



Technology in Parenting Programs: A Systematic Review of Existing Interventions

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Abstract

Behavioral parent training is an evidence-based intervention that reduces child problem behavior. Unfortunately, there are notable disparities in access to and use of evidence-based parenting interventions, including BPT. One way to address the service gap is through technology-based parenting interventions. The purpose of this systematic review is to identify the populations targeted in technology-based parenting interventions, the effectiveness of these interventions, and areas and populations where future research is warranted. A search of three databases yielded 31 articles that met inclusion criteria. We included articles if they (a) were treatment outcome studies using web-based interventions or (b) discussed methodologies or models pertaining to web-based interventions, (c) specified demographic information such as race, ethnicity, and SES, and (d) were published in English or Spanish. We coded 25 treatment outcome studies and six feasibility studies. Technology-based parenting interventions have successfully improved parenting variables such as parent knowledge, behavior, and self-efficacy. Yet the vast majority of these interventions are validated with White American families and lack adaptations that may make them more accessible to underserved populations. As the burgeoning area of technology-based interventions continues to grow, researchers should consider underserved populations and appropriate cultural adaptations that could reduce mental health disparities and increase the scope of evidence-based interventions.

Keywords Behavioral · Parenting · Intervention · Technology · Disparities

Over five decades of research on behavioral parent training interventions point to their utility in improving child, maternal, and family well-being across a host of populations from prevention to clinical samples. However, notable disparities are documented in the access to quality interventions, especially for families that are marginalized due to geography (rural) or social position (race/ethnicity, socioeconomic status). Technology may hold great promise in narrowing disparities created by differential accessibility and/or relevance.

Behavioral parent training (BPT) focuses on building parent skills and knowledge by training parents on a variety of parenting skills aimed to improve child behavior (Forehand et al. 2014). Their efficacy has been documented across developmental, cultural, and severity contexts

(Dishion et al. 2016; Forehand et al. 2014). Although packaged under different names, commonly covered intervention components include increasing praise and rewards for good behavior, providing effective commands/directions, developing contingency plans, and effectively implementing time-out (Kaminski et al. 2008). Numerous research studies have demonstrated the effectiveness of several behavioral parent training programs, including The Incredible Years (Webster-Stratton 1990), Parent Management Training Oregon Model (Dishion et al. 2016), Parent-Child Interaction Therapy (Eyberg and Robinson 1983) and Triple-P Positive Parenting (Bor et al. 2002; see Eyberg et al. 2008 for a comprehensive review). These programs are most commonly taught in a clinic setting over 10–12 weeks and exist in individual and group formats.

There are a number of factors that inhibit the success of BPT programs. The most severe and prevalent problem programs face is attrition (Assemany and McIntosh 2002; Nock and Ferriter 2005; Staudt 2007). Attrition rates in BPT programs can be as high as 48% (Assemany and McIntosh 2002). One reason for high levels of attrition may be the inconvenience of scheduling and attending weekly

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appointments when parent/caregiver time is sparse and life demands (e.g., work, family responsibilities, school) are high (Middlemiss 1996). Low socioeconomic status is also a predictor of attrition in BPT (Rinn et al. 1975; Snow et al. 2001). Another challenge to meeting the potential of BPT is consistent access to psychological services. Limited access can occur for a number of reasons, including living in a rural community (Angold et al. 2002; Nordal et al. 2003), membership in an underserved ethnic and racial minority group (U.S. Department of Health and Human Services 2001), and/or lack of means to attend a class (e.g., inflexible work schedule, lack of transportation; Middlemiss 1996; Prinz and Miller 1996). All of these issues may be addressed through the skillful use of technology. Delivering parenting interventions via computer programs, cell phones, and websites, among other media, increases the flexibility of when and where the program needs to be completed. Furthermore, culturally appropriate interventions that are less practitioner-dependent could increase access for those individuals who do not have access to a trained, culturally competent practitioner.

