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Note: Prior to Volume 16, Number 1 (Spring 2013) the *Journal of Behaviorology* went by the name of *Behaviorology Today,* which occasionally published fully peer–reviewed articles, explicitly so labeled. Beginning with Volume 15, Number 1, in January 2012, *all* material receives full peer review. See the "Submission Guidelines" for details.

* This issue does not contain any new or updated TIBI course syllabi. New syllabi, or updates of previous syllabi, may appear in future issues. (See the *Syllabus Directory* for details.)

Publishing about Autism Spectrum Disorder in the Journal of Applied Behavior Analysis *and the* Journal of the Experimental Analysis of Behavior: Bibliometric Analysis (1958–2017)

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Abstract: The article analyzes publications about autism in the leading behavioristic journals—the *Journal of Applied Behavior Analysis* (*JABA*) and the *Journal of the Experimental Analysis of Behavior* (*JEAB*). In total, 7,211 publications published between 1958 and 2017 were identified in Scopus. 597 of them contains terms (in the title, abstract, and/or in the author's key words) which were used as search topics: "autism," "autistic," "Asperger syndrome," and "pervasive developmental disorder." It was shown that the vast majority of articles concerning autism are published in the *JABA* (98%). The dynamics of publications including cumulative curves are explored. Six thematic clusters in the field of studying autism are highlighted by constructing the terms map based on keyword analysis. The practice of co–citation is analyzed. The results would suggest that there is the essential schism between experimental and applied research on autism within the framework of behavior analysis.

According to the data provided in the STM report[1] for 2015, more than 2.5 million scientific articles are published annually, and this number increases every year approximately by 3% (Ware & Mabe, 2015). This trend makes analytical surveys more relevant because they allow to present publications in a specific field of knowledge in a structured manner. One of the most effective methods for constructing such surveys is bibliometric analysis, which makes it possible to create a "map" of a particular field of scientific research on the basis of quantitative data. In this article, bibliometric analysis is applied to the publications about autism published in the leading behavioristic journals—the *Journal of the*

Experimental Analysis of Behavior (JEAB) and the *Journal of Applied Behavior Analysis* (JABA). It is worth noting that this type of research is only beginning to be applied to publications about autism spectrum disorders. Thus, in the 2016 article, authors explicitly state that their research is, as far as they know, the first bibliometric study on ASD (Sweileh et al., 2016). Their analysis, on the one hand, was limited because it covered the period from 2005 to 2014; on the other hand, it was global because it included all the articles indexed in the Scopus database during this time. Based on the findings, the authors—among other things—concluded that there is the linear increase of the publications on ASD, and one of the main focuses of analysis is molecular genetics. The focus of this article is the ASD research conducted within the framework of behavior analysis. As J. L. Matson with coauthors noted "while genetics has been the most studied of all topics,

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[1] The STM association is one of the leading professional associations, uniting scientific publishers from many countries of the world which in total control about 66% of all journal articles.

applied behavior analysis (ABA) has also received a great deal of attention, and has arguably yielded the most promising results of any research area to date" (Matson et al., 2012, p. 144). As mentioned above, this research is limited to two leading behavioristic scientific journals—the *Journal of the Experimental Analysis of Behavior* and the *Journal of Applied Behavior Analysis*. According to SCImago Journal Rank (SJR), these journals have the impact factors among the journals in the field of behavior analysis. The *JEAB* impact factor for 2016 is 0.941, and the *JABA* impact factor is 0.587. The third is the *Behavior Analyst* with an impact factor of 0.376. Thus, the analysis of publications in *JEAB* and *JABA,* which are not only the most ranked but also the most prestigious journals in the field of respectively experimental and applied analysis of behavior (Austin & Carr, 2000) can provide an adequate picture of studies of autism spectrum disorders within the behavioristic approach.

Methods

The data for this study were retrieved from the Scopus database which was chosen after comparison with Web of Science. It should be noted that none of these bases can claim the perfect representation of the publications within the scope of this research. For example, some articles on autism are included in Web of Science Core Collection without abstracts and keywords and, therefore, can be missed during the compilation of the information base if their titles do not include a direct indication of the ASD[2]. At the same time the Scopus database is also not free from inaccuracies[3]. In general, in the context of this research, Scopus has the following advantage. When searching for articles in Web of Science, Keywords Plus are used in addition to Author Keywords. Keywords Plus are extracted by an automatic computer algorithm that analyzes the titles of an article's references. These Keywords Plus may include terms that are not included in the list of Author Keywords, as well as those that do not appear in the title or the abstract of the article. The representativeness of this parameter remains controversial and, consequently, the compilation of information using

Web of Science may lead to the inclusion of irrelevant articles in it[4].

