Computerized cognitive training: a scientometric review*

Entrenamiento cognitivo computarizado: una revisión cienciométrica

Treinamento cognitivo computadorizado: uma revisão cienciométrica

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Abstract

This article presents a narrative review of the scientific literature on computerized cognitive training (CCT), supported by a scientometric approach to systematically map and contextualize research trends in the field. Records were retrieved from the Web of Science (WoS) and Scopus databases, yielding 290 and 239 documents, respectively. After merging datasets and removing duplicates, 328 unique publications published between 2000, and February 2023 were retained for analysis. Scientometric techniques were applied to describe the evolution of scientific production, citation dynamics, country-level contributions, journal impact, and collaboration structures among authors and sources, which subsequently informed the narrative interpretation of the field. Results show a sustained growth in CCT-related publications since 2011, with a notable increase in citation activity between 2011 and 2017. The United States leads scientific production and citation impact, followed by Australia and Germany. Journal analysis indicates that CCT research is primarily published in high-impact, Q1-ranked journals, including Biological Psychiatry, Schizophrenia Bulletin, and The American Journal of Geriatric Psychiatry. Overall, the combined narrative and scientometric perspective reveals that CCT constitutes a consolidated and expanding research domain, characterized by strong scientific visibility, thematic specialization, and increasing international collaboration.

Keywords

computerized cognitive training, cognitive rehabilitation, executive functions, scientometric analysis, research trends.

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Resumen

Este artículo presenta una revisión narrativa de la literatura científica sobre el entrenamiento cognitivo computarizado (ECC), apoyada en un enfoque cienciométrico para mapear y contextualizar de manera sistemática las tendencias de investigación en el campo. Los registros se recuperaron de las bases de datos Web of Science (WoS) y Scopus, obteniéndose 290 y 239 documentos, respectivamente. Tras la integración de ambos conjuntos de datos y la eliminación de duplicados, se conservaron 328 publicaciones únicas, correspondientes al período comprendido entre los años 2000 y febrero de 2023. Las técnicas cienciométricas se emplearon para describir la evolución de la producción científica, la dinámica de citación, las contribuciones por país, el impacto de las revistas y las estructuras de colaboración entre autores y fuentes, lo que permitió sustentar la interpretación narrativa del campo. Los resultados evidencian un crecimiento sostenido de las publicaciones sobre ECC desde 2011, con un incremento notable de la actividad de citación entre 2011 y 2017. Estados Unidos lidera la producción científica y el impacto por citaciones, seguido por Australia y Alemania. El análisis de revistas muestra que la investigación en ECC se concentra principalmente en revistas de alto impacto clasificadas en Q1, entre ellas Biological Psychiatry, Schizophrenia Bulletin y The American Journal of Geriatric Psychiatry. En conjunto, la perspectiva narrativa y cienciométrica revela que el ECC constituye un campo de investigación consolidado y en expansión, con elevada visibilidad científica, especialización temática y creciente colaboración internacional.

Palabras clave

entrenamiento cognitivo computarizado, rehabilitación cognitiva, funciones ejecutivas, análisis cienciométrico, tendencias de investigación

Resumo

Este artigo apresenta uma revisão narrativa da literatura científica sobre o treinamento cognitivo computadorizado (TCC), apoiada por uma abordagem cienciométrica para mapear e contextualizar sistematicamente as tendências de pesquisa na área. Os registros foram recuperados das bases de dados Web of Science (WoS) e Scopus, resultando em 290 e 239 documentos, respectivamente. Após a fusão dos conjuntos de dados e a remoção de duplicatas, 328 publicações únicas, publicadas entre 2000 e fevereiro de 2023, foram mantidas para análise. Técnicas cientométricas foram aplicadas para descrever a evolução da produção científica, a dinâmica de citações, as contribuições por país, o impacto das revistas e as estruturas de colaboração entre autores e fontes, o que posteriormente informou a interpretação narrativa da área. Os resultados mostram um crescimento sustentado nas publicações relacionadas ao TCC desde 2011, com um aumento notável na atividade de citação entre 2011 e 2017. Os Estados Unidos lideram a produção científica e o impacto de citação, seguidos pela Austrália e pela Alemanha. A análise de periódicos indica que as pesquisas sobre TCC são publicadas principalmente em periódicos de alto impacto, classificados no Q1, incluindo Biological Psychiatry, Schizophrenia Bulletin e The American Journal of Geriatric Psychiatry. De modo geral, a perspectiva combinada

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narrativa e cientométrica revela que o CCT constitui um domínio de pesquisa consolidado e em expansão, caracterizado por forte visibilidade científica, especialização temática e crescente colaboração internacional.

