistry and Laboratory Medicine, 50,* 1305–1308.

Fleischmann, M., & Pons, S. (1989). Electrochemically induced nuclear fusion of deuterium. *Journal of Electroanalytical Chemistry and Interfacial Electrochemistry, 261,* 301–308.

Fowler, J. H., & Aksnes, D. W. (2007). Does self-citation pay? *Scientometrics, 72,* 427–437.

Geraci, L., Balsis, S., & Busch, A. J. B. (2015). Gender and the *h* index in psychology. *Scientometrics, 105,* 2023–2034.

Gruzd, A. (2012). Non-academic and academic social networking sites for online scholarly communities. In D. Rasmussen Neal (Ed.), *Social media for academics: A practical guide* (pp. 21–37). Oxford, United Kingdom: Chandos Publishing.

Harzing, A. W., & Alakangas, S. (2016). Google Scholar, Scopus and the Web of Science: A longitudinal and cross-disciplinary comparison. *Scientometrics, 106,* 787–804.

Harzing, A. W., & van der Wal, R. (2008). Google Scholar as a new source for citation analysis. *Ethics in Science and Environmental Politics, 8*(1), 61–73.

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America, 102,* 16569–16572.

Hirsch, J. E. (2007). Does the *h* index have predictive power? *Proceedings of the National Academy of Sciences of the United States of America, 104,* 19193–19198.

Hunter, L. A. (2010). Parenting and research productivity: New evidence and methods. *Social Studies of Science, 40,* 433–451.

Jarvey, P., Usher, A., & McElroy, L. (2012). *Making research count: Analyzing Canadian academic publishing cultures*. Toronto, Canada: Higher Education Strategy Associates.

Kaur, J., Radicchi, F., & Menczer, F. (2013). Universality of scholarly impact metrics. *Journal of Informetrics, 7,* 924–932.

Kelly, C. D., & Jennions, M. D. (2006). The *h* index and career assessment by numbers. *Trends in Ecology and Evolution, 21,* 167–170.

Knapp, S. (2005). A suitable job for a woman. *Trends in Ecology and Evolution, 20,* 55–56.

Kulkarni, A. V., Aziz, B., Shams, I., & Busse, J. W. (2009). Comparisons of citations in Web of Science, Scopus, and Google Scholar for articles published in general medical journals. *JAMA, 302,* 1092–1096.

Kutikov, A., Rozenfeld, B., Egleston, B. L., Sirohi, M., Hwang, R. W., & Uzzo, R. G. (2012). Academic ranking score: A publication-based reproducible metric of thought leadership in urology. *European Urology, 61,* 435–439.

Kyvik, S. (1990). Motherhood and scientific productivity. *Social Studies of Science, 20,* 149–160.

Kyvik, S., & Teigen, M. (1996). Child care, research collaboration, and gender differences in scientific productivity. *Science, Technology and Human Values, 21*(1), 54–71.

Li, Y., Radicchi, F., Castellano, C., & Ruiz-Castillo, J. (2013). Quantitative evaluation of alternative field normalization procedures. *Journal of Informetrics, 7,* 746–755.

Lundberg, J. (2007). Lifting the crown—Citation *z*-score. *Journal of Informetrics, 1,* 145–154.

Meho, L. I., & Rogers, Y. (2008). Citation counting, citation ranking, and *h*-index of human–computer interaction researchers: A comparison of Scopus and Web of Science. *Journal of the American Society for Information Science and Technology, 59,* 1711–1726.

Misra, J., Hicke Lundquist, J., Holmes, E., & Agiomavritis, S. (2011). The ivory ceiling of service work. *Academe, 97,* 22–26.

Nosek, B. A., Graham, J., Lindner, N. M., Kesebir, S., Hawkins, C. B., Hahn, C., . . . Tenney, E. R. (2010). Cumulative and career-stage citation impact of social-personality psychology programs and their members. *Personality and Social Psychology Bulletin, 36,* 1283–1300.

O'Leary, J. D., & Crawford, M. W. (2010). Bibliographic characteristics of the research output of pediatric anesthesiologists in Canada. *Canadian Journal of Anesthesia/Journal Canadien d'Anesthésie, 57,* 573–577.

Pan, R. K., & Fortunato, S. (2014). Author Impact Factor: Tracking the dynamics of individual scientific impact. *Scientific Reports, 4,* 4880.

