

Biosystems & Biorobotics

Jesus Tornero
Diego Torricelli
Francesca Lunardini *Editors*

Advances in Applied Technologies for Disability and Inclusion

Proceedings of the 13th Congreso Iberoamericano de Tecnologías de Apoyo a la Discapacidad, IBERDISCAP 2025, November 3–5, 2025, Seville, Spain

 Springer



Computerized Cognitive Assessment and Training Across the Lifespan: Evidence from CogniFit

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Abstract. Cognitive decline threatens autonomy and well-being, yet the resources required for early detection and personalized intervention remain scarce. Digital platforms that embed both assessment and training in a single workflow can help close that gap, provided that their psychometric foundations and clinical benefits are demonstrated transparently. CogniFit's computerized Cognitive Assessment Battery (CAB) PRO™ measures five core domains—attention, memory, perception, coordination, and reasoning— and automatically recommends an adaptive Computerized Cognitive Training (CCT) plan calibrated to the user's deficits. Here we synthesize the empirical literature on the platform, present new lifespan normative data from a large sample ($N = 82,129$), and summarize the reported effects of training across healthy and clinical populations. We discuss practical implications for digital health deployment in schools, workplaces, and geriatric care, and propose future directions for ecological outcome tracking.

Keywords: Cognitive assessment · Computerized cognitive training · Lifespan development · Digital health · CogniFit

1 Introduction

Technological progress is reshaping every facet of healthcare, and cognitive science is no exception. Traditional neuropsychological assessment, with its paper-and-pencil inventories and examiner-dependent scoring, offers high construct validity but suffers from practical limitations: sessions are lengthy, results are delayed, and administration requires specialist training [1]. The same constraints apply to therapist-led cognitive rehabilitation, which, despite its efficacy, is costly to scale beyond small clinical cohorts. Computerized alternatives promise shorter, standardized, and more engaging sessions while harvesting precise millisecond-level behavioral data at scale. Yet enthusiasm must be matched by rigorous validation and demonstrations of near and far-transfer effects. Despite the long trajectory of digital cognitive training and evaluation tools, there is still a pressing need to systematically integrate evidence on how such platforms contribute to the assessment and remediation of age-related and pathological cognitive decline, and to highlight their utility across different populations.

CogniFit (CogniFit Inc., San Francisco, US), founded in 1999, was one of the first platforms to systematically address the importance of psychometric validation by embedding rigorous verification procedures at each product iteration. Its flagship Cognitive Assessment Battery (CAB) PRO™ integrates well-established paradigms (such as Go/No-Go, Stroop, Corsi Blocks, and Digit Span) into brief, engaging, gamified tasks that promote voluntary compliance and user engagement. The system's output scores are referenced against an ever-growing international normative database and are immediately translated into personalized training recommendations delivered within the same interface. Critically, both the assessment and training modules operate on shared code and hardware requirements, enabling a seamless “test–train–retest” loop deployable remotely with minimal clinician oversight.

Importantly, both the full Cognitive Assessment Battery (CAB) PRO™ and its specific tasks have been scientifically validated, demonstrating strong reliability and the ability to accurately capture the nuances of cognitive profiling across ages and populations. Numerous studies published over the past two decades have examined the platform's reliability, validity, and applicability across clinical, educational, and research settings. For instance, studies have shown its capacity to detect differences and patterns in cognitive functioning not only in older adults [2] but also across the lifespan [3, 4], including among specific groups such as intellectually gifted individuals [5]. The reliability of the Cognitive Assessment Battery (CAB) PRO™, supported by solid psychometric indices, ensures that it can be used confidently for monitoring cognitive decline, profiling individual strengths and weaknesses, and guiding tailored cognitive interventions across diverse demographic and clinical populations.

In the present article, we present lifespan data obtained from the Cognitive Assessment Battery (CAB) PRO™, and we integrate findings from randomized and quasi-experimental studies that evaluated CogniFit's training across ages and clinical conditions. While numerous individual studies have reported on the validity and applicability of CogniFit's tools, to our knowledge no previous work has provided a synthesis that brings together lifespan assessment data and intervention findings within a single framework. Moreover, epidemiological projections indicate that the global prevalence of dementia will triple by 2050 [6]. The World Health Organization [7] lists digital health (e-Health) tools among its recommended strategies, emphasizing digital delivery for geographic equity. Thus, the present article goes beyond marketing narratives by scrutinizing independent validation studies, delineating use-cases across age groups, and identifying the boundaries of current evidence.