Racial and ethnic minorities account for a growing proportion of the United States population; in 2010 racial and ethnic minorities made up 22.5% of the U.S. population and an additional 2.4% of people identifying with two or more races (Humes et al. 2011). Recent population projections estimate that over half of the U.S. population will belong to a racial or ethnic minority group by 2044, and that by 2060 almost 20% of the population will be foreign born (Colby and Ortman 2015). Racial and ethnic minority children are more likely to live in families classified as low-income or poor and encounter a heightened number of risk factors as a result (Alegría et al. 2010; Jiang et al. 2017). Food insecurity, one risk factor linked with poverty, has been associated with more prevalent internalizing and externalizing problem behaviors for children aged 4–16 (Slopen et al. 2010). Ethnic minority children aged 3–17 are significantly less likely to utilize mental health services than their White American counterparts (Kataoka et al. 2002).

Evidence-based culturally adapted interventions are available (Hall et al. 2016) with myriad theoretical models for adaptation (Bernal and Domenech Rodríguez 2012) and specific examples of clinical trials (e.g., Parra-Cardona et al. 2012) and clinical case studies (Koslofsky and Domenech Rodríguez 2017). Yet new ways of maximizing access to high quality and culturally relevant mental health care for racial and ethnic minorities are needed. Technology may provide an important avenue for access. American Community Survey data from 2013 show that the majority of Black, Asian, and Latinx households have a desktop or handheld computer (75.8, 92.5, and 79.5%) and internet access (61.3, 86.6, and 66.7%; File and Ryan 2014). Given the steady increase in computer and internet use since the

turn of the century (File 2013), one can predict that the percentages of racial and ethnic minorities with technology access has only increased since 2014. Broad access to internet and computers makes technology-based interventions a viable option for delivering mental health services to racial and ethnic minorities.

Family conditions and unaddressed problem behavior can put children at risk for more serious externalizing behaviors in the future (Donenberg and Baker 1993; Nock et al. 2006; Patterson and Stouthamer-Loeber 1984; Reid and Patterson 1989). Families living in rural communities have additional stress due to poverty, unemployment, and poor education opportunities that may put their children at risk (Conger et al. 2010; Human and Wasem 1991). While rates of childhood psychiatric disorders may be comparable in rural communities to national samples (Angold et al. 2002; Breslau et al. 2014), the lack of specialized providers and lack of treatment sought by rural community members heighten the treatment disparities between rural and metropolitan communities (Hogh et al. 2011; Nordal et al. 2003).

There are 46.2 million people living in rural communities in the United States as of 2014 (U.S. Department of Agriculture 2015). Fifteen percent of the entire U.S. population is distributed over 72% of the United States land area. With rural Americans spread so thinly across large geographical areas, having mental health providers in each town or community is not currently feasible. According to the Health Resources and Services Administration (US Department of Health and Human Services 2015), 4223 communities qualify as Health Professional Shortage Areas (HPSA) for Mental Health. HPSAs are defined as areas that have a ratio of one psychiatrist to every 30,000 people. Of those that live in rural communities, 60% live in HPSAs for mental health. Despite living in areas with less access to goods in general, internet use in rural communities has increased over the last 15 years from 42 to 78% of adults (Perrin and Duggan 2015). This is only 7% less than adults in urban and suburban communities. Furthermore, rural communities have a larger ratio of older adults. This may account for the 7% difference since older adults in general report lower internet usage. These statistics suggest that computer-based parenting interventions may be a viable option in underserved rural communities.

