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Elba M. Arredondo-Urtiz

Felipe de Jesús Díaz Reséndiz

Karina Franco-Paredes

Cheryl Fielding
The University of Texas Rio Grande Valley

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An overview of technology use for parent training in behavior analytic interventions[1,2]

Elba M. Arredondo-Urtiz[3]
Felipe de Jesús Díaz Reséndiz
Karina Franco-Paredes
University of Guadalajara

Cheryl Fielding
University of Texas Rio Grande Valley

Abstract

The efficacy of Applied Behavior Analytic (ABA) interventions for children who display problematic behavior has been well-documented and repeatedly demonstrated, however, global access to these interventions is restricted due to their limited availability. A promising strategy to attend a greater number of children in need of behavioral intervention is to train parents using various means of technology. The purpose of this overview is to present the process of incorporating technology into training parents in ABA interventions from a chronological perspective. A total of 65 studies were identified using an electronic search in eleven databases. The information collected is presented synthetically in tables and figures with data related to the content of training, the methods used, and the technological resources employed, as well as a narrative analysis of the information around four themes: technological advances on parent training, problems addressed, research methods and reported findings. The findings showed that technology has facilitated parent training in ABA interventions and thus contributed to advances in behavioral science and promoted the expansion of ABA services.

Keywords: *parent training, applied behavior analytic interventions, technology, behavioral problems, chronological overview*

Resumen

La efectividad de las intervenciones basadas en el Análisis Conductual Aplicado (ACA) para el manejo de problemas de comportamiento de niños ha sido plenamente demostrada pero el acceso a estos servicios es restringido debido a su limitada disponibilidad. Una estrategia prometedora para hacer llegar este tipo de

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[3] Correspondence: Mirella Arredondo Urtiz, Centro Universitario del Sur, Universidad de Guadalajara. Av. Enrique Arreola Silva # 883, Col. Centro, Ciudad Guzmán, Jalisco, México. C.P. 49066. +52 341 102 5725. elba.arredondo@cusur.udg.mx

atención a más niños es entrenar a los padres mediante el uso de tecnologías de la información. El propósito de este estudio es presentar el proceso de incorporación de la tecnología en la capacitación de los padres en las intervenciones de ACA desde una perspectiva cronológica. Se identificaron un total de 65 estudios mediante una búsqueda electrónica en once bases de datos. La información recopilada se presenta sintéticamente en tablas y figuras con datos sobre del contenido de los entrenamientos a padres, cómo y con qué recursos tecnológicos se ha hecho. Se realizó un análisis a partir de cuatro ejes: entrenamiento y avances tecnológicos, problemáticas atendidas, método de investigación y hallazgos reportados. Los resultados mostraron que la tecnología ha facilitado la capacitación de los padres en las intervenciones de ABA y, por lo tanto, contribuyó a los avances en la ciencia del comportamiento y promovió la expansión de los servicios de ABA.

Palabras clave*: entrenamiento a padres, intervenciones analítico-conductuales, tecnología, problemas de conducta, perspectiva cronológica*

Behavioral deficits in communication, social independence and self-care skills as well as behavioral excesses such as disruptive behaviors, tantrums, fights, noncompliance, aggression are the most frequent reason for psychological, neurological, and psychiatric consultation on children population (Benjet et al., 2009; Fombonne et al., 2006; Law et al., 2000; Peña-Olvera & Palacios-Cruz, 2011) and use to be the main difficulty underlying on various syndromes in childhood as Autism Spectrum Disorder (ASD), speech and language disorders, attention deficit hyperactivity disorders (ADHD) among others (Artigas-Pallarés et al., 2013; Valencia & Andrade, 2005). These childhood behavior problems tend to worsen over time when they are overlooked (Fisher et al., 2019; Simacek et al., 2017; Vite et al., 2008) so that timely and appropriate attention is important to ensure children's adequate adaptation to their environment and prevent such behaviors from compromising the acquisition of skills that are essential for a suitable adult life.

Regardless of whether they are typically developing children or cases in which some syndrome has been diagnosed, problem behavior is influenced by the same variables as any other behavior (Drash & Tudor, 1993); this means that problem behavior is learned, acquired, and maintained by environmental contingencies (Skinner, 1978). Therefore, such problems can be addressed by Applied Behavior Analysis (ABA) with satisfactory results for children, their families, and their social environment (Cooper et al., 2020; Martin & Pear, 2008).

ABA is an applied science that has achieved worldwide recognition via rigorous scientific investigations; has its origin in the United States of America (USA) with the work of Skinner, hence it is not surprising that this country is in a privileged position related to coverage and access to ABA services; has the largest number professional associations and Board Certified Behavior Analysts (ABAI, 2021, BACB, 2021). ABA interventions -a term used to refer to treatment approaches that using techniques, strategies, and procedures based on the principles of that science (Makrygianni et al., 2018)- have widely evidence of its effectiveness how an evidence-based treatment for individuals who display problem behavior (Fielding et al., 2013; Fein et al., 2013). However, even in USA (particularly on some rural or marginalized areas) numerous empirically validated ABA interventions (*e.g.* Dillenburger & Keenan, 2009;

Lovaas, 1987; Reichow et al., 2012) are inaccessible for many people (Barboza et al., 2015; Leaf et al., 2019; Moura et al., 2017; Parsons et al., 2017; Tomlinson et al., 2018; Unholz-Bowden et al., 2020) and in regions where ABA is still developing, such as some Latin American countries these interventions are definitely unattainable for most.

That limited availability mainly due to the fact that evidence-based ABA interventions use to be intensive and prolonged so require significant resources, hence, this services are mainly provided within a limited number of institutions (Connell et al., 1997; Vismara et al., 2013; Simacek et al., 2017; Zavaleta et al., 2018) or are available through private services whose costs are unaffordable for a large part of the population (Lindgren et al., 2016; Machado & Lima, 2017; Webster-Stratton, 1984; Webster-Stratton et al., 1988; Webster-Stratton, 1990). Many institutions are in urban centers and are difficult to access because they are geographically distant (Benson et al., 2018; Guðmundsdóttir et al., 2017; Heitzman-Powell et al., 2014; Vismara et al., 2012; Wainer & Ingersoll, 2013, 2015;). Additionally, ABA services are difficult to access because trained personnel are not enough (Meadan et al., 2013; Meadan & Daczewitz, 2015; Neely et al., 2017; Suppo & Floyd; 2012).

A strategy to expand the provision of those services and make them more accessible to the general population has been parent training in ABA interventions. It has been shown that parents may be able to meet a part of their children's behavioral needs and can successfully provide some ABA interventions directly at home if they are trained for that purpose (Leaf et al., 2019; Pacho & Triñanes, 2011; Piquero et al., 2016; Postorino et al., 2017; Santini & Williams, 2016; Schultz et al., 2011; Skotarczak & Lee, 2015; Strauss et al., 2013; Suppo & Floyd; 2012; Wallace et al., 2008).

Parent training in ABA interventions is already an evidence-based practice in which professionals in ABA teach parents effective behavior management procedures (*e.g.* differential reinforcement, extinction, stimulus control); the main goal is to provide behavior management tools to prevent inappropriate child behavior, promote prosocial behavior and support a healthy parent-child relationship (Axelrod & Santagata, 2021). There are a large number of trainings that includes a wide range of strategies ranging from the basic implementation of a single technique to the application of multicomponent programs of systematic instruction such as use of reinforcement, discrete trials, task analysis, prompt hierarchies (Haymes et al., 2015) through procedures as they are instruction, modeling, rehearsal and feedback (Miltenberger, 2015).