Palavras-chave

treinamento cognitivo computadorizado, reabilitação cognitiva, funções executivas, análise cientométrica, tendências de pesquisa.

Introduction

Scientometrics, a discipline dedicated to the quantitative study of science and research, provides a valuable approach for analyzing and assessing scientific production in emerging fields. One such field is computerized cognitive training (CCT), which has gained prominence as an intervention aimed at enhancing key cognitive skills such as memory, attention, language, problem-solving, and decision-making. Various studies have validated its applicability and efficacy across diverse populations, ranging from children to older adults, including individuals with specific conditions, whether neurological, such as ADHD, or psychiatric, such as depression (P. Harvey et al., 2023; Kirschner et al., 2008; Kueider et al., 2012; Park et al., 2014).

Although systematic reviews and scientometric studies have delved into subtopics of CCT—such as its effects in strokes or mild cognitive impairment (Fava-Felix et al., 2022; Li et al., 2022)—a gap remains in comprehensively mapping the global dynamics of CCT research. These dynamics encompass trends in annual production output, leadership contributions by country, the leading journals in the field, and patterns of collaboration among authors.

To address this gap, this study aims to provide a comprehensive scientometric mapping of academic production on CCT. To provide a comprehensive overview, data from the two most renowned academic databases, Scopus and Web of Science (WoS), was merged, using advanced tools like *bibliometrix* and tosr. This integration is crucial because, depending on the area of knowledge, there could be a preference for one database over another (Leydesdorff & Rafols, 2009; Peng et al., 2021; Pranckutė, 2021; Waltman & Eck, 2015). This dual and methodological approach represents an innovation in scientometric research on CCT.

Anticipating some findings, the prominence of the United States in scientific production stands out, accounting for 63.63 % of the publications. In addition, a notable increase was observed in publications related to CCT between 2011 and 2017. During this period, authors such as Lampit, Ebster, et al. (2014) underscored the relevance of cognitive skills as predictors of job performance.

This article is structured as follows: First, we describe the methodology used to retrieve and select documents. Next, we divide the results into four sections: annual trends, country analysis, journals of interest, and collaboration networks. Finally, we discuss conclusions, limitations, and directions for future research.

Methodology

To conduct a comprehensive analysis of the literature on CCT, a broad search was

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carried out in the WoS and Scopus databases, covering the period from 2000 to February 2023 (see Table 1). For the purposes of this study, the R packages bibliometrix (Aria & Cuccurullo, 2017) and tosr were used to facilitate data generation. Only recently have researchers begun to merge records from both databases into a single analysis. Grisales et al. (2023) highlighted the importance of incorporating both WoS and Scopus to achieve more comprehensive scientometric evaluations, as certain research domains show a higher volume of publications on one platform compared with the other. The search yielded 290 records from WoS and 239 from Scopus; however, after merging and removing duplicates, a total of 328 records were retained. This result indicates that 38 articles (11.58 %) were indexed exclusively in Scopus and were not present in WoS.

