



## Bibliometric Analysis of Publications on Augmentative and Alternative Communication: Survey of Electronic Databases

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### ABSTRACT

This paper uses bibliometric analysis to explore current trends in the production and dissemination of research in the field of Augmentative and Alternative Communication (AAC). A history of AAC as a set of nonverbal communication systems and a scientific field of study from the German, North American and Brazilian perspectives provides a foundation for understanding the importance of considering cultural influences on the development and application of scientific advances. Bibliometric results suggest that the United States perspective on the theory, development, and implementation of AAC pervades the literature. This may either restrict adoption of AAC in certain cultures or result in AAC globalization, reflecting the United States perspective. The analysis supports the need for dialog among researchers across cultures and for further research specific to cross cultural collaboration and problem solving in the area of AAC.

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**Key Words:** Alternative and Augmentative Communication; Bibliometric analysis; Literature review

## INTRODUCTION

Collaboration among researchers across continental boundaries is occurring with greater frequency. As such, there is a sharing of information using a variety of terms to reference theories, practices, and perspectives. Such dialog often increases the need for clarification, as the meaning of terms within one language may not easily translate to another [1]. Additionally, as researchers seek to examine practices across countries, differences are exposed with regard to methodology or theory driving implementation of intervention [2]. For those committed to communication, this type of dialog, and all it reveals, becomes quite curious indeed. Questions about how information is disseminated, understood, interpreted and applied between professionals from different cultures emerge. An area where terms take on different meanings is in the field of Augmentative and Alternative Communication (AAC) [1].

Beginning as a term used to represent nonverbal communication systems, the acronym AAC now encompasses a wide range of systems as well as a scientific field of study [3]. However, do scientific and clinical communities worldwide attach the same meaning to the term AAC? Where does the greatest scientific influence originate, and is this knowledge transferred across continental boundaries? Do cultural variables influence the interpretation and application of research to practice? This paper emerged as researchers from Brazil, Germany and the United States (US) began to exchange ideas in an attempt to collaborate and realized two important facts. First, while we often thought we were talking about the same aspect of communication, we were not: words did not easily translate and had different referents. Second, application of methods developed in one country did not neatly transfer to the other. Rather, cultural beliefs shaped interpretation and implementation of methods [4]. Indeed, even in developing this paper, differences in describing something as foundational as the meaning of AAC emerged. The authors realized that the process of examining such issues was an important and enlightening one for the global research community. Therefore, in this paper we examine aspects of the production and dissemination of literature in AAC in North America, Germany and Brazil along with the evolution of the term AAC and its meaning between these regions. The historical development of AAC as a term representing systems of nonverbal communication and a scientific field in these three different areas of the world provides the context for exploring how culture may intersect with practice.

In North America as in Europe during the 1960's, there was increased awareness and sensitivity to the rights of individuals from minority backgrounds [5]. This awareness focused on the rights of those from racial and cultural minority groups as well as persons with disabilities. Such awareness led to efforts to support the social inclusion of persons with a variety of developmental disabilities and to the development of nonverbal communication systems to enhance inclusion [5].

According to Hourcade et al. [5] in the 1960's oral-based intervention pervaded speech-language remediation practice. During that time, some professionals began to teach sign language to persons with severe disabilities.

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The limited fine-motor ability of many patients with severe disabilities along with few communicative partners with whom to share sign language restricted widespread application of this language system. As an alternative, visual communication boards were considered, but were viewed as a system of last resort for fear that the use of such systems would interfere with the individual's speech acquisition.

At that time in the 1960's, interventionists and researchers began to recognize that cognitive and social development were associated with the development of language [3]. Therefore, intervention practices moved from teaching grammar, syntax, and other structures of language to a greater focus on the functional/pragmatic component of communication [3]. Thus, research started to refute the belief that nonverbal communication systems inhibits the development of speech; indeed, multimodality or the use of a combination of communication modes for generating messages became an exemplary framework for Augmentative and Alternative Communication (AAC) [6]. Consequently, nonverbal communication systems became more attractive as an option to enhance social interaction, inclusion and generalization of skills across contexts for those with limited fine-motor and speech ability [3].

In 1971, a team from Ontario Crippled Children's Centre in Canada started a research project with the aim of developing alternative means of communication for children with neuromotor disabilities, and restricted speech skills [7]. This team adapted and applied two ideographic systems: "Signs and Symbols around the World" (developed by Elizabeth Helfman, 1967) and Blissymbols (by Charles K. Bliss, developed in the 1940's). The application of these systems expanded throughout the decade and across the North American continent. Since the 1980's, there has been tremendous growth in the number and variety of available communication devices and systems [3]. Consequently, significant changes in philosophy and intervention for those with limited speech ability have occurred across North America. This evolution in nonverbal communication systems lead to the acronyms AC or AAC (Augmentative Communication or Augmentative and Alternative Communication) being used to describe the types of communication systems (gestural and visual; low-tech boards to electronic systems), with AAC being the term to represent the field of study [8].

Advances in AC/AAC research and practice in North America, along with rapid change in computer technology, graphics and voice synthesis influenced practice across the fields of deafness, neuromotoric disorders, speech-language pathology, and cognitive rehabilitation [5]. In fact, research and practice in the field of AAC in North America has historically occurred across educational, psychological, and speech-language pathology fields [9]. Indeed, when the field of AAC became recognized worldwide with the creation of International Society for Augmentative and Alternative Communication (ISAAC) in 1983, membership included professionals from multiple disciplines pursuing the aims of promoting multi-disciplinary research and disseminating findings through literature and conferences, while also supporting and advocating for those using AC/AAC systems. In North America, AAC was accepted as a broad multi-disciplinary field of study. Sharing knowledge of AC/AAC with the world and across cultures with different languages, beliefs, and affinity for oral language transmission created a context ripe for

interpretational and implementation challenges [9].