Parent training shares accessibility issues of ABA interventions described previously, therefore, in order to expand the coverage of such services several authors (Boisvert & Hall, 2014; Meadan & Daczewitz, 2015; Neely et al., 2017; O'Dell et al., 1979; Parsons et al., 2017; Tomlinson et al., 2018; Unholz-Bowden et al., 2020; Zazula & Haydu, 2012) have proposed that parent training can be carried out, at least partially, in their own places through information and communication technologies (ICTs), a term generally used to refer infrastructure and components (devices, networking components, applications and systems) that combined allow people to interact in a virtual way.

Scientific evidence regarding technology-assisted training of parents in ABA interventions has increased exponentially in direct relation to overall technological development (Lattal, 2008; Cohen & Rozenblat, 2015) getting difficult to handle; students, researchers and practitioners must spend countless hours reviewing the literature to identify relevant information about ABA interventions, training methods, technology trends or starting point investigation, so, review works that organize and synthesize the

information are needed (Fettke, 2006; Grant & Booth, 2009). Therefore, the purpose of this overview is to present the process of incorporating technology into training parents in ABA interventions from a chronological perspective. This historical viewpoint is useful for professionals and researchers who are working on regions in which the development of ABA is still incipient because it allows to identify what was successful in specific historical contexts that resemble to those in which currently carry out their practice; each study included and reviewed in this article provides documented examples of the benefits resulting from the use of a technological innovation into training parents in ABA interventions which can be take it back for correcting methodological deficiencies, improving the quality of research, increasing the efficacy of interventions and to solve clinical problems through the ABA in new contexts.

Method

Although the general objective of any review of the literature is gathering research, debug and summarizing the best of what remains, recently multifarious review types with variations in the degree of rigour and structures and methodologies clearly different have been developed to meet a variety of demands from the domains of research. This work it is considered an overview since, although it does not reach the degree of rigor of a systematic review because the search lacked the participation of a second independent investigator and inclusion/exclusion criteria were less strict (*e.g.* not include a quality assessment of articles); uses a tidy and replicable method to summarize a body of literature and show and describe its characteristics through tables and figures as well as a thematic chronological narrative analysis (cf. Grant & Booth, 2009).

Search process and study identification. According of the purpose of this work the search process focuses on articles that had included three study variables: parent training, ABA interventions and use of technology. To locate them an electronic search without restrictions of publication date was carried out between February – May 2021 in multiple databases (APA PsychNet, PubMed, Scopus, Science Direct, Springer, Ebsco, ProQuest Central, Scopus, Web of Science, Wayley on Library, Scielo, Redalyc). Various combinations of the following words were used as search terms: "training", "coaching", "instruction", "parent", "caregiver", "individuals "behavioral" "analytical", "interventions", "treatments", "ABA". The results produced by each database were reviewed and when in an article title these terms were detected, keywords and/or abstracts of that article were reviewed looking for terms related to the use of technological resources how: audiotape, videotape, DVD, telephone, video modeling, video feedback, computers, internet, telemedicine, telehealth, online, teleconferencing, telecommunication, videoconferencing, internet-based technology, web-based, eLearning. If using this strategy at least one term related to each of the three variables of interest was identified in an article, that article was selected to be analyzed to full text.

Inclusion/exclusion criteria. Was included articles that reported results of original and empirical research on some type of parent training (which may include other participants) in ABA interventions that had made use, at least partially, of some technological resource. Articles that may have had components from other disciplines or therapeutic approaches (*e.g.* cognitive behavioral therapy) in combination or comparison with behavior analytical interventions aimed at children with problematic behavior were also included. Theoretical, instrumental and review of literature studies were not considered neither those in which training was aimed exclusively at professionals or technicians such as health personnel, therapists, teachers, or childcare workers. Articles based on other theoretical approaches, when no technological resources were used for the training, and when the interventions were directed to an adult population or a

child population without problematic behavior (such as for improving reading skills in children) were also excluded.

Data extraction. Selected articles were analyzed to full text. Reference data (authors, year, journal of the publication) were collected, as well as the purpose of the research and country where it was carried out. Also collected was data about: 1) participants: amount, clinical characteristics (*e.g.* comorbidities, diagnoses), sociodemographic data (*e.g.* age, gender, schooling); 2) design (sampling, study variables, instruments), 3) training program (type, objective, setting, technological resources), 4) statistical analysis; and 5) reported findings.

Results

The present study identified and includes 65 articles, almost all written in English (all of them except Moura et al., 2007; and Barboza et al., 2015; which one was written in Portuguese) published from 1968 to 2020 in specialized journals with three types of approaches: 1) in the field of behaviorism (e.g., Journal of Applied Behavior Analysis, Behavior Modification, Behavioral Interventions, Journal of Positive Behavior Interventions, Journal of Behavioral Education); 2) In clinical conditions affecting child populations (e.g., Research in Autism Spectrum Disorders, Journal of Autism and Developmental Disorders, Journal of Consulting and Clinical Psychology, Journal of Pediatric Psychology, Journal of Clinical Child & Adolescent Psychology, Journal of Abnormal Child Psychology, Clinical Child Psychology and Psychiatry, Topics in Early Childhood Special Education, American Journal of Speech-Language Pathology); 3) In interventions implemented through the use of technology (e.g., Journal of Medical Internet Research, Telemedicine and e-Health).

The training conducted in each study is presented in Table 1 which provides a concise overview of content. How the training was provided and technological resources they were implemented is also included. The first column presents each study by first author in chronological order. The second column lists the techniques, skills, procedures, or programs in which parents were trained. A brief description of the procedure used to conduct the training is given in the third column, including the duration and modality of the training and/or the materials used. Finally, the last column presents the technological resources used to provide the training.

Table 1. Technology-assisted parent trainings in behavior analytic interventions.

Study	Technology-assisted parent trainings		
	Content	Procedure	Technological resources
Bernal et al., 1968	Extinction, punishment, differentiate positive and negative responses	Three 45-minute sessions: 30 instruction and feedback per trainer and 15 rehearsal/videotaping.	Closed circuit television Video feedback
Bernal, 1969	Extinction, positive and social reinforcement	Seven 45-minute sessions: 30 instruction and feedback per trainer and 15 rehearsals/videotaping.	Closed circuit television Video feedback
Nay, 1975	Time out	One 40-minute session: 20 instruction and feedback per trainer and 20 rehearsal/audiotaping.	Video modeling Audio feedback

Table 1. *Continued*

Study	Technology-assisted parent trainings		
	Content	Procedure	Technological resources
Koegel et al., 1978	Discrete trials, use of prompts, shaping and consequences.	Two to eight 70-minute self-administered sessions of instruction, demonstration, and rehearsal activities.	Video modeling
Flanagan et al., 1979	Time out	Two 40-minute sessions; one group training session and one individual follow-up session, both moderated by the trainer.	Video modeling Audio feedback
O'Dell et al., 1979	Time out	Six 120-minute sessions of instruction, modeling, rehearsal, feedback, and measurement activities moderated by the trainer.	Video modeling
Webster-Stratton, 1981b 1982a, 1982b	Effective play techniques, limit setting, handling misbehavior, communication skills	Four 120-minute weekly group sessions moderated by the trainer for review and discussion of the video materials.	Video modeling
Hamilton & MacQuiddy, 1984	Positive reinforcement, time out	Three weeks for independent review of materials, independent audio-recorded rehearsals and trainer feedback via telephone.	Audio feedback Telephone advice Signal seat
Webster-Stratton, 1984, 1990, 1992,1994 Webster-Stratton et al., 1988	Modification of interaction model, play skills, use of praises and tangible rewards, nonpunitive discipline, problem solving	Three weeks for independent review of materials, independent audio-recorded rehearsals and trainer feedback via telephone.	Video modeling
Connell et al., 1997	Causes of behavior problems, establishing rules, time out, backing consequences, planned ignoring	Ten weeks of independent work for review of materials with feedback from the trainer via telephone.	Video modeling Telephone advice
Sharry et al., 2005	Parents Plus Early Years Program (PPEYP)	Twelve 120-minute sessions for independent review of materials and feedback from the trainer.	Video modeling Video feedback
Morawska & Sanders, 2006	Causes of behavior problems, establishing rules, time out, backing consequences, planned ignoring	Ten weeks of independent work for review of materials with feedback from the trainer via telephone.	Video modeling Telephone advice Video feedback
Moura et al., 2007	Differential reinforcement	Six 30-minute sessions for alternate training by video modeling and video feedback.	Video modeling Video feedback