Tabla 1

Parameters used for the literature search on computerized cognitive training (CCT)

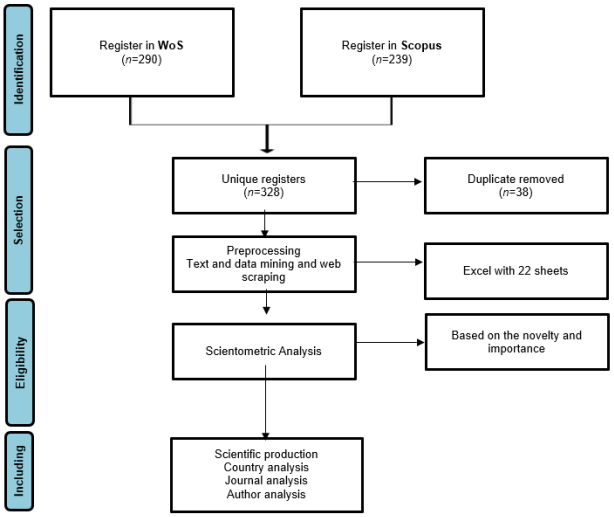
Parameters	Web of Science (WoS)	Scopus
Rank	2000–2022	
Date of search	February 17, 2023	
Type of document	Articles, books, book chapters and conferences	
Search field	Title	
Keywords	Computerized cognitive training	
Results	290	239
Total (WoS + Scopus)	328	

Source: own elaboration.

Figure 1 illustrates the overall process for identifying articles related to CCT. The PRISMA method was used to document the selection process step-by-step. Data preprocessing was performed using text mining and web scraping to extract information on authors, journals, and countries from the articles' DOI. This procedure generated an Excel file with 22 worksheets containing data from the initial queries, the merged files, and disaggregated data of authors, journals, and countries. The code for this process was developed in R and is available on GitHub. After the dataset was cleaned, a scientometric analysis was conducted to examine annual scientific production over the past 22 years and the metrics of countries measured in three variables: productivity (total articles), impact (citations received), and quality (journal quartiles in Scimago).

Figure 1

Workflow for the identification, processing, and scientometric analysis of literature on computerized cognitive training (CCT).



Source: own elaboration.

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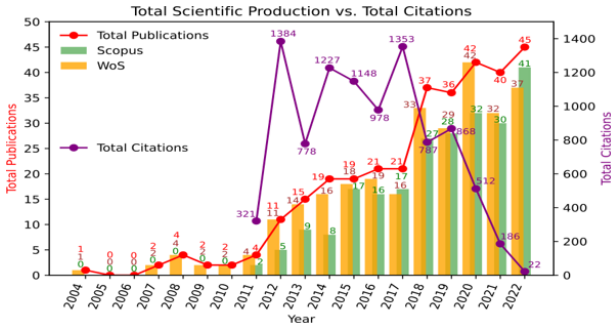
Results

Scientific production

Figure 2 presents the growth trend in publications on CCT. The graph shows a significant increase in research output within this field over the past 11 years. The number of articles indexed in Scopus stands out, underscoring its importance in the academic sphere. However, when focusing on the period between 2009 and 2020, the annual growth rate of publications in WoS reached 50.5 % compared with 27.2 % in Scopus.

Figure 2

Citations of literature on CCT.



Source: own elaboration.

Annual growth rate. Between 2004 and 2022, an annual growth rate of 23.55 % was observed, with 12 164 references in 321 documents produced by 1305 authors (Figure 3).

Figure 3

Annual growth rate of literature on CCT between 2004 and 2022.

Source: own elaboration.

Deceleration in citation growth rate. For the period between 2004 and 2010, the annual citation growth rate stabilized at 12.25 %. During this period, 11 documents were published by 59 authors, and no references were recorded (Figure 4).

Figure 4

Annual growth rate of literature on CCT between 2004 and 2010.

Source: own elaboration.

Citation growth rate acceleration. Between 2011 and 2017, CCT-related citations increased sharply. A pronounced peak was noticed in 2012, with a total of 1383 citations. Over this period, an annual growth rate of 31.83 % was observed, with 4272 references across 110 documents authored by 434 researchers (Figure 5). One of the most influential publications was by Lampit, Hallock, et al. (2014), who reported a moderate effect of CCT in healthy older adults. However, the impact varied across cognitive domains and was strongly

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influenced by study design. Unsupervised home training and training more than three times per week appear to be ineffective, highlighting the need for further research to enhance the efficacy of these interventions.

Figure 5

Annual growth rate of literature on CCT between 2011 and 2017.