2 Computerized Cognitive Assessment: The Cognitive Assessment Battery (CAB) PRO™

The Cognitive Assessment Battery (CAB) PRO™ comprises 17 tasks distributed across five theoretically grounded domains: attention, memory, perception, coordination, and reasoning. The full battery requires approximately 30–40 min on a standard laptop, tablet or smartphone. Instructions are delivered by presenting them in a textual form, accompanied by animated videos and voice-overs available in 26 languages or variants, and comprehension is verified with interactive demonstrations and practice trials. Tasks are implemented in HTML5 with precision-timed stimuli rendered locally

in the browser to circumvent server latency. Raw scores, comprising speed, accuracy, and derived efficiency metrics, are z-standardized against a demographically matched reference group of 1,282,242 users, and combined into skill-specific and domain composites via pre-registered factor loadings. Immediate feedback is provided through a traffic-light metaphor (green = strength, yellow = average, red = weakness) coupled with brief psychoeducational explanations to foster insight. Clinicians or researchers can access individual task-level data through an encrypted dashboard and export CSV files for secondary analyses.

3 Cognitive Trajectories Across the Lifespan

This section operationalizes the assessment framework introduced above by charting normative, age-referenced trajectories across the five cognitive domains (memory, attention, perception, reasoning, coordination). By deriving percentile performance against the test's reference norms, we address the central question of how domain-specific abilities change with age when measured with the same instrument across countries. Positioning these trajectories within the developmental and aging literature also provides the benchmark against which the intervention findings synthesized in the next section can be interpreted.

We analyzed archival data from $N = 82,129$ recent users (January 2023–December 2024) of the CogniFit Cognitive Assessment Battery (CAB) PRO™. Participants were randomly sampled selected from the company's cloud database. The sample included individuals aged 7–90 years ($M = 36.28$, $SD = 16.80$) and was composed of 43.11% males and 56.89% females. Data came from 178 different countries, with the largest percentage of test-takers being at the US (20.76%), Russia (10.65%), Brazil (8.63%), Spain (8.08%) and France (6.63%).

Participants completed all tasks online via personal computers (34.59%) or mobile devices (65.41%). Upon completion, the platform generated domain-level percentiles and stored de-identified data on secure servers for research purposes. While raw scores from the CAB PRO™ are automatically transformed into age-adjusted percentiles based on a continually expanding normative database in the available tool, this analysis aimed to explore how well the battery captures cognitive decline; consequently, unadjusted raw percentiles were used.

The platform is designed for functional equivalence across devices; however, and prior to running the present trajectory analyses, a sanity check was completed to ensure that the results from the different systems are comparable. To this end, Cliff's delta (δ) was individually computed for each cognitive domain and device type. Results confirmed negligible differences between devices across domains, with all $|\delta| < 0.066$.

For analysis, we fitted quadratic regression models with age as the predictor of the values associated with each of the cognitive domains. Quadratic regressions indicated a significant inverted-U relationship between age and attention scores (adj. $R^2 = 0.18$, $p < .001$), memory scores (adj. $R^2 = 0.11$, $p < .001$), perception scores (adj. $R^2 = 0.14$, $p < .001$), reasoning scores (adj. $R^2 = 0.18$, $p < .001$) and coordination scores (adj. $R^2 = 0.16$, $p < .001$). The quadratic trajectory shown across age, with performance increasing in childhood and declining in older age, is fully consistent with the expected developmental rise and age-related decline (see Figure 1).