Table 1. *Continued*

Study	Technology-assisted parent trainings		
	Content	Procedure	Technological resources
Stokes & Luiselli, 2008	Functional Analysis (FA)	One 45-minute session of oach-led modeling, instruction, rehearsal, and feedback activities.	Video modeling Video feedback
Hamad et al., 2010	Positive reinforcement, pairing and teaching cooperation, prompting and prompt fading	Online course of three modules to be completed in eight hours enriched with instructional videos, links, interactive activities, practical exercises.	Web Platform
Nefdt et al., 2010	Pivotal Response Treatment (PRT),	14-chapter course with instructional videos, interactive learning activities, and quizzes.	Interact DVD
Kobak et al., 2011	Enhancing Interactions Program	Three-module online course containing instructional videos, interactive learning activities, and various multimedia resources.	Moodle Platform Software Articulate
Jang et al., 2012	eLearning Program on discrete trials, contingencies analysis, prompting and fading, shaping, chaining, use of consequence	14-session online course to be completed in 40 hours consisting of visual notes, verbal instructions, and instructional videos.	Web Platform
Vismara et al., 2012	Early Start Denver Model (ESDM)	12 one-hour weekly sessions led by a trainer via videoconference.	Videoconferencing system
Young et al., 2012	Discrete Trial Teaching (DTT)	Five self-administered sessions to be completed in four hours.	Instructional videos
McDuffie et al., 2013	Naturalistic language intervention	16 sessions (4 face-to-face and 12 via videoconference) of content review and counseling.	Videoconferencing system
Vismara et al., 2013	ESDM	Online course of 12 weekly 90-minute sessions for real-time training with instructional activities, modeling, and feedback.	Videoconferencing system Web page
Wacker et al., 2013	FA	Seven weekly trainer-led sessions via videoconference and 15 minutes of independent practice per day.	Videoconferencing system Video feedback
Wainer & Ingersoll, 2013	Reciprocal Imitation Training (RIT)	Online course of five modules to be completed in 1.5 hours.	Web Platform
Xie et al., 2013	Barkley Model	10 weekly trainer-led remote sessions.	Videoconferencing system
Heitzman-Powell et al., 2014	Online and Applied System for Intervention Skills (OASIS)	Online course of eight modules organized in 13 sessions to be completed in 24 hours.	Web Platform

Table 1. *Continued*

Study	Technology-assisted parent trainings		
	Content	Procedure	Technological resources
St. Peter et al., 2014	Discrete Trial Instruction (DTI)	One self-administered training session and twelve independent practice sessions with face-to-face feedback from trainer.	Instructional video Video feedback
Suess et al., 2014	FA, Functional Communication Training (FCT)	Self-administered training and weekly counseling and feedback sessions.	Instructional videos Videoconferencing system Video modeling Video feedback
Suppo & Mayton, 2014	Ohio Department of Education Center for Autism and Low Incidence Program (OCALI)	Online course based on training videos and supplemented with telephone and e-mail counseling.	Web platform
Barboza et al., 2015	Preference assessment, discrete trial, prompting and correction	Six face-to-face training sessions supported by videos and rehearsals with feedback.	Video modeling Video feedback
Ingersoll & Berger, 2015	Improving Parents as Communication Teachers Project (ImPACT)	Online course of 12 self-directed sessions to be completed in 15 hours. Weekly telephone counseling.	ImPACT Platform Telephone advice
Reese et al., 2015	Positive Parenting Program (Triple P)	Eight weekly training sessions: four group sessions via videoconference, three telephone counseling sessions, one face-to-face feedback.	Videoconferencing system Telephone advice
Wainer & Ingersoll, 2015	RIT	Online course of four sessions complemented with telephone counseling.	Web Page Telephone advice
Buzhardt et al., 2016	OASIS	Online course of eight modules organized in 13 sessions to be completed in 24 hours, complemented with videoconference counseling.	Web Page Videoconferencing system
Ingersoll et al., 2016	ImPACT	Online course of 12 self-directed sessions to be completed in 15 hours enriched with presentations, practical activities, discussion forums, and counseling.	Web Page E-mail advice
Lindgren et al., 2016	FA, FCT	Multi-element intervention; on-site (home) visits, self-directed training, counseling, and feedback via videoconference.	Videoconferencing system

Table 1. *Continued*

Study	Technology-assisted parent trainings		
	Content	Procedure	Technological resources
Machalicek et al., 2016	Functional Behavior Assessment (FBA), Behavior Intervention Plan (BIP)	Three to four sessions of 60 - 90 minutes supplemented by videoconferencing and chat.	Videoconferencing system
McDuffie et al., 2016	Verbal behavior modification	17 sessions: five face-to-face training sessions and 12 videoconference counseling sessions.	Videoconferencing system
Meadan et al., 2016	Internet-Based Parent Implemented Communication Strategies (i-PiCS)	Two to three 45-minute videoconference training sessions per week until participants reached mastery criteria.	Videoconferencing system Video feedback Telephone advice
Suess et al., 2016	FBA, FCT	Multi-element intervention: self-directed training, videoconference counseling, Video modeling, and video feedback.	Videoconferencing system
Bullard, et al., 2017	Verbal behavior modification	12 sessions of two hours of training and remote implementation of the intervention.	Videoconferencing system
Guðmundsdóttir et al., 2017	Decide, Arrange, Now, Count and contemplate, Enjoy Program (DANCE)	Weekly training sessions followed by mentoring and guidance sessions for a period of 11 months.	Videoconferencing system
Simacek et al., 2017	FA, FCT	Basic training conducted during telehealth service sessions.	Videoconferencing system
Subramaniam et al., 2017	DTI	Eight sessions: first and last training sessions face-to-face, the rest remote counseling.	Videoconferencing system
Bearss et al., 2018	Parent Training of Research Unit on Behavioral Interventions (RUBI-PT)	16 training sessions: 13 face-to-face and three via telephone.	Videoconferencing system Telephone advice
Benson et al., 2018	FA, FCT	Basic training conducted during telehealth service sessions.	Videoconferencing system
Dai et al., 2018	Picture Exchange Communication System (PECS)	Ten self-administered training sessions with follow-up via telephone.	Instructional DVD Telephone advice
Dimian et al., 2018	Augmentative and Alternative Communication Program (AAC)	Basic training conducted during telehealth service sessions.	Videoconferencing system
Pennefather et al., 2018	Autism Parent Training (APT)	Three weekly 90-minute remote training sessions.	Videoconferencing system