Source: own elaboration.

Stabilization of citation growth rate. In the period between 2018 and 2022, citations stabilized, with an annual growth rate of 5.02 %, across 8041 references and 200 documents authored by 926 researchers (Figure 6).

Figure 6

Annual growth rate of literature on CCT between 2018 and 2022.

Source: own elaboration.

Country analysis

According to the scientometric analysis of CCT, the top five countries with the highest research output are: 1. United States, with 110 publications (33.13 %): 70 in Q1, 11 in Q2, 9 in Q3, and 1 in Q4. It's worth noting that this country received 1940 citations, accounting for 35.13 % of total citations. 2. Australia, with 30 publications (9.04 %): 24 in Q1, 4 in Q2, 1 in Q3, and 1479 citations (26.78 %). 3. Germany, with 20 publications (6.02 %): 14 in Q1, 3 in Q2, 1 in Q3, and 160 citations (2.9 %). 4. Canada, with 18 publications (5.42 %): 13 in Q1, 3 in Q2, and 170 citations (3.08 %). 5. United Kingdom, with 17 publications (5.12 %): 11 in Q1, 3 in Q2, and 439 citations (7.95 %).

In sixth place is China, with 16 publications (4.82 %) and 96 citations (35.13 %), followed by Italy, with 13 publications (3.92 %) and 173 citations (3.13 %). In eighth place is Korea, with 13 publications (3.92 %) and 84 citations (1.52 %), then Norway, with 12 publications (3.61 %) and 61 citations (1.1 %), and rounding out the top ten is the Netherlands, with 7 publications (2.11 %) and 236 citations (4.27 %) (Table 2).

Table 2

Scientific output, journal quality (quartiles), and impact on citation by country

	Sci. Output*		Citation		Quartiles			
Country	**n**	**%**	**n**	**%**	**Q1**	**Q2**	**Q3**	**Q4**
United States	110	33.13%	1940	35.13%	70	11	9	1
Australia	30	9.04%	1479	26.78%	24	4	1	0
Germany	20	6.02%	160	2.9%	14	3	1	0
Canada	18	5.42%	170	3.08%	13	3	0	0
United Kingdom	17	5.12%	439	7.95%	11	3	0	0
China	16	4.82%	96	1.74%	10	5	0	0
Italy	13	3.92%	173	3.13%	9	2	1	0
Korea	13	3.92%	84	1.52%	2	5	2	1
Norway	12	3.61%	61	1.1%	7	3	1	0
Netherlands	7	2.11%	236	4.27%	6	1	0	0

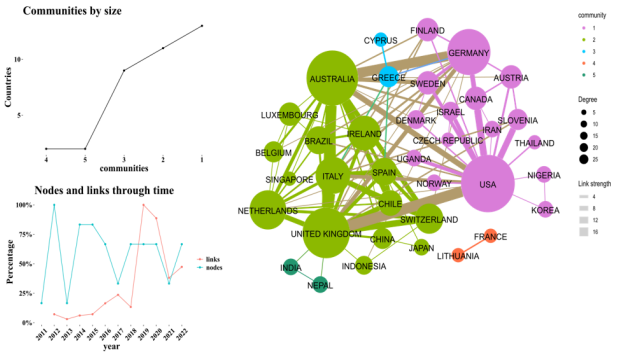
* The scientific output accounts for the number of publications found in the study.
Source: own elaboration.

In Figure 7, five communities are identified in terms of the collaboration index, as well as 5 nodes of significant relevance—the United States, Australia, United Kingdom, Germany, and the Netherlands— which are

concentrated in two of the five communities based on their level of collaboration. The strongest collaboration links were between the United States and the United Kingdom (frequency = 16), Australia and the United Kingdom (12), and Australia and Germany (8).

Figure 7

Collaboration of communities and structural nodes by country.



Source: own elaboration.

Similarly, over time, the percentage of nodes was higher, reaching its peak in 2012 (100 %), whereas the growth in links was more gradual. These links began to increase their presence from 2018 onwards, achieving their highest level in 2019 (100 %), which remained sustained until 2020 (approximately 90 %), before declining sharply in 2021 (35 %) and ending in 2022 at about 45 %. Finally, the analysis shows that the first and second scientific communities include more than 10 countries, while the fourth and fifth communities include only two countries each.