Petersen, A. M., Fortunato, S., Pan, R. K., Kaski, K., Penner, O., Rungi, A., . . . Pammolli, F. (2014). Reputation and impact in academic careers. *Proceedings of the National Academy of Sciences of the United States of America, 111,* 15316–15321.

Petersen, A. M., Wang, F., & Stanley, H. E. (2010). Methods for measuring the citations and productivity of scientists across time and discipline. *Physical Review E–Statistical, Nonlinear, and Soft Matter Physics, 81*(3 Pt 2), 036114. Retrieved from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med5&NEWS=N&AN=20365822

Podlubny, I. (2005). Comparison of scientific impact expressed by the number of citations in different fields of science. *Scientometrics, 64,* 95–99.

Radicchi, F., & Castellano, C. (2012). Testing the fairness of citation indicators for comparison across scientific domains: The case of fractional citation counts. *Journal of Informetrics, 6,* 121–130.
Radicchi, F., Fortunato, S., & Castellano, C. (2008). Universality of citation distributions: Toward an objective measure of scientific impact. *Proceedings of the National Academy of Sciences of the United States of America, 105,* 17268–17272.
ResearchGate. (n.d.). About us. Retrieved from: https://www.researchgate.net/about
Sanderson, M. (2008). Revisiting *h* measured on US LIS and IR academics. *Journal of the American Society for Information Science and Technology, 59,* 317–330.
Sax, L. J., Serra Hagedorn, L., Arredondo, M., & Dicrisi, F. A. (2002). Faculty research productivity: Exploring the role of gender and family-related factors. *Research in Higher Education, 43,* 423–446.
Schreiber, M. (2008). To share the fame in a fair way, h_m modifies *h* for multi-authored manuscripts. *New Journal of Physics, 10,* 040201.
Symonds, M. R. E., Gemmell, N. J., Braisher, T. L., Gorringe, K. L., & Elgar, M. A. (2006). Gender differences in publication output: Towards an unbiased metric of research performance. *PLoS ONE, 1,* e127.
Thelwall, M., & Kousha, K. (2015). ResearchGate: Disseminating, communicating, and measuring scholarship? *Journal of the Association for Information Science and Technology, 66,* 876–889.
Tinazzi, M., Toni, D., Veronese, M., Ajena, D., Cruccu, G., & Calabresi, P. (2014). Scientific research of Italian neurologists from 2008 to 2011. *Neurological Sciences, 35,* 437–442.
Villanueva-Felez, A. (2015). Nanotechnology researchers' collaboration relationships: A gender analysis of access to scientific information. *Social Studies of Science, 45,* 100–129.
Xie, Y., & Shauman, K. A. (1998). Sex differences in research productivity: New evidence about an old puzzle. *American Sociological Review, 63,* 847–870.
Yu, M. C., Wu, Y. C. J., Alhalabi, W., Kao, H. Y., & Wu, W. H. (2016). ResearchGate: An effective altmetric indicator for active researchers? *Computers in Human Behavior, 55,* 1001–1006.

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Institutions Included in the Survey

United States
- A.T. Still University
- Abilene Christian University
- Adelphi University
- Alabama Agricultural and Mechanical University
- Andrews University
- Appalachian State University
- Arizona State University
- Arkansas State University
- Armstrong State University
- Auburn University
- Ball State University
- Baylor University
- Bloomsburg University of Pennsylvania
- Boston University
- Bowling Green State University
- Brigham Young University
- Brooklyn College
- Buffalo State College
- California State University–Chico
- California State University–East Bay
- California State University–Fresno
- California State University–Fullerton
- California State University–Long Beach
- California State University–Los Angeles
- California State University–Northridge
- California State University, Sacramento: Sacramento State
- California University of Pennsylvania
- Calvin College
- Case Western Reserve University
- Central Michigan University
- Chapman University
- Clarion University of Pennsylvania
- Cleveland State University
- College of Saint Rose
- Duquesne University
- East Carolina University
- East Stroudsburg University
- East Tennessee State University
- Eastern Illinois University
- Eastern Kentucky University
- Eastern Michigan University
- Eastern Washington University
- Edinboro University
- Emerson College
- Florida Atlantic University
- Florida International University
- Florida State University
- Fontbonne University
- Fort Hays State University
- Gallaudet University
- George Washington University
- Georgia State University
- Governors State University
- Hampton University
- Harding University
- Hofstra University
- Howard University
- Hunter College
- Idaho State University
- Illinois State University

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Institutions Included in the Survey