Table 1. *Continued*

Study	Technology-assisted parent trainings		
	Content	Procedure	Technological resources
Vismara et al., 2018	ESDM	12-session online course enriched with access to various materials (e.g., resources, photos, text messages).	Web Page Videoconferencing system
Daczewitz et al., 2019	PICS	29 remote training sessions of 15 to 25 minutes each.	Videoconferencing system Telephone advice
Hoffmann et al., 2019	FA, FCT	Behavioral Skills Training (BST) based on the simplified Wacker et al. (2013) program. No more data.	Videoconferencing system
Monlux et al., 2019	Functional Communication Response (FCR)	Multi-element remote training of 12 weekly sessions supplemented by independent implementation sessions.	Videoconferencing system
Tsami et al., 2019	FA, FCT	Seven weekly remote training sessions supplemented by daily independent practice.	Videoconferencing system Telephone advice
Blackman et al., 2020	Strategies for managing problem behavior and increasing communication skills	Seven weekly remote training sessions supplemented by daily independent practice.	Web Platform
Boutain et al., 2020	Behavioral Skills Training (BST)	13-session online course. No more data.	Web Platform FaceTime App
Fisher et al., 2020	Early Intensive Behavioral Intervention (EIBI)	9-module online course enriched with interactive activities and live role-playing exercises.	Web Platform
Marino et al., 2020	Discrete trial training (DTT); and Natural Environment Teaching (NET)	12 one-on-one remote training sessions.	Videoconferencing system
Hao et al., 2020	ImPACT, Skills and Knowledge of Intervention for Language Learning Success (SKILLS)	Online course of six self-directed sessions enriched with videos, exercises, and interactive evaluations	Web Platform

Discussion

The analysis of the information collected in this review is discussed below based on the following topics: 1) training and technological advances, 2) problems addressed, 3) research method, and 4) reported findings.

Training and technological advances. The history of technology-assisted parent training in ABA interventions started more than 50 years ago (the oldest article identified data from 1968). The process of

incorporating different technological resources is illustrated in Figure 1 (own elaboration) where identified three distinct phases.

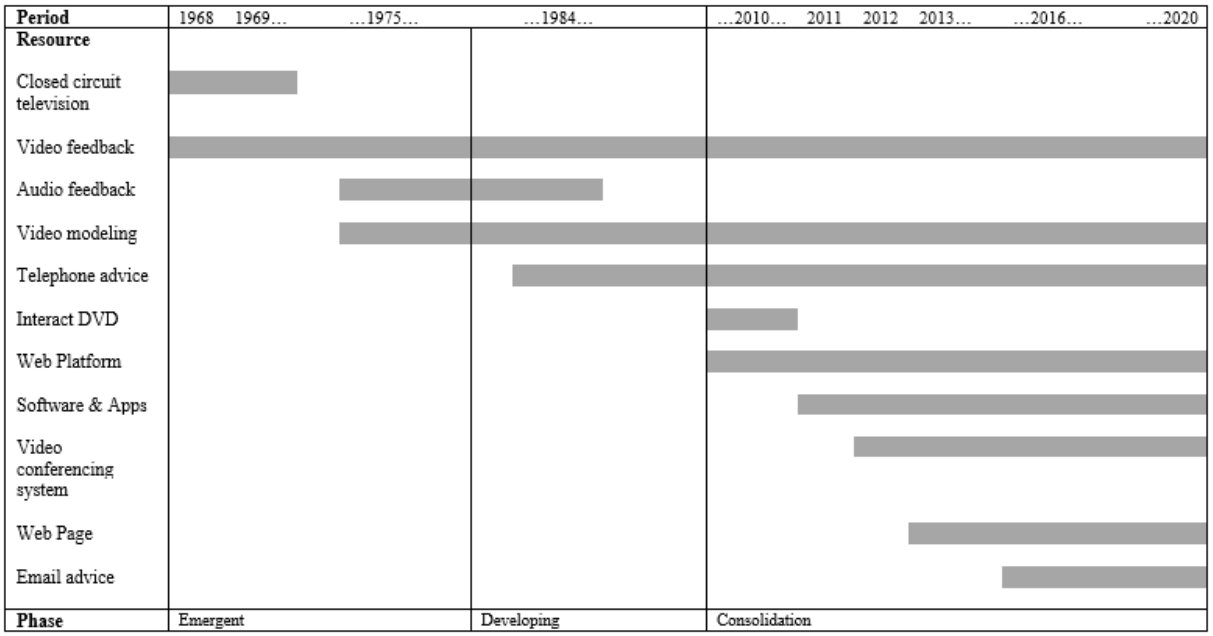

Figure 1. Process of incorporating different technological resources into parent training in behavior analytic interventions.

The first, emergent phase, at the end of the 1960s. During the 1970s a few early studies were published (n = 6) that explored the integration of some simple technological resources. Interestingly, some of these resources were refined and continue to be used to the present day. An intermediate phase of development occurred in the 1980s, 1990s, and the first decade of the 21st century. This phase was characterized by an increase in the scientific output in this area (n = 15). A final phase of consolidation took place in just one decade (2010–2020) with the publication of 46 articles documenting the use of state-of-the-art sophisticated technological resources. More details of this process are described below.

In the 1960s, Bernal and colleagues trained mothers of children with severe discipline problems (Bernal et al., 1968; Bernal, 1969). In their research, two studies pioneered technology-assisted training by using a closed-circuit television system for the first time. This system allowed for accurate collection of a large amount of data by recording mother-child interactions. It also provided and immediate and explicit feedback showing mothers how they had performed the implementation of the behavior management strategies in which they were being trained. This has since become known as video feedback.

In addition to technological advances, there have been significant improvements in the practical application of strategies and principles currently employed that are based on the science of ABA. For example, the inclusion of physical punishment as a valid strategy for the behavioral management of problematic behaviors cited in these studies (*e.g.* Bernal et al., 1968) is now considered an unacceptable treatment component.

An important challenge in the technology-assisted training process is the presentation of information in a new, attractive, clear, and accessible manner (Lattal, 2008; Cohen & Rozenblat, 2015). To meet this challenge, instructional materials such as videos in multimedia format (audio, image, and text)

which objective is to explain concepts or procedures, appeared almost at the same time as audiovisual materials became available to the general population. Exploring the instructional use of videos, some researchers developed and employed video modeling. Video modeling consists of recording demonstrations and examples of targeted behavioral skills (performed by practitioners, parents, or individuals with behavioral excesses/deficits). The application of these techniques was and still are used as an instructional method considered technology-assisted training. Studies on video modeling (Hanf, 1969; Nay, 1972; Peine, 1969) were presented at annual meetings. Nay (1975) first published information on video modeling that explicitly described its use to teach time-out techniques to a group of mothers. Furthermore, this study made audio recordings in the same training program to provide feedback on the performance of the participants, a procedure known as audio feedback. These two techniques reappear in subsequent research (Flanagan et al., 1979; Koegel et al., 1978; O'Dell et al., 1979) and include the extensive work of Webster-Stratton and colleagues (1981a, 1981b, 1982a, 1982b, 1984, 1988, 1990, 1992, 1994) who incorporated the review of videos with correct and incorrect examples of the implementation of behavior change procedures. They introduced a manual-based training process to improve the behavioral skills of a group of mothers of children with ASD and problematic behavior.

These favorable results paved the way for remote parent training and subsequent studies were published in the following years including provide parents with various materials, such as manuals, workbooks, and instructional videos (Moura et al., 2007; Sharry et al., 2005; Stokes & Luiselli, 2008). This allowed part of the training to be conducted independently and in the participants' homes. Some studies (Connell et al., 1997; Hamilton & MacQuiddy, 1984; Morawska & Sanders, 2006) added communication via telephone to monitor the performance of parents and provide feedback. In addition, Hamilton and MacQuiddy (1984) described the use of a device called Signal Seat (a cylindrical stool with a buzzer under the seat and a beeper) as a complement to implement the time-out technique.