The terms "autism," "autistic," "Asperger syndrome," and "pervasive developmental disorder," with the logical operator of "OR," were used as search words. These terms were identified in the article title, the abstract, and/or in the keywords of the publications. The search period was set from 1958 to 2017. Also, in the field "source title," the search was limited by two sources—the *Journal of Applied Behavior Analysis* and the *Journal of the Experimental Analysis of Behavior*. Initially all types of publications were retrieved. In total, 597 publications meeting these criteria were identified, the majority being articles (n = 584). The remaining 13 documents are scientific reviews, so they were also taken into account in further research.

The free software tool VOSviewer, version 1.6.7 (van Eck & Waltman, 2010) was used to analyze and visualize relationships between terms and co–citations. VOSviewer allows to construct bibliometric networks based on citation, co–occurrence of keywords, and other parameters. In these maps the size of the circles and the font of the label represents the number of occurrence, and the distance between two circles indicates the relatedness between them. The color of the circle is determined by the cluster to which it belongs. As developers of this software note, the VOS (Visualization Of Similarities) mapping method produces better structured maps than multidimensional scaling, another popular technique of bibliometric analysis (van Eck & Waltman, 2010).

Results and Discussion

Trends with Time

Figure 1 shows that there is the stable time trend of growth in the number of publications about autism. It is essential that this trend is connected exclusively with the *Journal of Applied Behavior Analysis* (JABA). For the entire period of the existence of the *Journal of the Experimental Analysis of Behavior* (JEAB; i.e., from 1958 to 2017), only 11 publications on autism were published, with a maximum number of annual publications not exceeding two. Most of the publications (8 of 11) fall in 2007–2017. Thus, 98% of autism studies within the framework

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[2] The paper "Suppression of self–stimulation—three alternative strategies" (Harris & Wolchik, 1979) would be an example. Its subjects are four boys with autistic–like behavior.

[3] For example, the article "Relationship of self–stimulation to learning in autistic children" (Koegel & Covert, 1972) is not indexed in Scopus.

[4] Example, the article "Reinforcement frequency and restricted stimulus control" (Dube & McIlvane, 1997) is included in the search results when the word autism is used as a search topic. Three individuals with moderate to severe mental retardation are studied in this article, and autism is not mentioned in the text at all. But references include articles that contain the term "autism," so this term was included in Keywords Plus.

of the behavioristic paradigm (586 of 597) refer to applied behavior analysis. The distribution of publications for the five–year periods is given in Table 1.

As can be seen from the data given in Table 1, not only the absolute number of publications about autism increases in time, but also their relative number, especially in the last 15 years. Thus, for 2013–2017 years, the percentage of publications related to the study of ASD was almost 44% in JABA[5]. Moreover, the share of similar publications in JEAB is also growing slowly: if prior to the beginning of the 2000s it fluctuated around 0%, then for 2013–2017 it increased to 1.5%.

Another interesting *general* trend is the change of the leader: before 1992 most of the articles appeared in the field of fundamental science, (i.e., the experimental analysis of behavior [JEAB]), but from 1993 articles in the field of applied science (JABA) began to prevail.

Term Analysis

Considering that the overwhelming number of articles included in the research base was published in the *Journal of Applied Behavior Analysis*, a term map was constructed only for this journal. The vosviewer software was used to analyze and visualize the terms. We determined for each pair of Author keywords the co–occurrence frequency with a threshold of seven. Terms with a general meaning, as well as those designating autism spectrum disorders directly were not included, because the very compilation of the information base of the research delineates the subject area. The list of excluded words is *autism, autistic children, developmental disabilities, autism spectrum disorder, children,* and *Asperger syndrome.* Singular and plural forms of the word were considered as one term (e.g., mand and mands). Also such terms as *discrete–trial instruction*, *discrete–trial training* and *discrete–trial teaching* were treated as synonyms. 50 terms of 978 met the final criteria.