Telemedicine (medical services delivered via technology instead of face-to-face) was the first step into the world of integrating technology and psychological interventions. Early telemedicine included the use of telephone calls, e-mail, and video conferencing (Zundel 1996). Telemedicine became an official term used in medical journals in 1993 and continued to gain momentum in the field of psychology in the years to come (Stamm 1998; Zundel 1996). Technology has since evolved from being solely the medium of

intervention to the mode of intervention. Researchers have been creating technology-based interventions for a variety of presenting problems, such as substance abuse (Fowler et al. 2016), smoking cessation (Bravin et al. 2015), weight loss (Khaylis et al. 2010), eating disorders (Schlegl et al. 2015), bipolar disorder (Hidalgo-Mazzei et al. 2015) and autism spectrum disorder (Meadan and Daczewitz 2015).

Interventions for child behavior and families have also begun to use technology-based interventions (Baumel et al. 2016; Hall and Bierman 2015; Meadan and Daczewitz 2015; Tarver et al. 2014). In the field of nursing, Breitenstein et al. (2014) conducted a meta-analysis to examine technology-based interventions. They excluded technology-based interventions that had face-to-face or group components, articles published before 2000, and interventions targeting specific disorders such as autism. Hall and Bierman (2015) reviewed feasibility, acceptability, and support for a variety of interventions targeting parents of children aged 0–5. Meadan and Daczewitz (2015) gathered current evidence for technology-based early interventions for children diagnoses with autism. Using only randomized control trials, Tarver et al. (2014) conducted a systematic review and meta-analysis of self-directed parenting interventions for externalizing behaviors compared to parenting interventions with a therapist.

Parenting programs are an effective way to decrease externalizing child problem behaviors, however there are a limited number of bilingual/bicultural treatment providers in both urban and rural areas, and few specialized providers in rural areas. Efforts are underway to incorporate technology with parenting interventions, however data on the scope and success of such interventions is limited (Breitenstein et al. 2014). Technology in parenting interventions can include email, texting, apps, websites, DVDs, and computer programs, among other formats. Some potential functions of technology may be to increase communication between treatment providers and parents, to deliver content, or to assess learning.

The purpose of the current paper is to provide a systematic review of existing technology-based parenting interventions and to serve as a resource in guiding future research that uses technology to decrease mental health disparities for parents and children. Results of this systematic review could (a) provide information on what BPT interventions have been adapted thus far, (b) evaluate the efficacy of technology-based interventions and compare evidence for different forms of technology-based interventions, and (c) identify limitations of existing research and areas that merit future research. We were particularly interested in identifying interventions that have been adapted for use in diverse geographical and cultural contexts as well as those that provided coaching from a therapist.

Method

We conducted a search for articles assessing technology-based parenting interventions and coding the articles that met inclusion criteria based on a coding sheet created by the author (available upon request). Finally, we synthesized the data collected for presentation.

Literature Search

Because the first article on telemedicine was published in 1993, we conducted a detailed search of research published in the last 23 years relevant to technology-based parenting interventions. We searched PsycINFO, PsycARTICLES, and SciELO. Published meta-analyses of technology-based parenting interventions found in this initial search served as search-forward articles to identify any missing search results. Preliminary search terms and phrases included combinations of the following keywords: *online interventions, parent training, web-based interventions, digital delivery, computer delivered, parenting, online interventions*.

Inclusion/Exclusion Criteria

In order to be included in the analysis, articles needed to meet the following criteria: (a) they were treatment outcome studies using web-based interventions or (b) they discussed methodologies or models pertaining to web-based interventions, (c) they specified demographic information such as race, ethnicity, or SES, and (d) they were published in English or Spanish. Articles that discussed cultural adaptations or rural healthcare without including a technology-based approach were excluded from the analysis.