In Germany, nonverbal communication systems were introduced in the 1980's; 20 years after introduction in North America. Of particular interest was how the field of special education lead the way in research and practice in the use of nonverbal communication systems in Germany. While application of nonverbal systems occurred across disciplines in North America, special educators were the primary professionals utilizing nonverbal systems in practice and conducting research.

Following a three-month training in Toronto (Canada) in the early 1980's, Hermann Frey, a special educator, published the Blissymbol communication method in German [10-12]. Other special educators from Germany visited North America in the late 1980's and became dedicated to the spread of these alternative communication methods in their country. With the founding of the German-speaking section of the International Society for Augmentative and Alternative Communication (ISAAC-GSC) in 1990 came the introduction of the term AAC in several German research articles. A direct German translation for AAC ("ergänzende und ersetzende Kommunikation EEK") was proposed [13], but a widespread adoption of the term did not occur. After some discussion, the ISAAC-GSC decided to introduce the term "Unterstützte Kommunikation" (supported communication) for AAC. While other terms were occasionally used within the literature during the 1990's, by the end of 1990's the term "Unterstützte Kommunikation" was most prevalent in the Germany literature and in practice [14]. Although AAC was at that time recognized as the term for the nonverbal communication systems and a field of study on the European continent, "Unterstützte Kommunikation" and not AAC was the term used to reference the communication systems in Germany.

The historical background of special education in Germany [15,16] might in part explain why alternatives to spoken language were so long contemplated but not accepted in Germany. It also sheds light on why the field of special education and not the field of speech language pathology embraced and developed the idea of nonverbal communication systems as alternative forms of interaction allowing access to educational contexts.

During the 1960's and 70's, differences in philosophies existed between special educators and speech language pathologists. While special educators were focused on using nonverbal communication systems with individuals with physical impairments, speech-language pathologists in Germany were addressing the communication needs of those with dysarthria. "Sprachheilbehandlung" (speech treatment) was the German term adopted in the 1960's and 1970's to describe intervention for individuals with dysarthria. The speech treatment used for those with dysarthria focused on oral communication [17,18]. During this time the first publications containing communication aids (signs and technology) in the title were published in the special education literature [19,20]. By the end of 1970's communication treatment for persons with profound multiple disabilities was increasing, and adopted communication intervention for individuals with limited cognitive skills [21] emerged like "basic communication" [22], "basal stimulation" [23]. These treatments supported very basic communication development and required

no requisites from the person with disability, no linguistic skills nor intentionality.

Following Hermann Frey's work in Canada, doctoral students in the field of special education began conducting research in Germany on nonverbal communication systems in the 1980's and 90's [24-26]. Dissemination of their work and the development of German researchers in the AAC field allowed for widespread use of AAC methods in German-speaking countries. Implementation of AAC methods moved from initial use with school children with physical disabilities and/or intellectual disabilities to adoption with preschoolers with physical disabilities and/or intellectual disabilities. It wasn't until the late 1990's and early 2000s, that AAC addressed adults with speech disorders [27,28]. About ten years later speech-language pathologists began implementing AAC systems, which had previously been used almost exclusively by special educators [29].

In Brazil, nonverbal communication systems were introduced in 1978 through the psychology department of a rehabilitation center "Quero-Quero" in São Paulo [30-32]. The speech-language therapy department of the same center soon began to utilize the Bliss Symbol System in clinical practice [30]. At that time, alternative communication methods were implemented to address the needs of children with severe communication disorders. Foundational to the Brazilian implementation of nonverbal communication using the Bliss Symbol System was the social-historical/interactional perspectives [30, 32-35]. According to this perspective, language is understood as part of social practice, as a person's constitutive activity, social interactions and societal organization. Therapeutic practice in this case based on the child's relationship with language, beginning with interactions within the evaluation to the formulation of a feasible therapeutic program with the aim of turning the communication-disabled child into a speaker quite irrespective of the communication mode (oral, with sign language, gestures, flashcard-based). This social-historical/interactional perspective is adopted in Brazil in clinical language therapy, along with other perspectives such as cognitive and behavioral.

The adoption of nonverbal communication systems as a clinical tool became more mainstream in the 1990's due to the following factors: widespread use of these alternative methods in clinical care specialist units in special educational institutions [36] and its implementation in hospitals and rehabilitation centers, especially in São Paulo and Rio de Janeiro [37]. Terminology was at first a rather complex issue in Brazil due to difficulties in translation which generated disputes in different areas of knowledge/clinical practice as well as to different theoretical perspective adopted in each study. However, a consensus was reached from 2007 with adoption of the term "Comunicação Suplementar e/ou Alternativa" [38,39].

From the 2000s to the present day there has been an expansion of educational practices in AAC arising from the inclusive school movement. The 2001 Decree of the Brazilian Government was one of the first official documents ensuring equal rights to children with deficiencies in schools<sup>1</sup>. With the inclusion of students with restricted oral

<sup>1</sup>Guatemala Convention (2012). Decree n. 956, October 8th, 2001.

skills in general education and public schools, and the availability of educational technology came the widespread distribution of the Boardmaker™ software (Mayer-Johnsson) by the Ministry of Education in Brazilian primary schools.