Figure 2 shows the results of the term analysis. The size of the circles represents the occurrence of a term (i.e., the larger the size, the higher the occurrence of a term in Author keywords). The distance between any pair of terms provides information on their relatedness as measured by co–occurrences. Colors are used to group terms into topics. Terms with the same color belong to the same cluster and are more closely related than terms with different colors.

The co–occurrence map shows that terms form a complex network in which six thematic clusters can be distinguished. The first cluster (red color) is associated

with the *functional analysis of behavior* in the context of studying the different types of reinforcement (differential, negative, non–contingent reinforcement, etc.) and the maintenance and extinction of different forms of behavior. The second cluster (cyan color) is closely related to the first and focuses around the concept of *stereotypy*. It includes the vocal stereotypy, procedures for reducing stereotypy, the possibility of using stereotypic behavior as reinforcement, etc. Central themes of the third cluster (blue color) are *preference assessment* and *compliance/ noncompliance*. The fourth cluster (green color) is associated with the study of *social skills* (play, social interaction, etc.). Its fundamental theoretical concept is *generalization.* The fifth cluster (purple color) focuses around the problem of *verbal behavior* and its various classes (mand, tact, etc.). Along with verbal behavior, its central concept is *stimulus control*. The sixth cluster (yellow color) concerns the problem of *skill acquisition* mainly by *discrete–trial training* (and also includes discrimination, error correction, etc.).

Authors and Their Cooperation

The 597 publications related to autism were written by 1,065 different authors. 1,048 are authors of articles published in JABA, and 31 are authors of articles published in JEAB. Thus, only 14 people (1.3%) have publications in both journals, and none of the authors have more than one article in JEAB. The majority of the authors (67.3%) are only credited in one publication, and only 7.6% have more than five articles. Table 2 shows the most productive authors publishing on the topic of autism within the behavior analysis framework.

As can be seen from the data presented in Table 2, the most productive authors are not necessarily the most cited. Thus, among authors with at least five publications, R. L. Koegel takes the first place in the number of citations, and E. G. Carr (N = 6, C = 687, C/N = 114.5, h = 38) ranked first in the ratio of the number of citations to the number of publications (this ratio can be considered as some indicator of effectiveness). From the top five of most productive authors, only W. W. Fisher has publications both in JABA and JEAB.

The cooperation of the authors was analyzed with vosviewer software. In order to create a readable network, the threshold was set to a minimum of five publications for an author. Authors who are not related with other authors in the network were excluded. With these criteria applied, 72 authors were found to be linked in nine clusters (Figure 3).

The most cited article belongs to the most efficient authors by the C/N criterion (N = 1, C = 266, C/N = 266). This article is an evaluative review on the token economy (Kazdin & Bootzin, 1972). The most cited article published after the 2000s focuses on the usage

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5 As one of behaviorists-experimenters in a conversation with the author of this article jokingly (and, it is worth noting, with displeasure) noticed: "It seems that behaviorism will become a synonym for autism soon."

of the Picture Exchange Communication System (PECS) with children with autism (C = 245) (Charlop–Christy et al., 2002).

Citation Analysis

To assess the interaction between JABA and JEAB, we analyzed self– and cross–citations in these journals from 1968 to 2017, both for all publications, and for publications about ASD. The period from 1958 to 1967 was not included in the citation analysis, because JABA was not published at that time.

In general, as can be seen from Table 3, the percentage of self–citations ranges from 27.2% to 40.5% for JABA, and from 25.1% to 45.1% for JEAB. It is noteworthy that these journals are characterized by differently directed time trends: the percentage of self–citations increases for JABA and decreases for JEAB. If to compare these data with the data shown in Table 1, it can be seen that the percentage of self–citations co–varies with the total number of articles: the more articles are published in the journal, the higher the level of self–citations (p=0.72 for JABA; p=0.85 for JEAB; p<0.05).

The value of cross–citations in these journals differs significantly. On average, 4.5% of all citations in JABA were JEAB publications (second rank), up to 7.8% in some periods (1993–1997). The percentage of cross–citations for JEAB is much smaller: on average, the value of citations from JABA is only 0.9% (14th place), but there is an upward trend: in the last two five–year intervals the value of citations from JABA was 2% and 2.3% respectively.