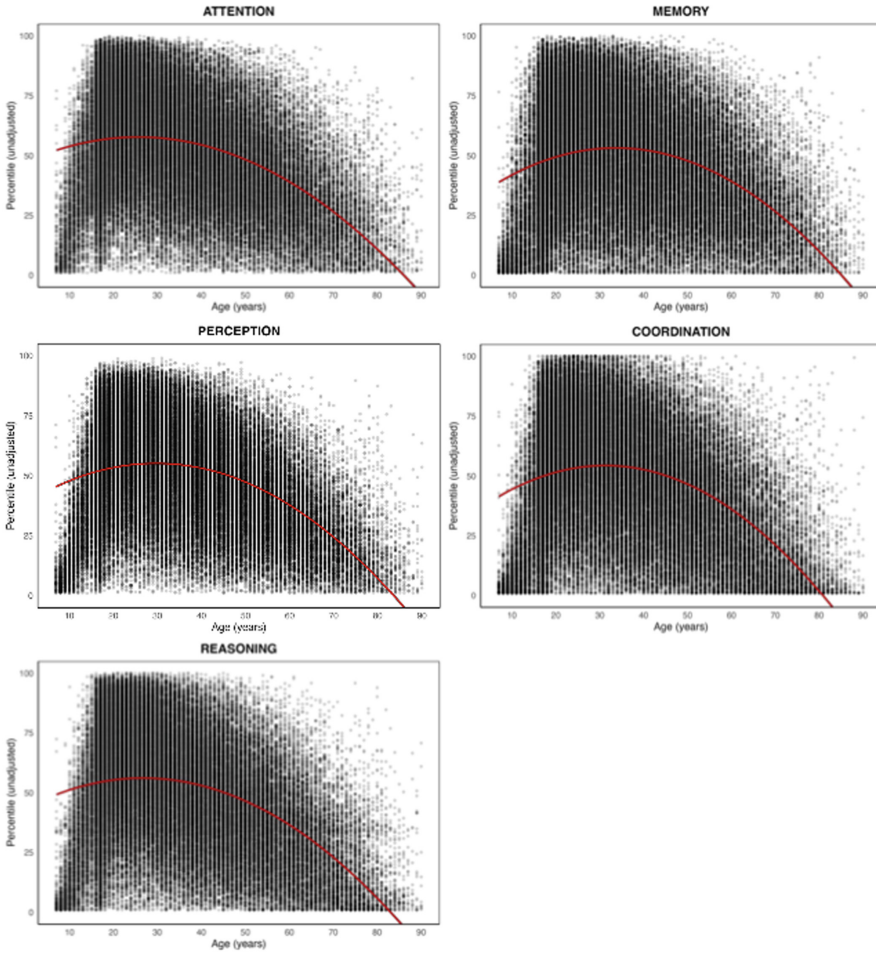


Fig. 1. Scatterplots of the different cognitive domains evaluated. The X-axis represents the age of the test-takers, and the Y-axis represents their score (in unadjusted percentiles). The quadratic regression line has been calculated for each domain and is presented in red.

As seen, the distribution of participants across age groups was uneven, with relatively fewer individuals over 80 years of age, which may account for the increased variability observed at the upper end of the lifespan. In addition, a small subset of participants below 65 years obtained very low scores. These values may arise from heterogeneity in cognitive functioning, fluctuations in task engagement, or technical issues during administration. Further studies are needed to clarify whether such cases should be considered outliers, measurement artifacts, or indicators of specific subgroups.

Mean percentiles increased during childhood and declined consistently with age during adulthood across all domains, underscoring the importance of age-adjusted interpretation. Although the present analysis relied solely on percentile scores without age or

gender adjustments, the Cognitive Assessment Battery (CAB) PRO™ platform itself provides immediate, age-equated percentiles that are continuously updated through an automatic re-norming routine. This ensures clinicians always benchmark individual scores against the most current population data without requiring manual software updates. Such real-time calibration enables the sensitive detection of even modest deviations from expected lifespan trajectories, offering early warnings of emerging cognitive change before functional difficulties arise. As score variability naturally increases with age, the battery's capacity for repeated, low-burden assessments makes longitudinal monitoring far more informative than one-time snapshots, supporting timely interventions and personalized care strategies. Together, these features validate the Cognitive Assessment Battery (CAB) PRO™ as a scalable, psychometrically robust tool for tracking cognitive health across childhood and adulthood and equip practitioners with actionable, globally anchored norms. Collectively, these age-conditional trajectories establish the expected range of performance across the lifespan and thus supply a necessary baseline for the following section, where we narratively evaluate training-related changes.

4 Personalized Computerized Cognitive Training (CCT)

CogniFit's Computerized Cognitive Training (CCT) system is an evidence-based, adaptable platform designed to enhance cognitive functions across diverse populations. Available on desktop, mobile, and tablet devices, it delivers a dynamic, personalized experience through its patented training algorithm, which continuously monitors performance, selects appropriate tasks, and adjusts difficulty in real time. Drawing from a growing pool of nearly 275 mini-games, each session focuses on the user's weakest domains and learning trajectory, selecting the tasks whose difficulty can adapt across multiple parameters (e.g., exposure time, distractor load, dual-task demands). Training sessions are recommended three times per week for at least six-to-eight weeks, following evidence-based dose-response guidelines [8]. Users receive instant feedback and progress summaries, while clinicians or researchers can monitor aggregate performance. To maintain engagement, participants unlock badges and receive normative comparisons against age-matched peers, making every session a meaningful step in their cognitive enhancement journey.