Coding

Prior to the literature search the first author developed a coding sheet meant to highlight several important components of the study using Google Forms. The sheet contained four sections in addition to general publication information: Research Design, Sample Characteristics, Intervention Characteristics, and Results. The Research Design section included the design implemented, types of dependent measures used, types of outcomes assessed, and threats to internal and external validity. Sample Characteristics included demographic information for parents and children, participant selection criteria, comorbidities, and concurrent child medications. Intervention Characteristics consisted of the parenting program adapted from, the format of the intervention, whether intervention delivery included coaching, the number of sessions, and the structure of delivery (individual or group). The Results section

Table 1 Basic study details and outcomes of technology-based parenting intervention studies

Authors	Study Type	Target Population	Sample Size	Follow-up points	Dependent Variables	Effect Size on Parent DV	Effect Size on Child DV
Baggett et al. (2010)	Experimental	Low SES families, EHS and WIC eligible	38 infants/mothers	0	Parent bx, child bx, ease of use of technology, satisfaction w/ intervention, program engagement, and maternal depression	Moderate to large	Moderate to large
Bert et al. (2008)	Experimental	Convenience sample	134 mothers	0	Knowledge acquisition, and satisfaction w/ intervention	Not reported	Not reported
Clarke et al. (2014)	Experimental	Children w/ asthma	13 parents ^a	0	Parent bx, child bx, medical information, weekly asthma diary card, and self-efficacy	Not reported	Not reported
Cotter et al. (2013)	Quasi-Experimental	Rural, impoverished, and ethnically diverse families	144 parents	0	Parent bx, child bx, self-efficacy, and satisfaction w/ intervention	Small to moderate	Small
Enebrink et al. (2012)	Experimental	Externalizing bxs	104 families	1	Parent bx, child bx, and diagnosis	Moderate	Moderate
Heitzman-Powell et al. (2014)	Pre-post single subject design	Children w/ Autism Spectrum Disorder	7 parents from 4 families	0	Parent bx, knowledge acquisition, and satisfaction w/ intervention	Not reported	Not reported
Hudson et al. (2012)	Experimental	Single, low income, young African American mothers	34 mothers	0	Parent bx, self-efficacy, maternal depression, stress, loneliness, satisfaction w/ parenting, social support, and number of medical visits	Small to moderate	n/a
Hudson et al. (2003)	Quasi-Experimental	First-time fathers	34 fathers	0	Satisfaction w/ intervention, self-efficacy, and parenting satisfaction	Small, large ^b	n/a
Jones et al. (2014)	Experimental	Parents w/ bipolar disorder	39 parents	0	Parent bx and child bx	Moderate	Large
MacKenzie and Hlgedick (2000)	Experimental	Externalizing bxs	52 parents	1	Parent bx, child bx, knowledge acquisition, satisfaction w/ intervention, parenting stress, and limit setting	Not reported	Not reported
Morawska et al. (2014)	Experimental	Externalizing bxs, emotional problems	139 parents	1	Parent bx, child bx, satisfaction w/ intervention, and self-efficacy	Small to large	Small to moderate
Na and Chia (2008)	Experimental	Parents in Singapore	821 Singaporean parents	0	Parent bx, knowledge acquisition, and self-efficacy	Not reported	n/a
Pacifici et al. (2005)	Experimental	Foster parents of children w/ externalizing bxs	74 foster parents	0	Knowledge acquisition, satisfaction w/ intervention, and parent perception of child's bx, and time engaging w/ program	Moderate	Not reported
Rabbitt et al. (2016)	Experimental	Externalizing bxs	86 children and their primary caregivers	1	Parent behavior, child behavior, satisfaction with intervention, diagnosis, family environment, therapeutic alliance, and treatment adherence	Moderate to Large	Large
Sanders et al. (2012)	Experimental	Externalizing bxs	116	1	Parent bx, child bx, satisfaction w/ intervention, and self-efficacy	Small to large	Small to large
Sanders et al. (2008)	Experimental	Externalizing bxs	454 parents	1	Parent bx, child bx, satisfaction w/ intervention, self-efficacy, and depression/anxiety	Small to large	Moderate to large
Sanders et al. (2014)	Experimental	Externalizing bxs	Families of 193 children	1	Parent bx, child bx, and satisfaction w/ intervention	Small to large	Moderate to large
Schramm and McCaulley (2012)	Quasi-Experimental	Children of separated parents	1295 parents	0	Parent bx, knowledge acquisition, and satisfaction w/ intervention	Small	Not reported
Self-Brown et al. (2015)	Pre-post	At-risk African American fathers	4 fathers	0	Parent bx and satisfaction w/ intervention	Not reported	Not reported
Taylor et al. (2015)	Experimental	Externalizing bxs and social deficits	77 families	0	Parent bx, child bx, knowledge acquisition, and parent-adolescent relationship quality	Large	Moderate to large
Taylor et al. (2008)	Experimental	Externalizing bxs	90 head start families (one parent from each family)	n/a	Satisfaction w/ intervention, goal achievement, and participation	Not reported	n/a
Tse et al. (2015)	Experimental	ADHD	37 families	0	Parent bx, child bx, and satisfaction w/ intervention	Not reported	Not reported
van der Zanden et al. (2010)	Pre-post	Parents w/ mental illness	48 parents	0	Parent bx, child bx, satisfaction w/ intervention, and self-efficacy	Moderate	Small