Our data coincide with the results of other authors (Poling, Picker, Grossett, Hall–Johnson, & Holbrook, 1981; Poling, Alling, & Fuqua, 1994; Elliott, Morgan, Fuqua, Ehrhardt, & Poling, 2005). Analyzing self–citations and cross–citations in JABA and JEAB for 1993–2003, Elliott et al. (2005) indicated that the growth in the percentage of JEAB citations in JABA is connected with the efforts of the editorial actions by JABA editors toward integration of applied and fundamental areas of behavior analysis. At the same time, the level of JABA citations in JEAB remained stable and can be connected with the fact that the editorial policy of this journal was unchanged. It can be pointed out that the twofold increase in the share of JABA citations in JEAB observed over the past decade gives reason to hope that the editors of JEAB also began to make efforts towards the integration of fundamental and applied science and, consequently, we can expect further increase in JABA citations. Nevertheless, the general observation that Pauling et al. (1981) made more than three decades ago remains fair: there is the schism between experimental and applied behavior analysis and it is still not overcome.

The analysis of values of self– and cross–citations for JABA for articles related to the study of autism, shows that they practically do not differ from general trends: the average percentage of self–citations is 38.6%, the average percentage of cross–citations of JEAB articles is 4.4%. Figure 4 shows the map of co–citations constructed with the VOSVIEWER software for articles on autism published in JABA. The minimum number of citations of the source was set to 50. 25 sources met this threshold.