Journal analysis

Frontiers in Psychology was the most impactful journal in the dataset (Table 3), indexing seven articles in WoS and five in Scopus, with an impact factor of 0.87. However, it was surpassed by *Biological Psychiatry*, which showed the highest impact factor (4.22) and a citation index of 333. On the other hand, *Frontiers in Psychiatry and Schizophrenia Research* each indexed six articles in WoS and six in Scopus; *Schizophrenia Research* ranked third in citation performance, with a citation index of 185 in Q1. In addition, *Biological Psychiatry* and *Brain Injury* indexed each six articles in WoS and none in Scopus, with the latter classified as Q2.

Table 3

Ranking of journals according to the impact factor, citation index, and quartile classification

Journal	WoS	Scopus	IF	H index	Q
Frontiers in Psychology	7	5	0.87	133	Q1
Schizophrenia Research	6	6	1.45	185	Q1
Biological Psychiatry	6	0	4.22	333	Q1
Brain Injury	6	0	0.62	109	Q2
Frontiers in Psychiatry	6	6	1.28	81	Q1
Schizophrenia Bulletin	6	0	2.43	200	Q1
BMJ Open	5	5	0.98	121	Q1
Clinical Practice in Pediatric Psychology	4	4	0.42	18	Q2
Journal of the Assoc. of Nurses in AIDS Care	0	5	0.64	51	Q1
American Journal of Geriatric Psychiatry	4	4	1.94	129	Q1

Note. IF = Impact Factor; Q = Quartile.
Source: own elaboration.

The most cited article published in *Frontiers in Psychology* was authored by Lampit et al. (2015). The study aimed to (1) conduct a pilot multimodal neuroimaging assessment to estimate the effect sizes of training-induced neurobiological changes, (2) evaluate the temporal dynamics of such changes, and (3) compare effect sizes and examine the relationships between

neuroimaging and cognitive findings in older adults subjected to CCT or active control over 12 weeks. The results showed that the CCT group exhibited greater gray matter density in the right postcentral gyrus after 9 and 36 hours of training. Positive correlations were also observed between gray matter changes and global cognition after 36 hours of training. Resting-state functional connectivity significantly differed between groups and was correlated with post-training cognitive improvement. Overall, these findings suggest that functional changes may precede structural and cognitive changes, with a substantial proportion of structural change occurring within the first nine hours of training.

Turning to journals featuring high-impact publications, thematic trends, emerging themes, and collaboration patterns related to CCT, *Schizophrenia Bulletin* stands out in WoS with six indexed articles, although it is less predominant in Scopus. One of its most recent articles addresses computerized home training aimed at improving cognitive processes in patients with schizophrenia (McDonald et al., 2019). This reflects the growing focus of CCT in psychiatric populations. *Schizophrenia Bulletin* is classified as Q1, with an impact factor of 2.43 and a citation index of 200.

Additionally, BMJ Open includes five articles indexed in WoS and five in Scopus, with an impact factor of 0.98, a citation index of 121, and a Q1 ranking. The most cited article in this journal performs a meta-analysis investigating the effects of CCT in older adults with mild cognitive impairment, providing evidence that CCT can improve cognitive functioning (Zhang et al., 2019).

Clinical Practice in Pediatric Psychology features four articles in WoS and four in Scopus, with an impact factor of 0.42, a citation index of 18, and is classified as Q2. The most cited article in this journal discusses ethical issues related to CCT. It notes that, although an increasing number of studies report positive effects on memory, attention, and language deriving from CCT, the ethical dilemmas involved in endorsing or providing CCT as a service for pediatric populations have received limited discussion. This paper briefly reviews the current empirical evidence of CCT, emphasizing potential benefits and risks associated with this form of intervention (Hague et al., 2020).