Table 1 (continued)

Authors	Study Type	Target Population	Sample Size	Follow-up points	Dependent Variables	Effect Size on Parent DV	Effect Size on Child DV
Vismara et al. (2013)	Experimental, single subject	Children w/ Autism Spectrum Disorder	8 children and parent(s)	3	Parent bx, child bx, and satisfaction w/ intervention	Not available	Large
Wainer and Ingersoll (2015)	Experimental, single subject	Social deficits, children w/ Autism Spectrum Disorder	5 families	2	Parent bx, child bx, knowledge acquisition, satisfaction w/ intervention, and parent engagement	Not available	Not available

^a100% attrition^bCalculated from data reported by authors

consisted of completion and attrition rates, whether the hypothesis was supported or not supported, clinical and statistical significance outcomes, follow up outcomes, effect sizes, limitations, and implications.

Reliability

Two undergraduate research assistants independently coded all articles included in the analysis (i.e., between the two assistants they coded 100% of the articles). The two coders trained with the first author by reviewing the coding sheet together and completing the first three articles with questions and feedback after each article. Coders resolved any disagreements through consideration of the specific disagreement and joint review/discussion of the article until they reached a consensus on the correct classification of information.

Validity

Two main threats to validity exist in meta-analyses: publication bias and quality of studies reviewed (Sutton et al. 2001). Publication bias refers to the tendency for only studies with positive results (statistically significant, novel data) to be published (Song et al. 2000). A related form of bias is language bias, where non-native English-speaking researchers publish negative results in non-English journals and positive results in English journals (Song et al. 2000). To address possible language bias we included articles published in English and Spanish in our search; however, no articles published in Spanish met the inclusion criteria. One way to control for positive results in low-quality studies is by including a coding item on clinical significance (a form of analysis that considers clinically meaningful change as opposed to statistically significant change; Jacobson and Truax 1991; Kendall et al. 1999). Studies were coded as including clinical significance measures if the authors reported percent change, normative comparisons, or reliable chance indices. Coders rated subjective quality of each study on a scale from 1 to 5, with 1 being *low quality* and 5 being *high quality*. Coders rated 80% of the studies as a 3, 4, or 5.

Results

The PsychINFO search yielded 56 initial results. Of those results, 25 intervention studies and six feasibility studies met inclusion criteria and were coded. One study was both an intervention and feasibility study, so it was coded as both (Tse et al. 2015). Reference list scanning and search forwards of the four meta-analyses cited in the introduction did not yield additional articles for the current review. For the intervention studies, Table 1 contains information about

Table 2 Demographic and coaching data of technology-based parenting intervention studies