New formats were used in 2010, such as interactive DVDs (Nefdt et al., 2010). This is also the year that marked the beginning of the use of computer software and web-based platforms (Hamad et al., 2010). This technology-assisted training significantly enriched the way in which information was delivered. Moreover, this optimized and improved the processes for collecting data by including the possibility of parents videotaping their performances or their children's behavioral episodes. Since then, scientific output in this area has grown exponentially parallel to technological development. In addition to the previously mentioned media and devices, the use of various electronic devices, such as desktop computers, laptops, web cameras, tablets, and smartphones became popular. Further, digital technologies such as platforms for online courses (e.g., Moodle) and videoconferencing (e.g., Skype, FaceTime, Zoom), social networks (e.g., Facebook, Instagram,), instant messaging and chat applications (e.g., Messenger, WhatsApp), and even sites that act as tools for business professionals to collaborate (e.g., Google Workspace).

Incorporating technology into clinical interventions has a close correlation with the progression of technology itself in all areas of human endeavor. Different materials, devices, and systems are included as they are developed for improving processes and procedures. Regarding ABA, technology has been included in three cases: 1) in the design of devices that enable the programming of contingencies and the precise recording of behaviors (i.e., light and/or auditory signals, counters), 2) in the development of virtual communication systems and digital materials to provide remote care (telehealth; *e.g* Marino et al., 2020), and 3) in the use of these same tools to enrich, facilitate, or enable the training of individual providers in behavior change procedures (*e.g.* Iwata, 1991; Cohen & Rozenblat, 2015).

Problems addressed. ABA interventions have been used with great success in the treatment of problematic behavior in individuals with ASD due that has gained such acceptance in this field it has been erroneously identified as a set of strategies aimed exclusively at that condition. However, there is significant evidence showing ABA interventions also can be effective in educational, occupational, and clinical settings, both in individual and group contexts (Demchak et al., 2020; Dillenburger & Keenan, 2009; Fielding et al., 2013; Martin & Pear, 2008).

This tendency to use ABA interventions particularly for individuals with ASD is a phenomenon consistent with the data obtained in the present review in more than 70% of studies included children with that diagnosis, with or without comorbidities. However, few studies included clinical populations with individuals who display significant behavior problems associated with others diagnoses such as developmental disorders (e.g., Dimian et al., 2018), attention deficit disorder (e.g., Connell et al., 1997; Reese et al., 2015; Xie et al., 2013), language disorders (e.g., Hoffmann et al., 2019), Fragile X syndrome (e.g., Bullard, et al., 2017; Machalicek et al., 2016; Monlux et al., 2019), cerebral palsy (e.g., Benson et al., 2018), and deafness (Daczewitz et al., 2019), or in non-clinical populations such as with individuals who display medium and high intensity behavior problems without other diagnoses (Bernal et al., 1968; Bernal, 1969; Morawska & Sanders, 2006; Webster-Stratton, 1982a, 1990, 1992; Webster-Stratton et al., 1988).

It is important to note that although in general the purpose of the studies reviewed was to provide evidence regarding the efficacy, relevance, and/or feasibility of training from the measurement of parents acquisition and implementation of behavior change procedures and strategies, many studies reported that improves on parents' skills reduced children problematic behavior and thus improved the overall quality of family member's lives, regardless of a specific diagnosed disorder (see Table 2).

*Research methods***.** The methodology adopted in research on technology-assisted training programs has evolved over time. The first studies (e.g., Bernal et al., 1968; Bernal, 1969; Flanagan et al., 1979; Koegel et al., 1978; Nay, 1975; O'Dell et al., 1979) were characterized by small samples (from 1 to 10 participants), selected by voluntary, snowball, or purposive sampling. They used single case designs with pre and post measurements. The objectives of the studies were to describe the components of the training programs that were generally brief and focused on the training of simple and specific techniques, such as modeling, reinforcement, shaping, and extinction. The variables related to their efficacy and other feasibility indicators linked to social, economic, and cultural characteristics of the population were also analyzed. Data were analyzed with t-tests and chi-square, and overlapping pair, visual graph, and content analyses for qualitative data.

Early findings subsequently influenced the design of more complex training programs and the development of further high-quality research (e.g., Guðmundsdóttir et al., 2017; Ingersoll & Berger, 2015; Jang et al., 2012; Lindgren et al., 2016; McDuffie et al., 2013; St. Peter et al., 2014; Suppo & Mayton, 2014). These included comparative and correlational studies, experimental and quasi-experimental research methods, and multiple baseline designs. The objectives of these studies were to compare the efficacy of two or more types of training with differentiated interventions in one or more experimental groups. They often included a control group composed of dozens of participants selected by stratified and quota samplings. In these studies, specific selection criteria were established to ensure the evenness of the groups and the validity of the comparisons. Training included more sophisticated procedures, such as differential reinforcement programs, functional analysis, functional communication training, discrete trials,

and functional communication responses. The statistical analyses included parametric and nonparametric tests of correlation and group comparison.

Significant funding provided to some universities has enabled large research projects to be developed in recent years (e.g., Bearss et al., 2018; Buzhardt et al., 2016; Dai et al., 2018; Fisher et al., 2020; Guðmundsdóttir et al., 2017; Hao et al., 2020; Simacek et al., 2017; Suess et al., 2014; Suess et al., 2016). These include multicomponent programs such as Improving Parents As Communication Teachers (ImPACT), Online and Applied System for Intervention Skills (OASIS), Ohio Department of Education Center for Autism and Low Incidence (OCALI), Parents Plus Early Years Program (PPEY), Early Start Denver Model ESDM, that have large samples (more than a hundred participants).

The large and growing number of children with behavior problems and the insufficient capacity of the healthcare system to provide ABA services mean that a significant number of families are on waiting lists (Machalicek et al., 2016; Meadan et al., 2016). This encourages research groups to offer participation in research projects that include distance care and training programs for caregivers as an alternative care option (Machalicek et al., 2016; Suess et al., 2014; Suess et al., 2016; Wacker et al., 2013). The abundance of individuals in search of behavior analytic services has enabled a highly specific selection of the population (in sufficient numbers) to participate in randomized clinical studies. Further, the selection of participants within potential research populations with the desired specific characteristics supports efforts to control extraneous and confounding variables. Measurements in these studies included multiple baselines for different groups, different study conditions, and allowed for the data to be processed with analysis of variance (ANOVA) and other complex statistical tests, such as factor analysis (FA) and structural equation modeling.

It should be noted that specific characteristics of study participants can significantly affect results. Most studies (66%) consisted of mother-child dyads while fathers alone participated in 20% of studies reviews. These studies did not report the effects of training on their children (e.g., Dai et al., 2018; Kobak et al., 2011; Pennefather et al., 2018), and only some studies (e.g., Connell et al., 1997; Jang et al., 2012) considered the participation of families (i.e., both parents and the child, grandparents, or siblings). Also of note, mothers participated in 95% of the studies reviewed and they often had a higher level of education. Those with less education had completed high school at a minimum (Blackman et al., 2020; Koegel et al., 1978). Moreover, it was not uncommon to find participating mothers with knowledge in special education or psychology with a master's or doctoral degree. (Fisher et al., 2020; Ingersoll & Berger, 2015; Meadan et al., 2016; Moura et al., 2007; Suess et al., 2014). Most cases included married women belonging to a middle or higher social class.

Reported findings. Results related to technology-assisted training reported in articles reviewed are summarized in Table 2. The first column presents each study by first author in chronological order. The stated objectives of each investigation are described in second column. The number and characteristics of the participants that were trained is given in the third column, including some data on the population for whom the behavioral-analytic interventions were targeted. Finally, the last column presents a brief description of findings reported.