A recent study examining articles published in Brazilian journals of Speech and Language Pathology and Special Education between 2005-2015 revealed that the production of knowledge on AAC methods is evenly distributed across the fields of “*Fonoaudiologia*” (Speech Language Pathology) and “*Educação Especial*” (Special Education) [40]. It should be stressed that descriptors in the Portuguese language were used in that study: “*Comunicação Alternativa*”; “*Comunicação Suplementar e ou Alternativa*”; “*Comunicação Alternativa e Ampliada*”.

Expansion of use of AAC systems beginning in the 1970's, and the emergence of ISAAC in 1983, meant that AAC was becoming a recognized field important to clinical practice, education and research across continents [3]. With the establishment of this field came the need to standardize terms which could facilitate the international and transdisciplinary development of the field [21]. Lloyd [8] proposed the standardization of a glossary of terms and concepts used in the AAC. He recommended integration of the terms Augmentative Communication and Alternative Communication which were both being used in the literature. Lloyd noted, “using both terms can become awkward in many communication situations” [8]. A second article proposed stronger emphasis on the issue of a taxonomy for AAC [41]. As a result, the ISAAC terminology committee formed in March 1988 with the purpose of standardizing terms used to represent nonverbal communication systems, the development of guidelines, policies and recommendations, and a discussion of evolving issues within the field [1,21,42]. This committee took into consideration the recommendations proposed by the *Augmentative and Alternative Communication Journal*, and established that publication as the hallmark journal in this new field.

For a consensual adoption of the AAC term, three documents on the policies and recommendations were published in the *Augmentative and Alternative Communication Journal* in 1985 [1,8, 42]. However, the term AAC was already being used in the titles of publications across disciplines [41,43]. The first document published by the ISAAC Governance and Committee Activities on AAC Terminology and Issues provided a list with definitions and justification for 13 key terms, one of which was AAC, recommended for use by researchers involved in the development of this new field [21].

In the second official document published in 1990, the ISAAC Governance and Committee Activities on AAC Terminology included the term AAC in the list of key terms as well as in the document's title [42]. This document also established an agreement to perform and publish a review of terms used in the field at two-year intervals, thereby updating keywords and concepts in the AAC field [42]. Two new procedures were introduced in this second document: the use of keywords and the establishment of AAC Terminology Policy and Issues [42]. The third document responsible for establishing AAC as a term representing nonverbal communication systems and a field in the US

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was the Update for AAC Terminology Policy and Issues. Again, the term AAC was one of the defined concepts and it was also found in the document's title [1].

Still, during its first three years of publication, the *Augmentative and Alternative Communication* journal did not often employ the term AAC. Despite the work of the ISAAC committee to standardize terms, publications originating in the US used numerous terms to describe the systems and methods. These included augmentative communication [44], communication augmentation equipment for impaired communication, nonverbal communication [45], augmentative communication aids and systems (ACS) [46], systems being used for nonverbal individuals [47], augmentative models of communication [48], augmentative communication system [49], augmentative systems of communication [50,51], assistive aid [52], nonverbal communication systems [53], visual-spatial augmentative communication, pictorial communication [54], and multiple augmentative communication systems [55]. In the *Augmentative and Alternative Communication* Journal, the first two published papers using the term AAC were by Berninger and Gans [56,57]. Shortly thereafter use of the term AAC became more frequent in the literature published within the US [41,58-62].

Researchers from other countries also used varying terms for AAC in publications during the early years of the field. A review of the journals published in Brazil between 1997 and 2007 [38] revealed six different terms to describe AAC including: "*Comunicação Alternativa e Suplementar*" [31]; "*Comunicação Alternativa*"; "*Comunicação Suplementar e/ou Alternativa*" [38]; "*Sistemas Alternativos e Facilitadores de Comunicação*"; "*Comunicação Suplementar*" (Pires & Limongi, 2002); and "*Comunicação Alternativa e Ampliada*". Research publication specific to AAC systems in Brazilian speech-language pathology [38] and special education journals [40] revealed the same six terminologies as in Chun's review [38], plus two additional terms: "*Comunicação Suplementar e Alternativa*" and "*Comunicação Aumentativa e Alternativa*". According to Krüger et al. [40], the selection of the term to reference AAC is strongly dependent on the theoretical basis adopted by the author. This perspective is an interesting one indeed and has implications for the dissemination of knowledge.

In Brazil, the reason for the lack of a consistent, official and general term for AAC may be due to the fact that AAC was only consolidated as an area of intervention when ISAAC was founded in 1983 but gained more acceptance following the last AAC Terminology and Issues Update [1]. Commonly, the short form "*Comunicação Alternativa*" (Alternative Communication) has been widely adopted, and has been the term used in the five National Conferences of ISAAC Brazil from 2005 until 2015.

The question of whether a term such as AAC reflects theoretical perspective or some other variable is an interesting one and can influence research and application of methods, materials, and technology related to the field.

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Examination of the terms used within a field of study and across languages can assist collaboration and understanding in this increasing global and culturally minded world, when access for all citizens is paramount. Lloyd & Blischak [1] suggest that, “although many people in the field may know what is meant by a given term, the same meaning may not be shared by others. Some terms used by many people in one country are not easily translated into others languages”.