Authors	Ethnicity	Ethnicity Percentages	SES/Education	Cultural Adaptation	Type of Cultural Adaptation	Coaching	Coaching Frequency	Coach
Baggett et al. (2010)	White, Latino, Black, American Indian, Asian, and Multiple Ethnicities	Mothers: 15% Hispanic/Latina, 2.5% American Indian, 5% African American, 82.5% White, 7.5% multiple ethnicities, and 2.5% not reported Children- 25% Hispanic/Latino, 5% American Indian, 2.5% Asian, 5% African American, 65% White, and 22.5% multiple ethnicities	Low: 8% no high school (HS), 22% HS, 44% some college, 28% college graduate	Yes	Used diverse actors for video models	Email, phone, website	Weekly	Graduate student
Bert et al. (2008)	White, Latino, Black, Asian, and Multiple Ethnicities	81.6% European-American, 10.7% African-American, 4.9% Asian-American, and 4.1% Latina	Collected but not reported	No	n/a	None	n/a	n/a
Clarke et al. (2014)	White, Pakistani, and Multiple Ethnicities	77% White, 8% Pakistani, and 15% multiple ethnicities	Collected but not reported	No	n/a	None	n/a	n/a
Cotter et al. (2013)	White, Latino, Black, Native American, and Multiple Ethnicities	53% Native American, 27% African American, 10% Hispanic, 8% White, and 2% multiple ethnicities	Low	No	n/a	None	n/a	n/a
Enebrink et al. (2012)	White	97% Swedish	74% with HS education	No	n/a	Website	Weekly	Research assistant
Heitzman-Powell et al. (2014)	Not reported	Not reported	Education range HS diploma to graduate degree	No	n/a	Video conference	90–120 mins after each module; Average of 17 sessions per family	Research assistant
Hudson et al. (2012)	Black	100% African-American	Low	No	n/a	Email, Forum	As needed, freely available	Community professional
Hudson et al. (2003)	White	100% White	Mixed, intervention group: all had some post HS education. 64% college grads.	No	n/a	Email, Forum	As needed, freely available	Community professional
Jones et al. (2014)	Not reported	Not reported	Mixed	No	n/a	None	n/a	n/a
MacKenzie and Hlgedick (2000)	White and Black	82.14% White, 8.92% African American, and 8.94% other	Middle to upper middle class; Mean education 16.65 yrs ($SD = 2.5$)	No	n/a	In person	Three to five 30–90 min study sessions	Graduate student
Morawska et al. (2014)	Conducted in Australia	Not reported	Not reported	No	n/a	None	n/a	n/a
Na and Chia (2008)	Asian	87% Chinese, 4% Indian, 2% Malay, 1% other, and 6% not reported	59% diploma or basic degree, 22% post-graduate education	No	Developed for families in Singapore but used information from North American and European research	None	n/a	n/a
Pacifici et al. (2005)	White, Latino, and “other”	90% non-Hispanic, 3% Hispanic, and 7% not reported; 20% not White	Mean college education two yrs	No	n/a	None	n/a	n/a
Rabbitt et al. (2016)	White, Latino, Black, Asian, and multiple ethnicities	86.7% White, 5% Black, 5% Asian, and 1.7% multiple ethnicities; 8.3% Hispanic	Mixed; 48.3% graduate level education and 28.3% undergraduate degree	No	n/a	Email and phone	15–20 min call every two weeks and as needed	Certified professional
Sanders et al. (2012)	Australian	91% White	Mixed	Yes	n/a	None	n/a	n/a

Table 2 (continued)