A completely different picture emerges in the analysis of JEAB articles on autism: the value for self–citations is 22.7% and the value for cross–citations of JABA articles is 13.4%. In other words, the percentage of self–citations is lower, and the percentage of cross–citations is much higher, than for the total number of publications. Interestingly, if in general JABA occupies the 14th rank in the list of journals that are cited in JEAB articles (after such journals as *Journal of Experimental Psychology: Animal Behavior Processes, Psychological Review, Journal of Comparative and Physiological Psychology, Science, Animal Learning & Behavior, Journal of Experimental Psychology*, etc.), then for the articles about autism, JABA rises to second rank. Thus, although the number of JEAB articles about autism is extremely small, it can be noted that much more attention is paid to the results of applied research there.

Conclusion

The results of our research showed that within the behavior analysis framework the study of autism is concentrated in the applied area, and there is a steady increase in the number of publications about ASD both in absolute and relative terms. Its percentage was almost 44% in 2013–2017. We have identified six main clusters of research in this area by the terms analysis. Both in behavior analysis in general and in the research field related to autism, there is the schism between experimental and applied works. Perhaps, as noted by Pauling et al. (1981), this is due to the fact that no one has yet clarified how experimental studies can be used in applied behavior analysis. And you can probably agree that this is no cause for concern; nevertheless the idea, that the fundamental study of the nature of ASD from the position of the experimental analysis of behavior is capable to advance applied works in this area, is quite intriguing.❧
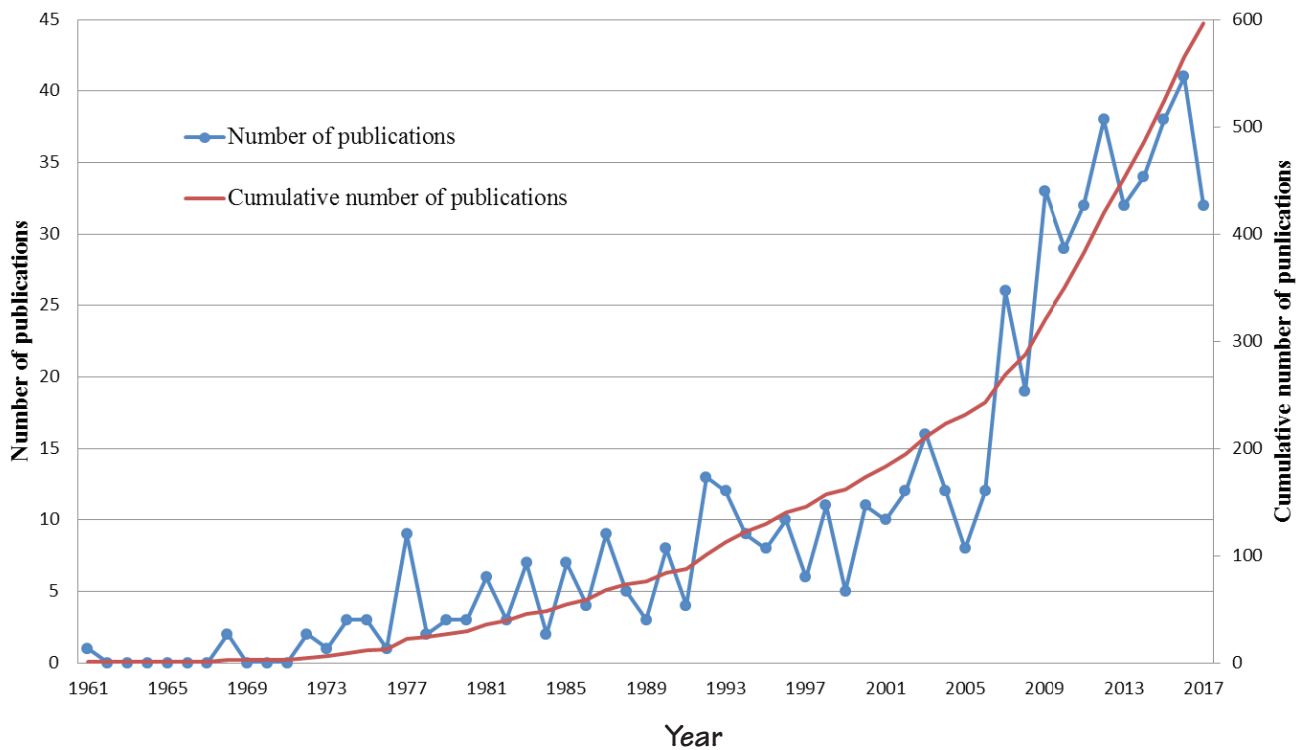
Figure 1. Number of publications on autism, and cumulative number of publications about autism, in JABA and JEAB by year (1958–2017)