A more recent study was conducted by Schlosser et al. [63], who reviewed of evidence-based practice (EBP) in AAC. One of the conclusions of Schlosser’s et al. research was that EBP in AAC was indeed scattered across disciplines, journals and databases. They noted that lack of training by AAC practitioners was one reason for limited cohesion in the field. They also recommended improvement in indexing and filtering of evidence across databases and AAC-relevant literature.

This discussion of the evolution of the field of AAC along with the application of the term AAC raises questions regarding trends in the AAC field across countries. Examining the origins of and trends in the literature on AAC may shed light on how knowledge of AAC is being researched across and within cultures. If different terms are being used to reference practice and research in the field, are scholars across countries able to benefit from each other’s knowledge? As such exploring use of the terms AC/AAC across the literature has the potential to increase our understanding of why certain cultures and countries do or do not implement AAC as a viable alternative for individuals with severe communication impairments. It may also help us to understand how researchers across continental boundaries can share knowledge, expanding perspectives, and theoretical foundations with an appreciation of cultural backgrounds.

## MATERIALS AND METHODS

The research method with utility for exploring dissemination of literature across countries and languages is bibliometric analysis. Bibliometric analysis is defined as the quantification of production indices and the overall dissemination of scientific knowledge by means of quantitative and statistical techniques. In the present study, such analysis was performed for assessing quantitative parameters of AAC-related publications. According to de Oliveira Lacerda et al. [64], observable parameters are the theme-related papers, the literature references used and the most cited authors, journals and papers. In the last few years, bibliometrics has been used as a statistical method for analyzing distribution and features of scientific publications, which allows researchers from different fields of knowledge to better justify choices of journals by relevance, impact and contribution in a given area [65]. In addition, according to Hammouti [66] bibliometric studies are becoming efficient tools for the evaluation of research output of institutions and countries. For our purposes, bibliometrics can also provide insight into challenges faced when multicultural research is conducted.

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Using bibliometric analysis, this study explored the following questions: 1) Are there historical trends in the evolution of terms AC/AAC? 2) Which countries are contributing the most to the field of AAC? 3) Which fields of study currently contribute to this body of knowledge? 4) Are there trends in contributions to the literature by country?

In April 2015, a search in the relevant databases was performed using the keywords “Alternative Communication” and “Augmentative and Alternative Communication” (AC/AAC). Both Alternative Communication, and Augmentative and Alternative Communication were chosen as keywords for the search because of the historical evolution of the terms as referents for various nonverbal communication systems. We were interested in understanding if terms were used more in one country versus another. Additionally, the time span included in the search represented an overlap in the use of terms. We wanted to capture as many publications that would represent changes in trends as possible, and it was deemed that use of the two terms would accomplish that goal.

Databases were selected that most aligned with the aims and focus of this study with regard to content specific to AC/AAC. For each database the title of article, abstract and keywords were used as the main search terms. The sequence below describes the process followed for this study:

1. Identify relevant databases to use as sources for the bibliometric analysis. Three databases were searched: SCOPUS, Web of Science, Science Direct, PubMed;
2. Survey papers, exporting data and data formatting;
3. Engage in data analysis.

SCOPUS is the largest database of peer-reviewed abstracts and citations worldwide. SCOPUS has search engines for tracking, analyzing, viewing, classifying and refining search results. SCOPUS is comprised of 21,915 titles of over 5,000 editors worldwide, which resulted in 55 million records. In total, 883 documents were found specific to the searched topic terms.

Web of Science has records covering over 110 years, which makes it the most relevant database with regard to number of records and diversity of contents. Web of Science offers researchers the opportunity of obtaining information from different disciplines, as well as past and present trends. In total, there are 18,711 titles from diverse scientific journals in Web of Science and 634 records were found to on topics be related to the search terms.

PubMed is a service offered by the US National Library of Medicine® (NLM) that provides free access to the MEDLINE® database of indexed citations and abstracts to medical, nursing, dental, veterinary, health care, and pre-clinical sciences journal articles. This database was developed by the National Center for Biotechnology Information (NCBI) and is updated daily with new citations, including additional selected journals not in MEDLINE®. Our search yielded 435 documents specific to AC/AAC.

The total number of records obtained from the three databases was 1,952 documents. It was necessary to adopt a filtering procedure in order to avoid redundancy, or documents that were present in more than one database. Duplicated records had a same title, author name and year of publication, following the same criteria of EndNote® X6 software. The redundancy check yielded 690 duplicated records, resulting in an end total sample of 1,262 valid documents for this analysis.

Although the main aim of EndNote® is to manage bibliographies, citations and references, the software also offers features useful in bibliometric research. It was possible to extract year of publication, authors, sources of articles and keywords used from the total sample of publications on AC/AAC. SCOPUS offers additional reports such as country of origin, affiliation, citations and areas of research, all of which were salient to this study. However, due to the implementation of multiple search engines for the initial review of data, results were separated in two groups. The first group was related to the total sample and yielded the reports provided by EndNote®; whereas the second group included SCOPUS records found using the “analyze search results” tool offered by that search engine. As a result, this paper represents the findings from both the SCOPUS and EndNote search engines.

## RESULTS

The bibliometric indicators allow for the characterization and discussion of important aspects with respect to the term AC/AAC as it appears in the literature. Graphs and tables are presented along with an explanation of the findings. To begin, a search to examine the frequency of publications using AC or AAC in the title was conducted. Figure 1 represents a timeline of frequency of publications using the terms “Augmentative and Alternative Communication” or “Augmentative Communication”.