Table 2. Summary of main findings related to parent training.

Study	Purpose	Participants trained	Findings
Bernal et al., 1968	Describe a disruptive behavior management training program.	One mother of a child diagnosed with "brat" syndrome.	From the training the mother was able to establish control over her son's behavior.
Bernal, 1969	Describe feedback via television procedure for training parents in behavior child management.	2 mothers of children aged five and eight years respectively.	Gradual shaping in parental skills resulted in a reduction of disruptive behavior on children.
Nay, 1975	Compare the efficacy of four instructional techniques for parent training in time out procedures.	77 mothers of children in age range 1 to 10 years old.	Videotaped modeling and modeling with roleplaying were better than written and lecture presentation for application of knowledge acquired.
Koegel et al., 1978	Examine the influence of several components of different parent/teacher training programs on the generalization of learning.	3 caretakers (teacher, therapist, and mother) of a children diagnosed with ASD.	Four components of video modeling were related to the generalization of learning: specific instructions, visual and auditory model, use of examples and practice after observing videotapes.
Flanagan et al., 1979	Compare the efficacy of four instructional techniques for parent training in time out procedures.	48 parents of children in age range 2 to 7 years old.	Parent's ability to apply time-out was better with video modeling and audio feedback instruction than the written presentation and the control condition.
O'Dell et al., 1979	Assessed effectiveness of five training models for administering time-out to children.	60 parents of children in age range 1 to12 years old.	Although their efficiency is not higher than written or face to face presentation, media-assisted programs were better accepted and more cost-efficient.
Webster-Stratton, 1981b	Determine if a video modeling group discussion program produce significative changes in maternal attitudes and behaviors.	35 mothers of children in age range 3 to 5 years old.	The program, relatively short and inexpensive, produced marked behavioral changes but only small attitudinal changes.
Webster-Stratton, 1982a	Determine if a standardized video modeling parent training produce significative changes in children's general behaviors.	35 mothers of children in age range 3 to 5 years old.	After the program application children's behaviors became significantly less negative, noncompliant and submissive as well as more positive and friendly.

Table 2. *Continued.*

Study	Purpose	Participants trained	Findings
Webster-Stratton, 1982b	Evaluate long-term effectiveness of a parent-training program based on videotape modeling.	32 mothers-child pair. Children in age range 3 to 6 years old.	Behavioral and attitudinal changes in both mothers and children immediately after the program were maintained one year later.
Hamilton & MacQuiddy, 1984	Evaluate a self - instructional parent training manual and audiotape to learn implementation of time out.	27 parent-child pairs. Children in age range 2 to 7 years old.	Training was effective in decreasing number and intensity of problems child behavior and increasing positive attitudes and compliance to parental commands.
Webster-Stratton, 1984	Evaluate long-term effectiveness of a video modeling parent-training program to change parent attitudes and parent-child interactions in a clinical population.	35 mother-child pairs. Children diagnosed with psychiatric behavior disorder.	The low-cost video modeling parent-training program showed significant attitudinal and behavioral improvements with a clinical population and these results were maintained one year after.
Webster-Stratton et al., 1988	Compare the outcomes of three cost-effective parent-training treatment programs in families with conduct-problem children.	114 parents of children with behavior problems, in age range 3 to 8 years old.	Parents who participated in programs with video modeling support reported significantly fewer child behavior problems, more prosocial behaviors and less spanking.
Webster-Stratton, 1990	Compare the effectiveness of two cost-effective self-help videotape parent training programs for families with conduct-problem children.	43 parents of children with behavior problems, in age range 3 to 8 years old.	Individually self-administered videotape training is effective by itself, but the outcomes improve if it is complemented with therapist consultation.
Webster-Stratton, 1992	Determine which secondary variables at pretraining predicted successful parent´s implementation of a treatment program 1 year later.	100 families of children with behavior problems, (72 boys, 28 girls, 100 mothers and 65 fathers).	Five variables predicted the success of the intervention: mother depression, socioeconomic status, number of negative life experiences, mental age and marital status.
Webster-Stratton, 1994	Examine the specific effects of adding a broader based videotape treatment component to a basic parent skills training program.	78 families of children diagnosed with oppositional-defiant or conduct-disordered (88 boys, 20 girls, 77 mothers and 5 fathers).	Families in enriched program showed significant improvements in problem-solving, communication and collaboration skills; and major satisfaction with usefulness and ease of implementation of the techniques.

Table 2. *Continued.*

Study	Purpose	Participants trained	Findings
Connell et al., 1997	Present a self-directed behavioral intervention for parents of oppositional children.	44 parents of children diagnosed with oppositional-defiant living on rural areas.	A self-directed minimal intervention was effective in reducing levels of disruptive child behavior.
Sharry et al., 2005	Describe development and components of a video-based early intervention for parents of children with behavioral and developmental difficulties.	38 parents of children diagnosed with ASD.	Indirect training of separate components is sufficient to increase parenting skills, but improvement in children requires mastery of all components.
Morawska & Sanders, 2006	Examine the efficacy of a self-administered behavioral family intervention.	126 families of toddlers with behavior problems. Children in age range 18 to 36 months old.	The self-administered intervention reduced child behavior problems in the short term, improved maternal parenting style and self-confidence; the effects are maintained at 6 months.
Moura et al., 2007	Compare results of video feedback and video modeling procedures in parent training for use of the differential reinforcement.	2 mother-child pairs. Children with behavior problems.	Improved maternal skills that are maintained at one year (slightly better for video modeling). The main factor for success was feedback and discussion of behaviors with therapist.
Stokes & Luiselli, 2008	Determine if parents can acquire the skills necessary to conduct functional analysis with a home training.	2 families of children diagnosed with ASD.	From an abbreviated training supplemented with verbal, written and video feedback, the parents were able to adequately conduct a functional analysis.
Hamad et al., 2010	Evaluate the feasibility of implementing a distance learning program for parents in behavioral interventions.	51 caretakers (educators, professionals, teacher aides, parents, and family members) of children diagnosed with ASD.	Significant increase in the level of knowledge of the participants and a high degree of satisfaction with the course.
Nefdt et al., 2010	Evaluate whether a self-administered parent training program generates changes in child behavior.	27 primary caretakers of children diagnosed with ASD.	Parents demonstrated learning of specified procedures and appeared more confident during parent-child interactions.
Kobak et al., 2011	Evaluate a web-based behavioral skills training tutorial for parents.	23 parents of children diagnosed with ASD.	The course produced a statistically significant increase in users' knowledge.

Table 2. *Continued.*

Study	Purpose	Participants trained	Findings
Jang et al., 2012	Evaluate effectiveness of ABA eLearning program for training family members of children diagnosed with ASD.	28 family members (24 mothers, two grandmothers and two fathers) of children diagnosed with ASD.	E-learning program was effective in training caregivers in ABA procedures and increased their level of commitment – adherence.
Vismara et al., 2012	Examine feasibility and acceptance of telehealth intervention program implemented by parents for promoting child learning.	2 families of child diagnosed with ASD.	Increased parenting skills and verbal repertoire in children. Parents reported a high level of satisfaction with the program.
Young et al., 2012	Evaluate a self-instructional package to train parents to conduct discrete-trials teaching.	5 mothers of children diagnosed with ASD.	Components of the instructional package that were shown to increase effectiveness were role-playing, feedback and instructional video.
McDuffie et al., 2013	Examine proximal effects of a naturalistic language intervention on the use of specific language support strategies by mothers.	35 mothers-child pairs of children diagnosed with ASD.	Mothers increased use of different strategies of instigation of verbal behavior and children increased communicative acts.
Vismara et al., 2013	Discuss the findings from the use of telehealth to provide health services and parent training.	8 parents of children diagnosed with ASD.	Parents improve understanding and and skills to meet their children's needs. Emphasized the importance of feedback via videoconference with therapists.
Wacker et al., 2013	Investigate the effectiveness and acceptability of performing functional analysis trained via telehealth.	20 parents (19 mothers, 1 father) of children diagnosed with ASD. Children in age range 1 to 6 years old.	The procedures trained through telehealth had comparable results and were as acceptable to parents as in-personas the procedures performed in person at home, with a good cost-effectiveness ratio.
Wainer & Ingersoll, 2013	Evaluate efficacy of a self-directed, internet-based, distance learning program for teaching intervention techniques.	3 mother-child pairs of children diagnosed with ASD.	Mothers improved their knowledge and learned to apply techniques; children improved their imitation skills.