Authors	Ethnicity	Ethnicity Percentages	SES/Education	Cultural Adaptation	Type of Cultural Adaptation	Coaching	Coaching Frequency	Coach
Sanders et al. (2008)	White and Multiple Ethnicities	94.7% White and 3.8% multiple ethnicities	Mixed	No	Multicultural video models. Goals informed by parents' values and traditions	Email	As needed	Certified professional
Sanders et al. (2014)	White	90% New Zealander with European background	54% with income over \$57,000	No	n/a	None	n/a	n/a
Schramm and McCauley (2012)	White	92% (control) and 88% (online) White	39% HS grad, 28% some college, 26% college degree, 6% graduate degree	No	n/a	None	n/a	n/a
Self-Brown et al. (2015)	Black	100% Black	Low to middle	No	n/a	In person	Every session	Graduate student, community professional
Taylor et al. (2015)	White, Latino, Black, and Asian	77% White, 4% Latino, 14% Black, and 5% Asian	68% college degree or higher	No	n/a	None	n/a	n/a
Taylor et al. (2008)	White, Latino, Black, Asian, Indian/Alaska Native, and Multiple Ethnicities	18% Hispanic/Latino, 85% non-Hispanic; 81% White, 4% Indian/Alaska Native, 2% Asian, 1% Native Hawaiian, 3% Black, 7% multiple ethnicities, and 2% not reported	14% less than HS education, 27% high school diploma or equivalent, 51% some college, 8% college graduate	No	n/a	In person, Website	Five home visits, weekly phone calls, electronic messages as needed	Certified professional
Tse et al. (2015)	White	90% White	Middle; 50% college degree or higher	No	n/a	No	n/a	Community professional
van der Zanden et al. (2010)	White	90% Dutch, 10% Belgian, Turkish, and Danish.	42% intermediate and 27% higher vocational education	Yes	Parenting competence measured using a Dutch scale	Email, Forum	Weekly/as needed	Community professional
Vismara et al. (2013)	White and Latino	25% Latino and 75% White	Middle; 100% college graduates	No	n/a	Forum, Video conference, Website	1.5 h weekly	Research assistant, faculty
Wainer and Ingersoll (2015)	White, Latino, Asian, Multiple Ethnicities	40% Asian/Pacific Islander, 20% multiracial, 20% White, 20% Hispanic	80% graduate degree	No	n/a	Email, Video conference	3 × 30 mins	Not reported

Table 3 Effect sizes for child behavior outcome measures

Authors	Outcome	Treatment Effect	Absolute Effect	Relative Effect
Baggett et al. (2010)	Infant positive behavior		$\eta^2 = 0.11$	
Cotter et al. (2013)	CBCL—Externalizing	$d = 0.20$		
Enebrink et al. (2012)	ECBI—Intensity, Problem		$\eta^2 = 0.10, 0.22$	
Jones et al. (2014)	Strengths and Difficulties Questionnaire		$d = 1.00$	
Morawska et al. (2014)	ECBI—Intensity, Problem		$d = 0.56, 0.39$	
Sanders et al. (2012)	ECBI—Intensity, Problem; SDQ—Conduct, Emotion		$d = 0.60, 0.74$ $d = 0.43, 0.22$	
Sanders et al. (2008)	ECBI—Problem	$d = 0.63$		$d = 0.28$
Sanders et al. (2014)	ECBI—Intensity, Problem for mothers and fathers			$d = 1.54, 1.44$ $d = 0.85, 0.73$
Taylor et al. (2015)	PSI Difficult Teen		$d = 1.18$	$d = 0.37$
Tse et al. (2015)	Vanderbilt ADHD Rating Scale—Inactivity, Hyperactivity, ODD, Role Performance			$d = -0.01, 0.20,$ $-0.14, 0.25$
Rabbitt et al. (2016)	CBCL Externalizing; Interview for Antisocial Behavior; Child Global Assessment scale	$d = 1.06$ $d = 0.78$ $d = 0.92$		

CBCL Child Behavior Checklist, ECBI Eyberg Child Behavior Inventory, PSI Parenting Stress Index