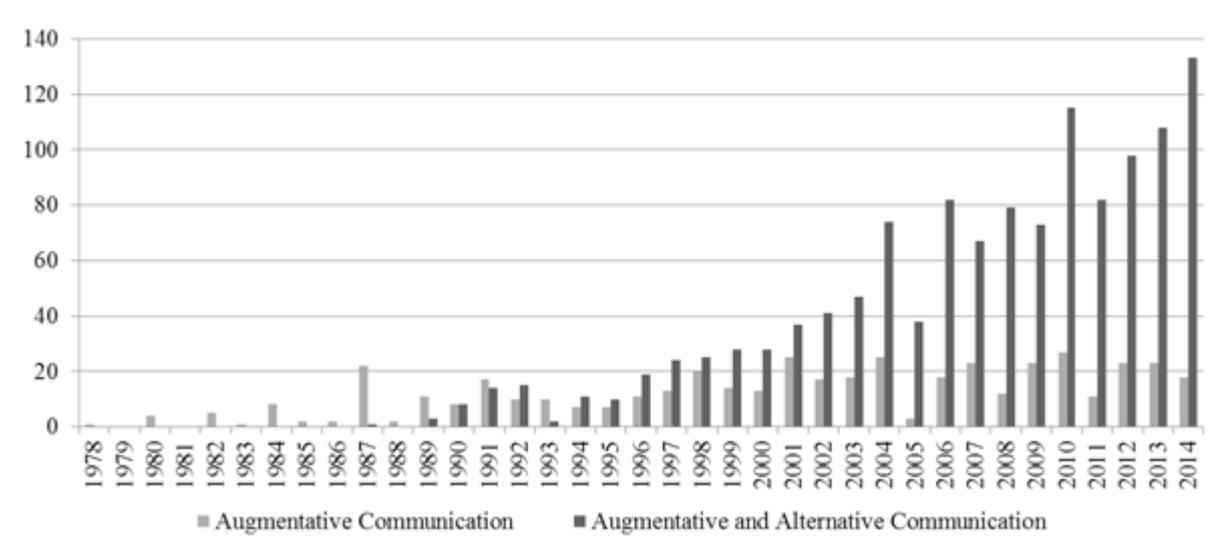


Figure 1: Publications using the terms AAC or AC over time, from 1978 until 2014, according to EndNote®

Figure 1 represents an almost 4-decade period examining the use of the terms “Augmentative and Alternative

Communication” (AAC) and “Augmentative Communication” (AC). AAC yielded 1,262 records, whereas AC resulted in 454 records. Inspection of the figure reveals that the original descriptor for nonverbal communication systems in the treatment of those with severe communication impairments was the term AC. The gradual introduction and use of the more explicit term AAC evolves from its introduction in 1987 with consistent increase in use from 1994 onwards. The prevalence of this term from 1994 could be a result of the last AAC Terminology and Issues Update published in June 1992 [1]. The second observation is that while the frequency of the term AC in the literature remained stable across the 4-decade period, the frequency of AAC as the term referring to nonverbal communication has steadily increased.

To better examine where the scientific research in AAC is occurring, frequency of papers by country was tabulated. Table 1 presents a list of the 10 countries where the highest percentage of publications originates between 1978 and 2014. Note that in the following Tables (1-8) percentages are relative to the total number of papers surveyed. However, it must be stressed that the total of papers according to this criterion does not necessarily correspond to the total sample as international collaborations could lead to more than one country of origin per publication. Still, the US was the most productive country in the field of AAC during that 36-year time frame. With regard to the list of 10 countries with the highest contribution of publications, the English-speaking countries represent just over 85% of the publications. Results illustrated in Table 1 corroborate findings from another study [67], where the authors analyzed 52 papers published only in the *Augmentative and Alternative Communication* Journal between 1993 and 1994; among 52 papers, 41 (78%) were from the US.

Country	N	%
United States	482	54.59%
United Kingdom	88	8.72%
Canada	69	7.81%
Italy	33	3.74%
Sweden	30	3.40%
New Zealand	27	3.06%
South Africa	21	2.38%
Norway	19	2.15%
Netherlands	16	1.81%

Table 1: 10 countries of origin and percentages for AAC topic papers according to SCOPUS

Tables 2 and 3 present the ranking of the publications found by journal title, using both EndNote® and SCOPUS searches. Again, a list of the 10 journals with the most publications and related percentages is provided. The bulk of the scientific production is published in the *Augmentative and Alternative Communication* Journal. However, for

some journals ranking appeared to vary according to the search engine used, while other scientific journals ranking did not change. For example, the Journal of Speech, Language, and Hearing Research (JSLHR) appeared in both search engines with the same number of papers, but there was a discrepancy in the number of papers on the subjects disability and rehabilitation assistive technology across the two search engines used. Note that percentages refer to the total number of AAC papers surveyed (N=1,262 in Endnote, N=883 in Scopus).