Table 2. *Continued.*

Study	Purpose	Participants trained	Findings
Xie et al., 2013	Evaluate the effectiveness of group parent training on ADHD treatment delivered via videoconferencing.	9 parents of children diagnosed with ADHD.	The acceptance and effectiveness of the videoconference program was the same as the face-to-face program with a significant effect on the improvement of parental disciplinary practices.
Heitzman-Powell et al., 2014	Investigated the feasibility of training seven parents using a web-based program and telemedicine technology to implement ABA strategies.	7 parents of children diagnosed with ASD.	Parents increased their knowledge of ABA strategies and concepts and improved their implementation of ABA strategies with their children.
St. Peter et al., 2014	Compare parental adherence during written or asynchronous video teleconsultation designed to teach parents to implement Discrete-Trial Instruction.	42 mothers and fathers of children diagnosed with ASD.	Parents who received video instructions adhered to the training procedures to a significantly greater extent than did parents who received written instructions.
Suess et al., 2014	Evaluating the treatment fidelity of parents who conduct in-home functional communication training with coaching via telehealth.	3 families of children diagnosed with ASD.	Telehealth can be used to implement Functional Communication Training with acceptable fidelity and to achieve substantial reductions in children's problem behavior.
Suppo & Mayton, 2014	Investigate the extent to which parents were able to obtain and apply knowledge of how to create a visual support for their children by using a self-directed, online program.	12 primary caretakers of a children diagnosed with ASD.	Parents who receive training using an online program can accurately apply a research-based practice and showed strong satisfaction with this method of obtaining and applying knowledge.
Barboza et al., 2015	Develop and evaluate the effect of an instructional video modeling package on the accuracy of the application of teaching programs for parents.	35 parent-child pairs of children diagnosed with ASD.	Package had a positive effect on the accuracy of the performance of all caregivers, especially in the performances that showed lower accuracy in the baseline measurement.
Ingersoll & Berger, 2015	Compare adherence self-directed and therapist-assisted versions of a novel telehealth-based parent-mediated intervention.	27 parents of children diagnosed with ASD.	Parent adherence and satisfaction was high for both online versions of the program, although therapist assistance increased engagement.

Table 2. *Continued.*

Study	Purpose	Participants trained	Findings
Reese et al., 2015	Evaluated the effects of using videoconferencing technology to deliver an evidence-based parenting program.	13 families of children diagnosed with ADHD.	Results of the videoconference program are comparable to those of the face-to-face program, both in terms of child outcomes and parenting outcomes.
Wainer & Ingersoll, 2015	Assess the degree to which parents could learn about and effectively implement Reciprocal Imitation Training using a self-directed and coaching telehealth program.	5 parent-child pairs of children diagnosed with ASD.	Parents improved in their use of the intervention techniques and indicated that the intervention and telehealth service delivery model were acceptable, useable, and effective.
Buzhardt et al., 2016	Describe the cultural adaptations of an online parental training program for a Hispanic population.	4 families of children diagnosed with ASD.	Although there were improvements in parenting skills, it was noted that highly structured programs may have limited generalizability to other cultures.
Ingersoll et al., 2016	Compare by randomized clinical trial an intervention administered by therapists with one administered by trained parents via telehealth.	28 families of children diagnosed with ASD.	Both programs improved children's language, parents' perception of them and decreased stress. The therapist-assisted group performed with greater fidelity and was the only one that produced changes in social skills.
Lindgren et al., 2016	Determine the effectiveness of treatment lower cost implemented by trained parents via telehealth.	94 parents of children diagnosed with ASD.	Parents can use ABA procedures to successfully treat behavior problems associated with ASD regardless of whether treatment is directed by behavior consultants in person or via remote video coaching.
Machalicek et al., 2016	Evaluate the use of telehealth to facilitate behavioral consultation to three families of children with ASD.	3 parent-child pairs of children diagnosed with ASD.	Telehealth is an effective option for parents to implement functional behavior assessment. It has effectiveness, acceptability and feasibility.

Table 2. *Continued.*

Study	Purpose	Participants trained	Findings
McDuffie et al., 2016	Examined the effects of a naturalistic parent-implemented language intervention on the use of verbally responsive language.	3 mother-child pairs of children diagnosed with fragile X syndrome.	Mothers increased the use of expressions that favored the child's acts of communication; these strategies, learned by the mothers in the face-to-face sessions, were generalized for the distance sessions.
Meadan et al., 2016	Describe a pilot program that provides long-distance training and coaching via internet to parents.	3 parent-child pairs of children diagnosed with ASD.	Parents learned to implement the targeted naturalistic teaching strategies with fidelity when, and only when, they were provided with training and coaching over the Internet.
Suess et al., 2016	Determine whether parents coached via videoconference could effectively conduct a brief Functional Analysis matched Functional Communication Training.	5 parent-child pairs of children diagnosed with ASD.	Coached parents achieved identify social function of their children behavior and reduce their behavior problems.
Bullard, et al., 2017	Examine the effectiveness of a language intervention implemented by remotely trained parents.	3 mother-child pairs of children diagnosed with fragile X syndrome.	Parent implemented language intervention approach by demonstrating generalized improvements in both targeted strategy use and measures of child spoken language.
Guðmundsdóttir et al., 2017	Describes the development and results of behavioral training to parents via telecommunication.	3 primary caretakers (two mothers, one teacher) of a children diagnosed with ASD.	The procedure was effective in increasing caregivers' teaching and children's socio-communication skills.
Simacek et al., 2017	Examined the efficacy of parent-implemented communication assessment and intervention with remote coaching via telehealth.	3 parent-child pairs of children diagnosed with ASD.	Telehealth was an effective mechanism to deliver Naturalistic Developmental Behavioral Interventions, parents were able to implement successfully and rated the treatment as acceptable.
Subramaniam et al., 2017	Observe the long-term integrity with which rural parents of children with ASD implemented Discrete-Trial Instruction.	4 rural parents of children diagnosed with ASD.	Parents accurately implemented untrained programs with their children and maintained accurate implementation over several months of remote supervision.