Table 1: Distribution of Publications about Autism in JABA and JEAB (1958–2017)

	Number of articles on autism		Total number of articles		% articles on autism	
	JABA	*JEAB*	*JABA*	*JEAB*	*JABA*	*JEAB*
1958–1962	Not published	1	Not published	301	Not published	0.3
1963–1967	Not published	0	Not published	503	Not published	0
1968–1972	4	0	219	533	1.8	0
1973–1977	17	0	369	476	4.6	0
1978–1982	17	0	285	364	6	0
1983–1987	29	0	215	337	13.5	0
1988–1992	31	2	255	317	12.2	0.6
1993–1997	45	0	317	293	14.2	0
1998–2002	49	0	304	246	16.1	0
2003–2007	72	2	308	234	23.4	0.9
2008–2012	149	2	432	241	34.5	0.8
2013–2017	173	4	396	266	43.7	1.5
Total number	586	11	3100	4111		

Note: Only scientific articles and reviews were taken into account when counting the number of publications. The total number of publications, including notes, errata, editorial articles, etc., was 7423.
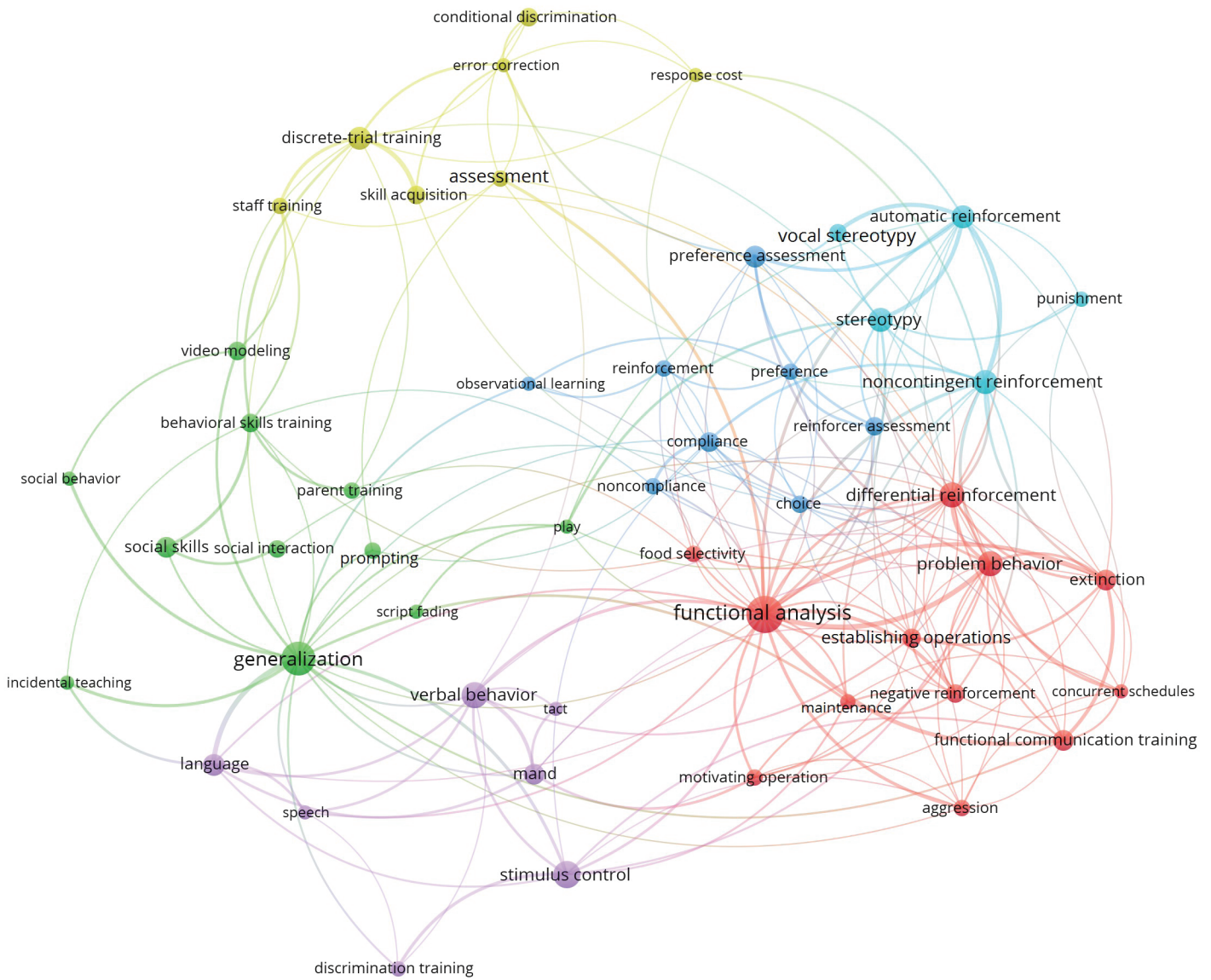
Figure 2. The term map of Author keywords of the publications about autism in JABA (1968–2017)

Table 2: Top 5 Productive Authors Publishing on ASD in JABA and JEAB (1968–2017)