The *Journal of the Association of Nurses in AIDS Care* does not have any articles indexed in WoS but contains five in Scopus. Its most recent and cited articles suggest that HIV-associated neurocognitive disorder can affect individuals' quality of life (QoL), which may be improved by targeted CCT. The findings indicate that certain cognitive training approaches, such as spatial learning and memory, may be particularly beneficial for QoL facets, including everyday cognitive complaints, depression, and mental health (D. E. Vance et al., 2022). This journal has an impact factor of 0.64, a citation index of 51, and is ranked in Q1.

Finally, the *American Journal of Geriatric Psychiatry* includes four articles in WoS and four in Scopus, with an impact factor of 1.94, a citation index of 129, and a Q1 classification. The most cited article in this journal evaluates the efficacy of CCT and

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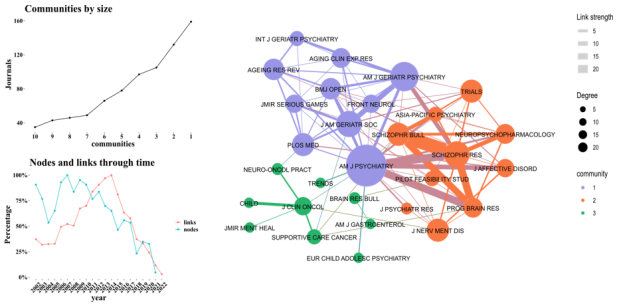
virtual reality cognitive training (VRCT) in individuals with mild cognitive impairment (MCI) or dementia, who are therefore at high risk of cognitive decline. The study reports that both CCT and VRCT are moderately effective for long-term cognitive improvement in these high-risk populations, while emphasizing the need for further research to improve study design and evaluate the broader effect of cognitive training.

According to Table 3, although most journals are ranked in Q1, those with the highest bibliometric index (FI)—and thus the most relevant for this scientometric review—are *Biological Psychiatry* (4.22), *Schizophrenia Bulletin* (2.43), and the *American Journal of Geriatric Psychiatry* (1.94). These journals commonly publish research on psychiatric disorders and the use of CCT to improve cognitive functioning in affected individuals (Coyle et al., 2015).

Figure 8 presents the journal thematic structure (citation network), community sizes, and the evolution of nodes (journals) and links over time. The citation network reveals the three most significant groups identified using the Blondel et al. (2008) algorithm. Overall, the *American Journal of Psychiatry* appears at the center of the network, connecting all three groups, although it is assigned to Group 1. This first group primarily includes studies on the effects of CCT interventions on aging (Lenze et al., 2020). The second group is centered on *Schizophrenia Research* and includes articles on schizophrenia treatments using cognitive training (Haining et al., 2022; Khan et al., 2023). The third group comprises research on cancer-related applications of cognitive training (Conklin et al., 2015).

Figure 8

Journal citation network of research articles on CCT.



Source: own elaboration.

The community-size diagram in Figure 4 shows the relative size of the 10 groups (clusters) identified in the citation network. A turning point is observed starting from group 4 onward, indicating that groups 1, 2, and 3 account for a significant representation in the academic community of cognitive training research. Notably, the node and link figure over time reveals that the proportion of links has surpassed the number of nodes (i.e. journals) published on the topic since 2010. This suggests that the number of journals has stabilized over time, and citation connections among them have increased. Overall, the journal analysis indicates a growing scientific consolidation of CCT research.

Authors' analysis

Table 4 highlights prominent authors who have made significant contributions to the scientific literature on CCT. It also summarizes the number of articles produced

by each author or author community, as well as their academic affiliation and publishing metrics. Among the most prolific contributors is Amit Lampit, with 13 published articles. He is affiliated with Humboldt-Universität zu Berlin, Germany[1]. One of his most notable publications is a study on a multi-domain CCT program designed to enhance performance on accounting tasks. The study highlights cognitive abilities as predictors of job performance and reports, for the first time, that a CCT program targeting attention, memory, reasoning, and visuospatial skills can boost productivity in healthy young adults on accounting tasks with real-world-workplace relevance (Lampit, Hallock, et al., 2014).