Table 2. *Continued.*

Study	Purpose	Participants trained	Findings
Bearss et al., 2018	Evaluate the feasibility of the a structured parent training program when delivered via telehealth to families in rural communities.	13 families of children diagnosed with ASD.	Parents improved their skills and reported training via telehealth was acceptable. Treatment could be delivered reliably by therapists by these modality.
Benson et al., 2018	Extend use of Functional Analysis plus Functional Communication Training by using telehealth in home with parents as interventionists.	2 families of children diagnosed with intellectual disability.	Parents faithfully implemented the remotely supervised training. Children decreased their self-injurious behavior and improved verbal behavior.
Dai et al., 2018	Explore whether a video-enriched parent-training program would (a) be comprehensible and acceptable to parents and increase their knowledge and self-efficacy.	29 parents of children diagnosed with ASD. Children in age range 1 to 6 years old.	Parents rated the intervention as feasible and highly acceptable. They reported an increase in self-efficacy and their knowledge of behavioral strategies increased significantly.
Dimian et al., 2018	Examine the efficacy of parent-implemented communication interventions delivered via telehealth coaching in home settings.	2 parent-child pairs of children diagnosed with neurodevelopmental disability.	Caregivers implemented with satisfactory fidelity the procedures with which they achieved that children acquired alternatives communicative skills.
Pennefather et al., 2018	Evaluated feasibility, usability and social validity program online for parents on behavioral interventions.	23 parents of children diagnosed with ASD.	Parents reported decreases in parental stress and child hyperactive behaviors; also increases in relevant knowledge and child prosocial behavior.
Vismara et al., 2018	Compare telehealth parent training in the Early Start Denver Model by randomized trials.	24 parent-child pairs of children diagnosed with ASD.	Telehealth training facilitated high parent fidelity and program satisfaction, children's social communication skills improved regardless.
Daczewitz et al., 2019	Implement and assess tele practice teaching and coaching of parents.	1 mother-child pair of child diagnosed hard-of-hearing.	Mother expressed satisfaction with the goals, procedures, and outcomes of the intervention.

Table 2. *Continued.*

Study	Purpose	Participants trained	Findings
Hoffmann et al., 2019	Examine the effects of a telemediated parent training program implemented by a professional in Early Childhood Special Education.	2 mother-child pairs of children diagnosed with ASD.	Parents in rural settings were able to successfully apply assessment and intervention procedures with the advice of a specialist through telehealth.
Monlux et al., 2019	Examined whether function-based behavior analytic interventions could be delivered via telehealth.	10 parent-child pairs of children diagnosed with fragile X syndrome.	Parent procedural integrity and acceptability ratings remained high throughout the treatment; rates of child behavioral problems decreased.
Tsami et al., 2019	Determine if a telehealth training package is than efficient and acceptable for other countries as it has been for the USA.	8 mother-child pairs of children diagnosed with ASD.	Parent-implemented procedures were highly effective in reducing child problem behavior, also, parents rated it as acceptable and effective.
Blackman et al., 2020	Evaluate the relative efficacy of content delivered via self-directed online training modules relative to group in vivo training.	18 parent-child pairs of children diagnosed with ASD.	Online and in vivo groups showed comparable outcomes: both showed significant improvements in positive parent– child interactions and knowledge of ABA.
Boutain et al., 2020	Evaluating a telehealth parent training program for teaching basic self-care skills.	3 parent-child pairs of children diagnosed with ASD.	Parents implemented programs with near-perfect levels of fidelity and children acquired self-care skills and independence.
Fisher et al., 2020	Evaluate a virtual parent-training program with e-learning modules and scripted role-play via a virtual private network.	25 parents of children diagnosed with ASD.	Parents showed significant improvements on implementation of ABA skills and rated the training as highly socially acceptable.
Marino et al., 2020	Compare the effect of a tele-assisted and in-person intervention based on a behavioral intervention protocol.	42 parents of children diagnosed with ASD.	Substantial improvements in the perception and management of children's behavior by parents, as well as a reduction in parent stress levels were obtained by tele-assisted intervention.

Table 2. *Continued.*

Study	Purpose	Participants trained	Findings
Hao et al., 2020	Compare traditional face-to-face therapy for facilitative speech intervention with teletherapy strategies applied to trained parents.	30 parent-child pairs of teens diagnosed with ASD.	Both strategies showed comparable results with respect to improvements in parents' implementation fidelity and children's language diversity and complexity.

The most striking result is that all studies, to a greater or lesser extent, demonstrated the efficacy of the procedures and met certain objectives, such as the reduction of undesirable behaviors, the increase of socially acceptable behaviors, and/or the increase in the knowledge or skills of parents for behavior management of their children. The elements that showed a greater influence on efficacy were training combining distance and face-to-face training (e.g., Bearss et al., 2018; Benson et al., 2018; Bullard, et al., 2017; Koegel et al., 1978; Lindgren et al., 2016; Machalicek et al., 2016; McDuffie et al. 2016; Meadan et al., 2016; Reese et al., 2015; Subramaniam et al., 2017; Vismara et al., 2013), and interventions implemented by parents but supervised, mentored, and complemented with the intervention of professional behavior analysts (e.g., Ingersoll & Berger, 2015; Ingersoll et al., 2016; Morawska & Sanders, 2006; Moura et al., 2007; Suess et al., 2014; Webster-Stratton et al., 1988; Webster-Stratton, 1990; Young et al., 2012). The use of technology was a positive factor in most cases as it made the content more accessible and user friendly, however, it was a limitation in some cases for parents with poor knowledge in the use of technological devices and digital platforms (e.g., St. Peter et al., 2014; Vismara et al., 2018; Xie et al., 2013). For example, Zooder-Martell and colleagues (2021) studied teachers' willingness to use a telepresence robot to support students with ASD. They found great acceptance to use technology among teachers with technological background, but teachers with less experience showed less acceptance.

Conclusions and future lines

The current overview presented the process of incorporating technology into training parents in ABA interventions from a chronological perspective to identify in each study included the contribution of technology at advance this disciplinary field. The examination of this process allowed identify how technological development contribute to improve factors that impact quality of life, in the case of ABA interventions specifically, each technological innovation has been rapidly adopted to the extent that it solves a problem or meets a specific demand. The analysis of the chronology of such contributions and the changes they produced supports the understanding of the current state of the discipline and its success as an intervention. From this perspective, this review supports various positive outcomes with the expectation they will be replicated, even in places where ABA knowledge is incipient.

Although the analyzed information showed that technology has contributed significantly to advances in the provision of ABA services, it highlights the importance of considering in future research the role of technical training and constant supervision (e.g., Hoffmann et al., 2019; Subramaniam et al., 2017), the development of multicomponent programs implemented with fidelity and including generalization measures (e.g., Boutain et al., 2020; Hamilton & MacQuiddy, 1984; Hoffmann et al., 2019; McDuffie et al. 2016; Nefdt et al. 2010; Tsami et al., 2019; Vismara et al, 2013; Vismara et al., 2018; Wacker et al., 2013), and the provision of ABA services within the context of research to varying

populations with different social, economic, and cultural variables (e.g., Buzhardt et al., 2016; Connell et al., 1997; Dai et al., 2018; Dimian et al., 2018; Hao et al., 2020; Webster-Stratton et al., 1988).

The results discussed herein present and support the way forward so ABA services exist and are provided in many more places thereby contributing to the improvement of the quality of life of individuals that living there. This is relevant considering the main challenge of ABA today is to expand beyond the limits of the context in which it was created and developed. ABA is highly regarded in first world countries since there is significant scientific support for its efficacy. It is imperative to disseminate the benefits of the treatment of problematic behavior based on the science of ABA to geographical regions with far less economic development such as in Latin America, where the socioeconomic and cultural conditions are in a state comparable with the United States approximately 50 years ago, specifically regarding the availability of and access to ABA services; and technology-assisted training is effective, valuable, and desperately needed strategy to do it. Findings of this review makes a strong case that technology is an excellent option to provide more parent training especially because of the lack of service providers; and encourages work hard to disperse services to more underserved areas and to continue to seek the funding to do so.

Ethical statement. This article does not contain any studies with human participants or animals performed by any of the authors.

Disclosure of interest. No potential conflict of interest was reported by the author(s).

Data availability statement. All data generated or analyzed during this study are included in this document. All articles included and analyzed in this study are in the public domain and can be accessed through the links found in the references section.

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