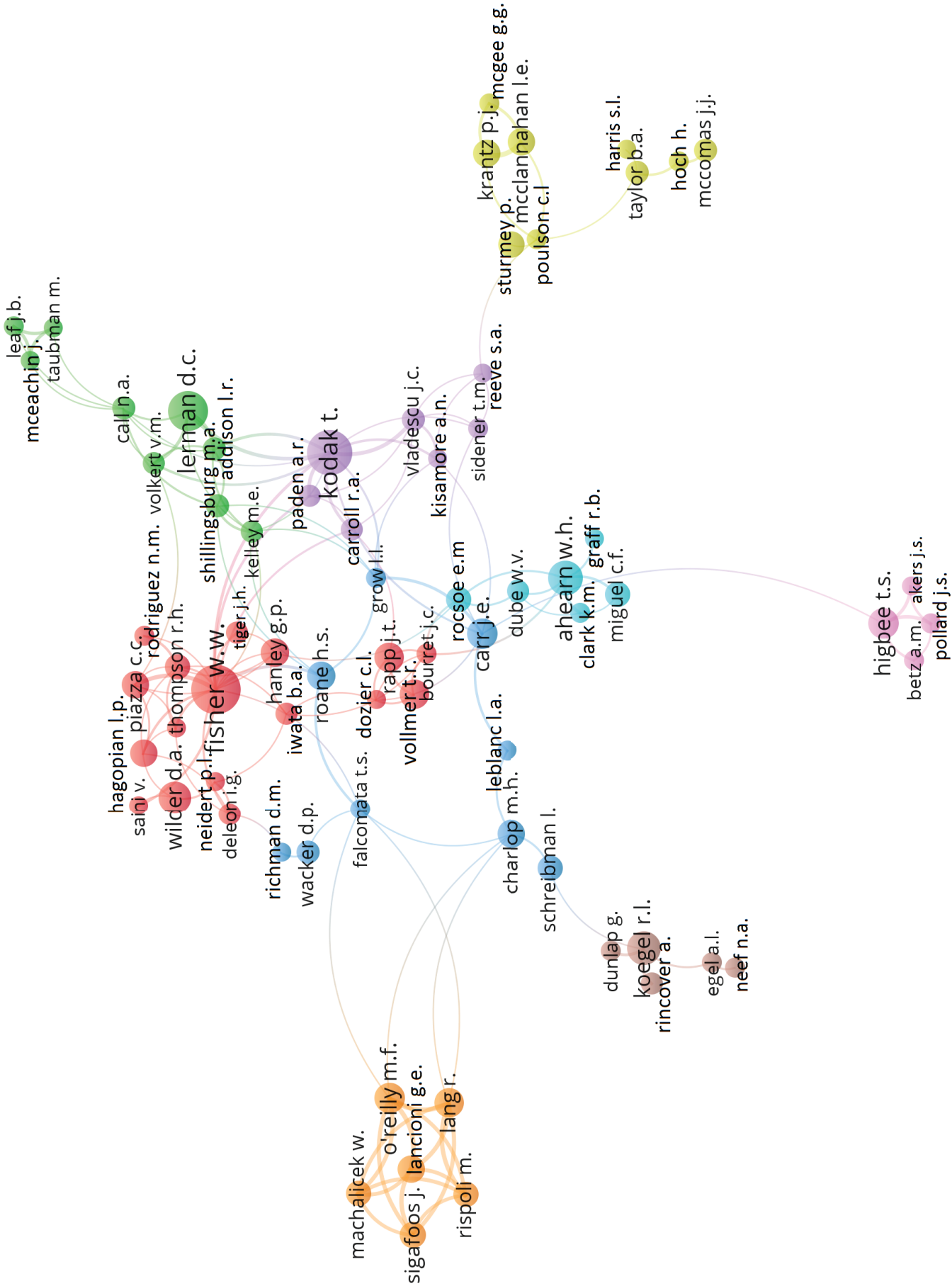| Rank	Author	Country	Number of publications (N)	Citations (C)	C/N	*h*–index
1	Fisher W.W.	США	36	841	23.36	39
2	Kodak T	США	30	288	9.60	13
3	Lerman D.C.	США	23	329	14.30	26
4	Ahearn W.H.	США	18	442	24.56	17
5	Koegel R.L.	США	17	1590	93.53	47