Indiana State University
Indiana University–Bloomington
Indiana University of Pennsylvania
Ithaca College
Jackson State University
James Madison University
Kansas State University
Kean University
Kent State University
La Salle University
Lamar University
Lehman College
Loma Linda University
Long Island University–Brooklyn
Long Island University–Post
Longwood University
Louisiana State University
Louisiana Tech University
Loyola University Maryland
Louisiana State University Health–New Orleans
Louisiana State University Health–Shreveport
Marquette University
Marshall University
Marywood University
Mercy College
Massachusetts General Hospital (MGH) Institute of Health Professions
Miami University
Michigan State University
Minnesota State University–Mankato
Minnesota State University–Moorhead
Minot State University
Misericordia University
Missouri State University
Molloy College
Montclair State University
Murray State University
Nazareth College
New Mexico State University
New York Medical College
New York University
North Carolina Central University
Northeastern State University
Northeastern University
Northern Arizona University
Northern Illinois University
Northwestern University
Nova Southeastern University
The Ohio State University
Ohio University
Oklahoma State University
Old Dominion University
Our Lady of the Lake University
Pennsylvania State University
Portland State University
Purdue University
Queens College
Radford University
Rockhurst University
Rush University
Saint Louis University

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Institutions Included in the Survey

Saint Xavier University
Salus University
San Diego State University
San Francisco State University
San Jose State University
Seton Hall University
South Carolina State University
Southeast Missouri State University
Southeastern Louisiana University
Southern Connecticut State University
Southern Illinois University–Carbondale
Southern Illinois University–Edwardsville
Southern University and Agricultural and Mechanical College
St. Ambrose University
St. Cloud State University
St. John's University
State University of New York at Buffalo
State University of New York at Fredonia
State University of New York at New Paltz
State University of New York at Plattsburgh
Stephen F. Austin State University
Syracuse University
Teachers College, Columbia University
Temple University
Tennessee State University
Texas A&M University–Kingsville
Texas Christian University
Texas State University
Texas Tech University Health Sciences Center
Texas Woman's University
Touro College
Towson University
Truman State University
University of Akron
University of Alabama
University of Arizona
University of Arkansas
University of Arkansas at Little Rock
University of Central Arkansas
University of Central Florida
University of Central Missouri
University of Central Oklahoma
University of Cincinnati
University of Colorado Boulder
University of Connecticut
University of Florida
University of Georgia
University of Hawaii at Manoa
University of Houston
University of Illinois–Urbana-Champaign
University of Iowa
University of Kansas
University of Kentucky
University of Louisiana at Lafayette
University of Louisiana at Monroe
University of Louisville
University of Maine
University of Maryland
University of Massachusetts Amherst
University of Memphis

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Institutions Included in the Survey

University of Minnesota–Duluth
University of Minnesota–Twin Cities
University of Mississippi
University of Missouri
University of Montana
University of Montevallo
University of Nebraska–Lincoln
University of Nebraska at Kearney
University of Nebraska Omaha
University of Nevada–Reno
University of New Hampshire
University of New Mexico
University of North Carolina at Chapel Hill
University of North Carolina at Greensboro
University of North Dakota
University of North Texas
University of Northern Colorado
University of Northern Iowa
University of Oklahoma
University of Oregon
University of Pittsburgh
University of Redlands
University of Rhode Island
University of South Alabama
University of South Carolina
University of South Dakota
University of South Florida
University of Southern Mississippi
University of Tennessee–Knoxville
University of Texas at Austin
University of Texas at Dallas
University of Texas at El Paso
University of Texas–Pan American
University of the District of Columbia
University of the Pacific
University of Toledo
University of Tulsa
University of Utah
University of Vermont
University of Virginia
University of Washington
University of West Georgia
University of Wisconsin–Eau Claire
University of Wisconsin–Madison
University of Wisconsin–Milwaukee
University of Wisconsin–River Falls
University of Wisconsin–Stevens Point
University of Wisconsin–Whitewater
University of Wyoming
Utah State University
Valdosta State University
Vanderbilt University
Washington State University
Washington University in St. Louis
Wayne State University
West Chester University
West Texas A&M University
West Virginia University
Western Carolina University
Western Illinois University

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Institutions Included in the Survey

Western Kentucky University
Western Michigan University
Western Washington University
Wichita State University
William Paterson University
Worcester State University
Canada
Dalhousie University
McGill University
Université Laurentienne
Université de Montréal
Université du Québec à Trois–Rivières
Université Laval
University of Alberta
University of British Columbia
University of Ottawa
University of Toronto
University of Western Ontario