Journal Title	n	%
AAC: Augmentative and Alternative Communication	416	32.96%
Disability and Rehabilitation Assistive Technology	44	3.49%
Journal of Speech, Language, and Hearing Research	31	2.46%
American Journal of Speech Language Pathology	30	2.38%
Assistive Technology	29	2.30%
Aphasiology	16	1.27%
International Journal of Language and Communication Disorders	14	1.11%
Revista Brasileira de Educação Especial	13	1.03%
Child Language Teaching and Therapy	13	1.03%
Communication Disorders Quarterly	12	0.95%

Table 2: 10 journals with the most frequent publications on the topic of AAC according to EndNote®

Journal Title	n	%
AAC: Augmentative and Alternative Communication	346	39.18%
Journal of Speech, Language, and Hearing Research	29	3.28%
American Journal of Speech Language Pathology	24	2.72%
Assistive Technology	15	1.70%
Disability and Rehabilitation Assistive Technology	14	1.59%
International Journal of Language and Communication Disorders	13	1.47%
Child Language Teaching and Therapy	13	1.47%
Communication Disorders Quarterly	12	1.36%
Aphasiology	11	1.25%
Journal of Developmental and Physical Disabilities	11	1.25%

Table 3: 10 journals with the most frequent publications on the topic of AAC according to SCOPUS

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Figure 2 shows the publications on AAC during the time frame 1978-2014 in journals whose titles contain the descriptor “language” and those with “education and teaching” descriptors. It should be stressed that at this juncture, from findings shown in Figure 1, only the AAC term was surveyed as AAC yielded three times more hits than the shorter version AC, with a growing trend (cf. Figure 1). Grouping journals into these two categories occurred by assigning “Language” to journals on speech-language therapy and social psychology, and “Education” to journals on education and teaching.

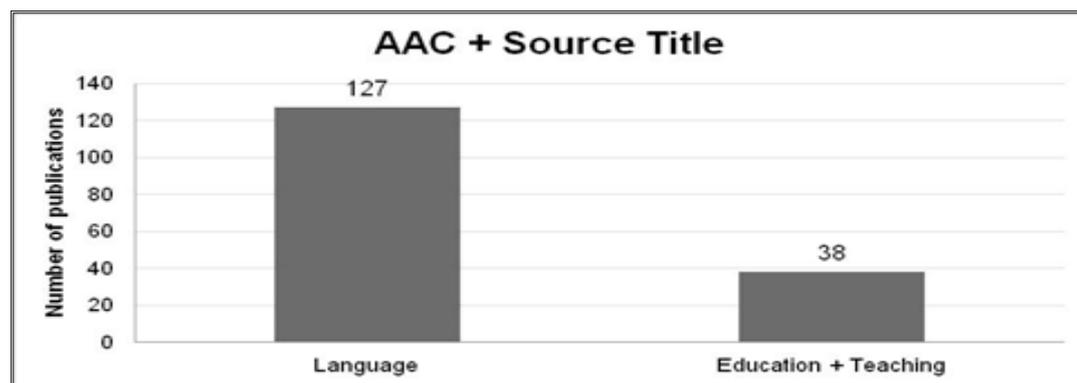


Figure 2: Publications using the terms AAC or AC over time, from 1978 until 2014, grouped into two main categories

Table 4 represents the 10 universities where published research originates on the topic of AAC. Percentages are relative to the total number of papers found in Scopus. Pennsylvania State University ranks first, followed by three other institutions, two of which are located in the US. Eight of the 10 universities listed are located in an English-speaking country. Those that are non-English-speaking are identified with an \*.

Affiliation	n	%
Pennsylvania State University	75	8.49%
University of Nebraska - Lincoln	31	3.51%
University of Sydney	28	3.17%
Northeastern University	23	2.60%
University of Texas at Austin	23	2.60%
Universiteit van Pretoria*	21	2.38%
University of Toronto	21	2.38%
Universita degli Studi di Bari*	20	2.27%
Victoria University of Wellington	19	2.15%

Table 4: Documents by affiliation (10 most relevant) using SCOPUS

Table 5 provides a listing of the most frequent disciplines publishing on the topic of AAC. It should be noted that the total number of articles does not correspond to the total number of publications, as the same paper could be classified as pertaining to more than one discipline area. Percentages are relative to the total number of papers found in Scopus. However, medical and health professions fields prevail, while computer science ranks third. This may be due to the development of software and hardware for AAC.

Subject Area	N	%
Medicine	676	76.56%
Health Professions	571	64.67%
Computer Science	232	26.27%
Social Sciences	186	21.06%
Psychology*	166	18.80%
Arts and Humanities	81	9.17%
Neuroscience*	52	5.89%
Nursing	47	5.32%
Engineering	29	3.28%
Biochemistry, Genetics and Molecular Biology	22	2.49%

Table 5: Ranking of discipline areas publishing on the topic of AAC according to SCOPUS

Tables 6 and 7 provide a listing of the most productive authors, according to searches done with EndNote® and SCOPUS. Note that percentages refer to the total number of AAC papers surveyed (N=1,262 in Endnote, N=883 in Scopus).

Author	n	%
Light, J.	63	4.99%
Beukelman, D. R	44	3.49%
Sigafoos, J.	43	3.41%
O'Reilly, M. F.	42	3.33%
Balandin, S.	40	3.17%
McNaughton, D.	39	3.09%
Schlosser, R. W	36	2.85%
Alant, E.	33	2.61%
Lancioni, G. E.	28	2.22%
Sutton, A.	19	1.51%

Table 6: 10 most productive authors on the topic of AAC according to EndNote®

English speakers are among the most frequent authors. The most productive author is American, affiliated with Pennsylvania State University, Department of Communication Sciences and Disorders. The second and third most prolific authors are Australians from the University of Sydney, Children's Hospital Education Research Institute, and Deakin University in Melbourne.