Figure 3. Network of co-authorship for ASD research in JABA and JEAB (1958–2017)
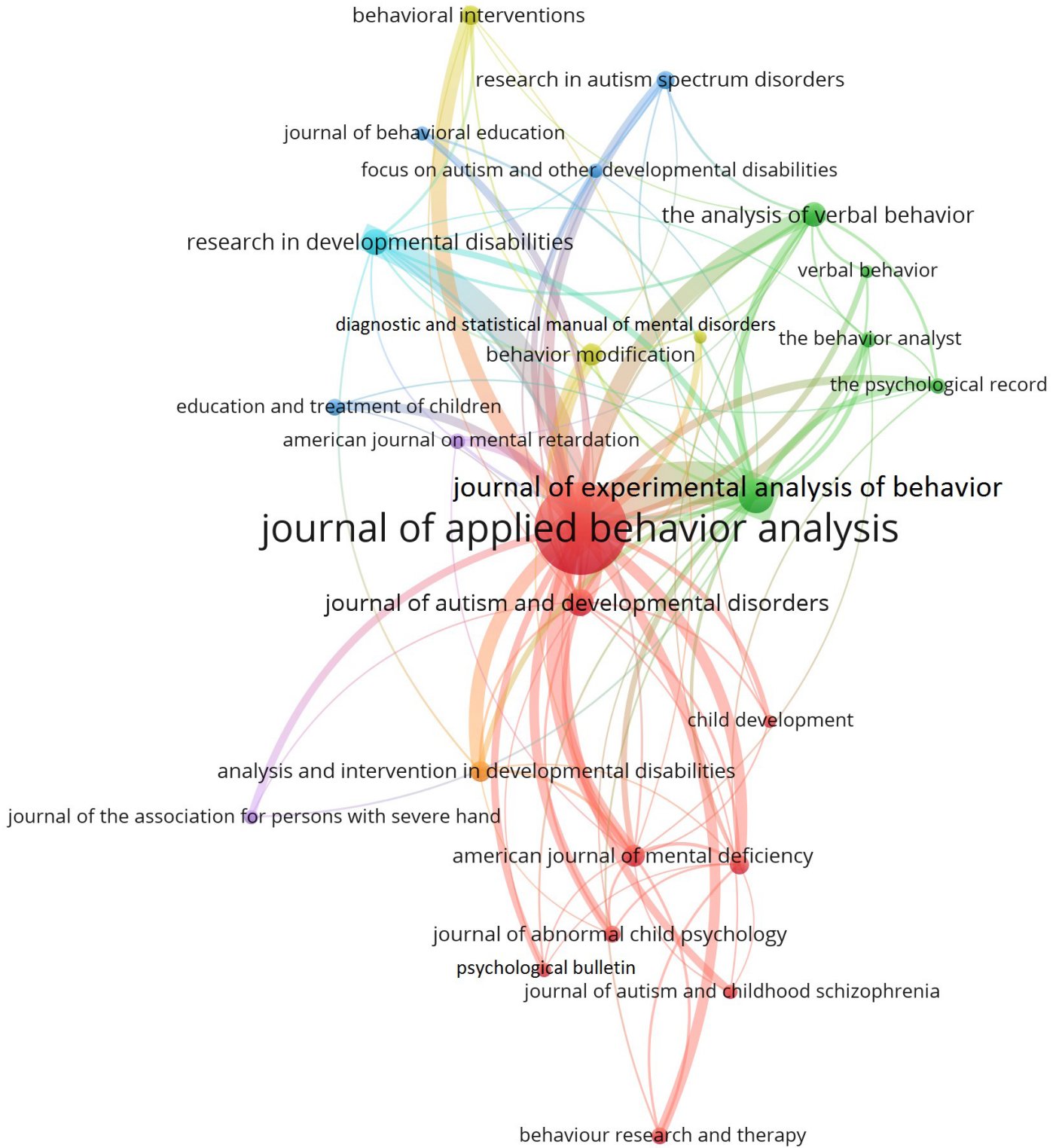
Figure 4. Co–citation analysis for cited sources in the publications about autism in JABA (1968–2017)

Table 3: Self– and Cross–Citations in JABA and JEAB (1968–2017)

| | All articles | | | | | | Articles about autism | | | | | |
| | *JABA* | | | *JEAB* | | | *JABA* | | | *JEAB* | | |
	JABA %	*JEAB %*	*JEAB rank*	*JEAB %*	*JABA %*	*JABA rank*	*JABA %*	*JEAB %*	*JEAB rank*	*JEAB %*	*JABA %*	*JABA rank*
1968–1972	27.2	5.8	2	44.0	0.1	62	19.0	2.0	10			
1973–1977	30.2	2.5	3	45.1	0.2	37	27.2	6.9	3			
1978–1982	22.9	0.7	15	44.9	0.3	31	23.9	0.5	45			
1983–1987	24.1	2.3	4	39.7	0.6	19	25.0	0.5	27			
1988–1992	24.1	2.7	2	38.0	0.8	16	33.6	1.4	8			
1993–1997	28.6	7.8	2	32.8	0.5	25	32.3	8.5	2			
1998–2002	39.8	7.0	2	35.7	0.6	18	45.8	7.3	2			
2003–2007	40.1	6.8	2	31.6	0.9	9	45.3	6.5	2			
2008–2012	40.5	4.8	2	30.2	2.0	5	46.6	4.4	2			
2013–2017	38.0	4.9	2	25.1	2.3	4	40.2	4.1	2			
In total	32.3	4.5	2	36.1	0.9	14	38.6	4.4	2	22.7	13.4	2

Note: Considering the small number of publications about autism in JEAB, self–citations and cross–citations for five–year intervals were not analyzed.

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