Another notable author is Pariya Fazeli[2], with 11 published articles. He has examined the potential of CCT for HIV-associated neurocognitive disorder based on a case study (Hossain et al., 2017). Similarly, David Vance[3] has demonstrated that CCT programs can be a safe and effective approach to improving cognitive functioning (D. E. Vance et al., 2018). Philip Harvey[4], on the other hand, although having fewer publications, stands out for a 95-impact score. His research focuses on understanding schizophrenia and related disorders through computer-assisted therapy (P. D. Harvey, 2018).

In the case of Michael Boivin[5], his publications focus on mental and cognitive health. Among his most recent and highly cited studies are research showing that depressive symptoms in mothers have been associated with lower-quality parent-child interactions, particularly regarding behavioral acceptance, active engagement with children, and interaction diversity. However, these conditions do not appear to independently increase children's risk of parasitic infection (Garrison et al., 2022). Another highly cited publication addresses cerebral malaria, a condition affecting over 785 000 African children annually. This research examines the long-term effects of cerebral malaria on children's cognitive functions (John et al., 2008).

Similarly, authors Philip D. Harvey from the University of Miami, with a Scopus index of 95, and Sophia Vinogradov from the University of Minnesota, with a Scopus index of 55, stand out. Both authors have nine articles in the dataset. With eight articles, Joel Sneed from New York University, holding a Scopus index of 30, and Miguel Valenzuela from the Regenerative Neuroscience Group of the Brain and Mind Institute, University of Sydney, Australia, are also among the leading contributors. Finally, Michael Boivin, affiliated with the Yale Department of Psychiatry in New Haven, USA, has a Scopus index of 38 across seven articles.

In their work, P. Harvey evaluates the efficacy of pharmacological treatment in schizophrenia patients undergoing CCT (P. D. Harvey et al., 2020). S. Vinogradov examines the effects of computerized social cognitive training exercises on neural and behavioral systems in schizophrenia (Vinogradov et al., 2014). Sneed has investigated the impact of CCT on individuals at risk of developing Alzheimer's disease (Petrella et al., 2023),

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whereas M. Valenzuela has studied how a multi-domain CCT program can improve performance on accounting tasks (Lampit, Hallock, et al., 2014).

Three author collaboration-communities were identified. The first academic community is associated with the author Vinogradov et al. (2014) and their contributions around nanogels for drug delivery across cellular barriers. The second community highlights Boivin & Giordani (2009), with significant contributions concerning constructivism as a multidimensional approach in understanding reciprocal interactions between culture and the genome in shaping brain–mind organization. The third community includes D. Vance et al. (2023), which reports that cognitive training in HIV patients shows differential effects on objective and subjective functioning. In addition, Hardy et al. (2011) report positive outcomes of computerized cognitive therapy for working memory in the recovery of childhood cancer survivor patients.

The remaining authors mentioned in Table 4, who are predominantly based in the United States, have fewer publications in the dataset but exhibit a significant scientific impact. For example, Hardy et al. (2011) have attracted sustained attention in the scientific community due to their recent publications on cognitive performance and schizophrenia (Badal et al., 2023; Dalkner et al., 2023; Parrish et al., 2023), showing their influence in this knowledge area. Similarly, Vinogradov, from the University of Minnesota, focuses on cognitive dysfunction in psychosis and cognitive training methods in neuroscience (Fisher et al., 2022; Miley et al., 2022). Finally, Valenzuela has contributed recent research on cognitive decline (Litkouhi et al., 2023; Welberry et al., 2023). Collectively, these authors represent influential research trajectories within the CCT literature.