Author	n	%
Light, J.	47	5.32%
Beukelman, D. R	34	3.85%
Sigafoos, J.	32	3.62%
O'Reilly, M. F.	32	3.62%
Balandin, S.	29	3.28%
McNaughton, D.	24	2.72%
Schlosser, R. W	19	2.15%
Alant, E.	18	2.04%
Lancioni, G. E.	15	1.70%
Sutton, A.	15	1.70%

Table 7: 10 most productive authors on the topic of AAC according to SCOPUS

Finally, with regard to citations, Table 8 represents the 10 most cited papers in AAC (from 1978 to 2014). Seven of the most frequently cited papers were published between 2000 and 2010. Interestingly, not all authors in the most productive lists are among the most cited, although the first authors and some of the next authors are within the most cited. Again, publications are in US journals, representing a US theoretical and cultural perspective. Again, percentages refer to the total number of publications surveyed in Scopus.

Title	Citations
Mirenda, P. (2003). Toward functional augmentative and alternative communication for students with autism: Manual signs, graphic symbols, and voice output communication aids. <i>Journal of Language, Speech and Hearing Services in Schools</i> . [68]	5.32%
Millar, D.C., Light, J., Schlosser, R.W. (2006). The impact of augmentative and alternative communication intervention on the speech production of individuals with developmental disabilities: A research review. <i>Journal of Speech, Language, and Hearing Research</i> . [69]	3.85%
Ganz, J.B., Simpson, R.L. (2004). Effects on communicative requesting and speech development of the picture exchange communication system in children with characteristics of autism. <i>Journal of Autism and Developmental Disorders</i> . [70]	3.62%
Light, J., Drager, K. (2007). AAC technologies for young children with complex communication needs: State of the science and future research directions. <i>Journal of Augmentative and Alternative Communication</i> . [71]	3.62%
Schlosser, R.W., Wendt, O. (2008). Effects of augmentative and alternative communication intervention on speech production in children with autism: A systematic review. <i>American Journal of Speech-Language Pathology</i> . [72]	3.28%

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Schepis, M.M., Reid, D.H., Behrmann, M.M., Sutton, K.A. (1998). Increasing communicative interactions of young children with autism using a voice output communication aid and naturalistic teaching. <i>Journal of Applied Behavior Analysis</i> . [73]	2.72%
Hemsley, B., Sigafoos, J., Balandin, S., Forbes, R., Taylor, C., Green, V.A., Parmenter, T. (2001). Nursing the patient with severe communication impairment. <i>Journal of Advanced Nursing</i> .	2.15%
Yorkston, K.M. (1996). Treatment efficacy: <i>Dysarthria Journal</i> . [74]	2.04%
Light, J. (1997). "Let's go star fishing": Reflections on the contexts of language learning for children who use aided AAC. <i>Journal of Augmentative and Alternative Communication</i> . [75]	1.70%
Parette Jr., H.P., Brotherson, M.J., Huer, M.B. (2000). Giving families a voice in augmentative and alternative communication decision-making. <i>Journal of Education and Training in Mental Retardation and Developmental Disabilities</i> . [76]	1.70%

Table 8: Top 10 Documents Cited Pertaining to AAC According to SCOPUS

## DISCUSSION

Important to this study was the historical evolution and use of the terms AAC and AC across countries. Therefore, both terms "Augmentative and Alternative Communication" and "Augmentative Communication" were searched for in the fields: title, abstracts or keywords of the scientific papers. All records returned one of these identifiers in at least one of the three fields. However, subsequent analyses focus only on the AAC term as this term yielded three times more hits than the shorter version AC, with a growing trend (cf. Figure 1).

The broadest finding suggests that the term AAC has been accepted by the scientific community and has been used with increased frequency within scientific works published since 1994. The second observation is that the majority of the work being conducted on AAC is occurring in the US and in English-Speaking countries. As such, the work is being published in journals from those countries. A third observation confirms that AAC is not only a term used to represent nonverbal communication systems, but it is also a field in and of itself, and one that is multi-disciplinary in nature. This bibliometric survey revealed that publications on the topic of AAC do not exclusively evolve from speech-language pathology researchers. Rather, publications regarding AAC originate from many areas of study, thus confirming that AAC is a multi- and interdisciplinary field. Still, results suggest that although the numbers of articles using the term AAC increased each year in the various disciplines, the speech-language pathology literature had the most publications. However, the most significant findings are that the majority of research being conducted in the field of AAC originates from the US; and overall the research in AAC appears to represent the work of a core group of researchers.

These findings point towards some interesting trends in the AAC literature from the early development of nonverbal communication systems, to the inception of the field, and application of AAC across countries. Historically, different professions took the lead in AAC research and practice across countries. This diversity of perspectives has created a field that is truly multi-disciplinary. However, our results suggest that in the US, speech-language pathologists currently contribute the most to the understanding of the field. Often, literature represents collaboration across disciplines, which is not surprising given that it is the application of AAC systems across several aspects of living

(e.g., education, vocation) that would be of interest for many researchers. However, the preponderance of papers published within the speech-language pathology literature has the potential to restrict application of the content across disciplines. Although the intimate tie between AAC and enhance communication makes speech-language pathology a natural fit for research and practice, it does raise questions regarding theoretical perspectives. That is, increased diversity within the literature from a professional discipline perspective has the potential to expand our knowledge.