A growing body of scientific research underscores the efficacy of CogniFit's Computerized Cognitive Training (CCT) across a wide range of cognitive domains, including Memory, Attention, Perception, Reasoning, and Coordination. Perceptual abilities such as visual scanning and time estimation have shown notable enhancement through CogniFit's platform, as demonstrated in the studies by Shatil et al. [9, 10]. Reasoning and executive functions also improve significantly with CogniFit's CCT, while gains in coordination and hand-eye control have been reported in earlier studies [11, 12], highlighting the platform's broad cognitive impact.

Importantly, CogniFit's CCT has shown strong promise as a non-pharmacological intervention for cognitive health, particularly in older adults. Gigler et al. [12] demonstrated improvements in working memory and processing speed following online training, and Peretz et al. [13] found that CogniFit's CCT outperformed computer games in enhancing visuospatial learning and focused attention. Combined interventions, such as

pairing cognitive and physical training, have proven particularly effective, with studies showing cognitive gains surpassing those from physical activity alone [9, 14]. The program's benefits also extend to functional outcomes: Verghese et al. [15] showed that cognitive remediation improved gait in sedentary seniors, while other studies have further confirmed CogniFit's utility in both non-demented and cognitively impaired older adults [16, 17].

Beyond aging populations, CogniFit's CCT has been valuable in addressing cognitive decline related to specific health conditions. In older adults with diabetes, different studies have demonstrated improvements in cognition and disease self-management following home-based CogniFit interventions [18, 19]. For adults with insomnia, studies have shown that CogniFit's CCT improved not only cognitive performance but also sleep quality and mood, offering an effective non-pharmacological treatment option [20, 21]. Additionally, CogniFit's adaptability has shown promise in clinical populations such as individuals recovering from COVID-19-related cognitive dysfunction [22] and patients with unipolar and bipolar disorder [23], further supporting its broad applicability. For individuals with mild cognitive impairment (MCI) and neuropsychiatric symptoms, Bahar-Fuchs et al. [24] reported that home-based, adaptive CCT led to improvements in memory, learning, and global cognition, as well as reductions in caregiver burden.

Interestingly, prior research has also demonstrated the effectiveness of CogniFit's CCT in younger populations, including children and adolescents. Conesa and Duñabeitia [25] demonstrated that computer-based training can improve executive functions and academic achievement in children, while Reina-Reina et al. [26] showed that cognitive stimulation programs can enhance reading comprehension in primary school students. These studies highlight that CogniFit's training tools are not only effective in aging or clinical populations but also hold promise for supporting cognitive development and educational outcomes in children and adolescents. Collectively, these findings reinforce CogniFit as a scientifically validated, scalable solution for enhancing cognitive health and resilience across the entire lifespan.

5 Conclusions

The aggregated evidence positions CogniFit's integrated assessment-and-training platform as a mature digital-health tool. From a psychometric standpoint, the Cognitive Assessment Battery (CAB) PRO™ meets or exceeds conventional reliability thresholds, supports a theoretically coherent factor structure, and demonstrates sensitivity to age and disease-related variance. From an interventional viewpoint, the summary of cognitive training studies commensurate with those reported for educational, psychological and pharmacological cognitive enhancers, albeit with negligible side-effects. Nonetheless, future research should prioritize hybrid designs that combine CCT with motivational interviewing or coach-guided reflection to enhance transfer and adherence.

Implementation science also warrants attention. Attrition in digital interventions should be clearly at the focus of action, to boost adherence and maximize cognitive gains. While CogniFit's gamification and social-sharing features mitigate dropout, sustainable adoption will require integration with electronic health-record workflows and reimbursement models [27]. Preliminary pilots indicate that embedding a screening into

annual check-ups is feasible and cost-neutral when nurse assistants oversee administration. Similar integration in educational settings could offer universal cognitive baselines that flag children at risk of learning disorders before academic failure crystallizes.

Lastly, the rapid proliferation of generative AI offers opportunities and risks. Adaptive engines could soon leverage large language models to craft more naturalistic training scenarios; however, uncontrolled content generation may jeopardize the tight psychometric calibration that underpins reliability. Transparent, version-controlled stimulus repositories and ongoing validation will therefore remain indispensable. Thus, addressing challenges of adherence, accessibility, and integration remains essential. Ongoing research grounded in comprehensive AI-based frameworks with multidirectional information flow and both prognostic and diagnostic capabilities, including Digital Cognitive Twins, offers a promising pathway to enhance the personalization, reliability, and clinical relevance of digital health tools like CogniFit [27].

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