Table 4

Top authors by research output on CCT

No.	Researcher	Articles	Index	Affiliation
1	Lampit A.	13	21	Humboldt-Universität zu Berlin, Berlin, Germany
2	Fazeli P.	11	23	University of Alabama at Birmingham School of Nursing, United States
3	Giordani B.	11	63	Michigan Medicine, Ann Arbor, United States
4	Vance D.	11	37	University of Alabama at Birmingham, Birmingham, United States
5	Hardy K.	9	31	George Washington School of Medicine and Health Sciences, Washington, D.C., United States
6	Harvey P.	9	95	Miami VA Healthcare System, Miami, United States
7	Vinogradov S.	9	55	University of Minnesota Twin Cities, Minneapolis, United States
8	Sneed J.	8	30	Queens College, City University of New York, Flushing, United States
9	Valenzuela M.	8	45	UNSW Sydney, Sydney, Australia
10	Boivin M.	7	38	Yale Department of Psychiatry, New Haven, United States

Note. Total articles = total articles found in the study; Scopus-index = author's h-index according to Scopus.
Source: own elaboration.

In Figure 9, which shows the nodes and social networks of the authors reviewed, nine nodes are identified, represented by Vinogradov, Harvey, Vance, Hardy, Fazeli, Giordani, Boivin, Valenzuela, and Lampit. Regarding interactions among these nodes,

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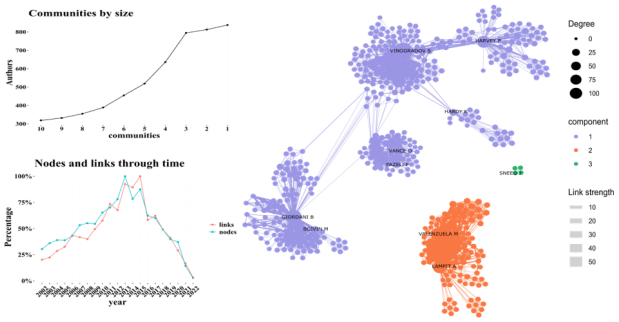
a clear peak in author collaborations is observed between 2012 and 2015, followed by a decline in collaborative activity thereafter.

Figure 9

Nodes and social networks of authors.



Source: own elaboration.

Conclusions

Over the past decade, research on CCT has expanded substantially, highlighting its growing prominence in the academic sphere. However, the pace of this growth varies across databases, with noticeable differences observed between WoS and Scopus. At the international level, the United States stands out as the leader contributor to CCT research, closely followed by countries such as Australia, Germany, Canada, and the United Kingdom. This landscape has fostered an environment of international collaboration in the field, with particularly strong links between the United States, Australia, and several European countries.

The gathered data emphasizes the relevance of CCT for addressing cognitive difficulties, especially in elderly population. It's vital to recognize that CCT interventions do not show uniform effectiveness across studies, reinforcing the need for more detailed and precise research. The leadership of countries such as the United States suggests a sustained attention and investment in cognitive and health-related research. However, findings should be interpreted with caution considering the inherent limitations associated with database coverage and the potential influence of publication bias.

Similarly, renowned journals such as *Biological Psychiatry* and *Schizophrenia Bulletin* play a pivotal role in disseminating CCT research, centering their research on psychiatric disorders. The diverse applications of CCT range from age-related cognitive concerns to more specific conditions, such as schizophrenia. The marked increase in literature citations reflects the maturity and consolidation of CCT research as a field.

Nevertheless, it is crucial to recognize that publication counts alone are not a reliable indicator of intrinsic research quality. CCT has demonstrated remarkable adaptability, ranging from efforts to enhance cognition in older adults to targeted interventions for specific clinical conditions. In this context, addressing ethical concerns is essential, particularly when interventions involve populations considered vulnerable.

Regarding the limitations of our research, future work should broaden the range of sources and literature to provide a more comprehensive perspective. Metrics based on impact and citations, while informative, do not provide a complete view of a study's intrinsic quality. Furthermore, a more exhaustive analysis over a longer time span would help clarify the historical evolution of research on CCT.

In conclusion, several authors, such as Amit Lampit (with 13 publications), followed by Pariya Fazeli and David Vance, emerge as major contributors to CCT. Despite their diverse research profiles, these researchers converge in emphasizing the relevance of CCT. Additionally, the active commitment of prestigious academic institutions further underscores the versatility and applicability of this technique in different contexts, as well as the challenges that may arise. However, interpreting findings solely through publication volume risks overlooking the depth and quality of the research; therefore, a more comprehensive approach is crucial to understand the true impact and scope of CCT research.

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