The second consideration pertains to the increase in scholarship in the field of AAC. From the introduction of AAC as a referent for nonverbal communication systems and as a field, there has been skepticism about AAC and debate for persisting with oral methods of intervention. This has been especially true in countries other than the US. However, the increase in publications on AAC would suggest that its application is widespread and accepted. Interestingly, our analysis suggests that acceptance of AAC may not be true across all cultures and countries. That is, while AAC is discussed in the English literature, the frequency of AAC research from authors and universities residing in non-English-speaking countries is low. ISAAC has a presence around the world and our research suggests that more work needs to occur to better understand the cultural considerations that would promote expansion of AAC knowledge in other countries. For instance, prior research revealed numerous publications from Brazil on nonverbal communication systems using a variety of terms. Yet, our survey did not capture that literature as the terms Brazilian used were the Portuguese terms for AC/AAC [38,40].

From this analysis, the bulk of scientific research on AAC has been conducted in the US, which corroborates findings from von Tetzchner and Jensen [67]. These authors propose that one reason for the limited diversity in theoretical framework and intervention approaches in AAC may be the predominance of research from the US. In 1996, they proposed the need for more research from other countries in order to integrate a cultural component that would enhance understanding development and implementation of AAC across cultures and countries [67]. Currently, it is not known if the reason for fewer scientific publications on AAC from non-English-speaking countries is related to cultural or philosophical (reliance on oral intervention methods as best practice) beliefs, access to translated English manuscripts on which to build new theoretical models, cultural differences in the theoretical constructs guiding AAC development or application, limited funding for research in AAC, limited researchers specializing in AAC, use of different terms to represent similar concepts, or some other reason. All of these avenues would be important to explore as the field of AAC expands and cross-cultural research collaboration occurs.

The 1992 publication of the ISAAC Governance and Committee Activities concerning AAC Terminology and Issues [1] identified AAC as the official term for the field and the numerous nonverbal communication systems. It was the aim of this paper to evaluate the overall acceptance of the term AAC in an international context, as well as to explore the spectrum of scientific evidence produced in the field of AAC. As such, we found that AAC is accepted as the term for numerous nonverbal communication systems and is an area that has been most researched in the US.

As a preliminary study, this paper reveals important discrepancies in the science of AAC across countries. It is plausible that research is occurring in other countries, but not under the title of AAC. Zangari et al. [3] suggest that the discussion of terms and definitions of AAC is likely to continue into the next decade, though that was 20 years ago. This paper reopens that discussion and recommends that the dialogue now include a global/cultural perspective.

## CONCLUSIONS

There are limitations to this study to explain prior to drawing conclusions and discussing future research directions. First, the time frame for this study was from 1978 to 2014. Given the proliferation of research in AAC findings should be considered with this in mind. Second, only three databases were used to identify relevant publications which could have restricted professional and cultural representation. Likewise, this bibliometric analysis identified specific aspects of publications for evaluation including the terms AC/AAC, countries of origin, main journals with AAC output, affiliations, discipline areas, productivity by authorship. Certainly, other aspects could be analyzed and are available for analysis within the search engines chosen.

Third, given that alternative terms for nonverbal communication systems are used in European and Brazilian cultures, this study only reflects adoption of the term AAC in these cultures. It would be inaccurate to assume that research and practice using nonverbal communication systems is not occurring in other cultures because the key term AAC did not yield more publications for various countries. Therefore, a comparative analysis of AAC with more common terms from other countries could yield differing findings. Fourth, as a result we cannot claim that our results represent every article published on AAC using AAC, AC or another culturally relevant term. Finally, our results were not cross-referenced. Future research should engage in cross referencing to obtain correlations of partial outcomes. For example, analysis of country of origin versus affiliation, and affiliation versus field of study could be explored.

Given that our research represents an initial examination of this topic, and that AAC is the official term for the field and the varied nonverbal communication systems, beginning our research using AC/AAC and limiting the search parameters was reasonable. Yet, given the historical evolution of nonverbal communication systems in other countries, it is not surprising that the official term is not widely used across countries. The findings of our study suggest that currently there is a strong US and speech-language pathology influence on dissemination of knowledge in AAC. It is not known if the prevalence of research on AAC in the US, speech language pathology literature is resulting in globalization of the US perspective on AAC or restricting application of AAC across countries. It certainly is possible that one prevailing view on AAC would have an influence on application and possess different cultural beliefs and/or history with the development of intervention for those with communication impairments. Knowledge of this would provide valuable insight and enhance perspectives. Therefore, our research does suggest the need for inter-cultural dialogue and collaboration.

Future studies could explore if research in nonverbal communication is being conducted in non-English-speaking countries.

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If research is not being conducted, or if nonverbal systems are not being widely implemented, it would be important to understand why. To better understand cultural aspects of AAC, it will be important to search terms relevant to specific cultures, as well as to engage in a comparative analysis across professional fields and across cultures. For example, future work should extend searched keywords to include terms specific in foreign languages such as “*Comunicação Suplementar e/ou Alternativa*” in Brazil and “*Unterstützte Kommunikation*” in Germany. An extension of this would be to analyze theoretical frameworks grounding research from other countries and engage in intercultural comparisons.

We also suggest that future studies review the glossary of terms and definitions developed by the ad hoc terminology committee for ISAAC presented in the last AAC Terminology Policy and Issues [1]. Exploration of changes in those definitions and terms is also needed. Integrating a cultural perspective into that work would be important.

To close, if language represents and is intimately tied to culture, and AAC is a mechanism for transmitting language, there is greater need to study AAC utilizing a cultural perspective lens. Such research would help to identify if and what types of initiatives or mechanisms need to be implemented to extend the body of knowledge on AAC globally, as well as expand upon and adapt the current English-speaking perspective prevalence on the topic.

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