Table 4 Effect sizes for parent behavior outcome measures

Authors	Outcome	Treatment Effect	Absolute Effect	Relative Effect
Baggett et al. (2010)	Parent responsiveness		$\eta^2 = 0.05$	
Cotter et al. (2013)	Problem solving			$d = -0.49$
Enebrink et al. (2012)	Parenting Practices Interview		$\eta^2 = 0.17$	
Jones et al. (2014)	Parenting Scale		$d = 0.73$	
Morawska et al. (2014)	Parenting Scale—Laxness, Overreactivity, Verbosity		$d = 0.49, 0.39,$ 0.88	
Sanders et al. (2012)	Parenting Scale—Laxness, Overreactivity, Verbosity		$d = 0.53, 0.61,$ 0.57	
Sanders et al. (2008)	Parenting Scale	$d = 0.67$		$d = 0.36$
Sanders et al. (2014)	Parenting Scale—Laxness, Overreactivity, Verbosity for mothers and fathers			$d = 1.20, 1.00,$ 1.06 $d = 0.45, 0.41,$ 0.36
Taylor et al. (2015)	Monitoring		$d = 0.74$	$d = 0.84$
van der Zanden et al. (2010)	Parenting Scale—Laxness, Overreactivity	$d = 0.52, 0.48$		
Rabbitt et al. (2016)	Family Environment Scale—Relationship Total	$d = 0.57$		

Negative effect sizes indicate results favoring the comparison group

study design, participants, and outcomes and Table 2 summaries demographic parent coaching information.

The intervention studies consisted of 19 experimental, three quasi experimental, and three pre-post designs. Target populations included parents of children with externalizing behaviors (40% of studies), racial and ethnic minority and/or impoverished families (16% of studies), parents of children with autism spectrum disorder (12% of studies), and parents with mental illness (8% of studies). Common

outcome variables were child behavior, parent behavior, self-efficacy, and satisfaction with the intervention. Tables 3–5 report effect sizes for treatment (i.e., pre-post), absolute efficacy (i.e., treatment compared to control), and relative efficacy (i.e., treatment compared to alternative treatment). Of the 19 studies that reported statistical results for parent outcomes, 47% reported statistical significance, 42% reported mixed statistical results, and 11% reported non-significant findings. Child outcomes were reported for

Table 5 Effect Sizes for Parent Self-efficacy Outcome Measures

Authors	Outcome	Treatment Effect	Absolute Effect	Relative Effect
Cotter et al. (2013)	Parenting Sense of Competence scale; Parenting Self-efficacy scale	$d = 0.55$ $d = 0.75$		
Hudson et al. (2012)	How I Deal With Problems Regarding Care of My Baby		$d = 0.02$	
Hudson et al. (2003)	Infant Care Survey			$d = -0.05$
Morawska et al. (2014)	PTC—Behavior, Setting; Child Adjustment and Parent Self Efficacy Scale —Confidence		$d = 0.57, 0.19$ $d = 0.38$	
Sanders et al. (2012)	PTC—Behavior, Setting		$d = 0.84, 0.64$	
Sanders et al. (2008)	PTC	$d = 0.66$		$d = 0.22$
Sanders et al. (2014)	PTC—Behavior, Setting for mothers and fathers			$d = 1.27, 1.38$ $d = 0.41, 0.54$
van der Zanden et al. (2010)	Opvattingen over Opvoeding questionnaire—Incompetence, Competence	$d = 0.61, 0.46$		

Negative effect sizes indicate results favoring the comparison group

PTC Parenting Tasks Checklist

17 studies; 35% of studies reported statistically significant results, 41% reported mixed statistical results, and 24% reported non-significant findings. Eleven of the 25 studies did not report effect sizes, and effect sizes for parent and child outcomes varied by study. Where possible, effect sizes were calculated from data provided in the publication. For parent outcomes, eight studies reported large effect sizes, 12 reported moderate effect sizes, and eight reported small effect sizes. For child outcomes, eight studies reported large effect sizes, seven reported moderate effect sizes, and four reported small effect sizes. Parent outcomes were clinically significant for four of the five studies that reported those data, and for five of seven studies for child outcomes.

Participant ethnicity was reported for 24 of the feasibility and intervention studies. Of those 24 studies, 18 had predominantly White samples. Four studies had an ethnic minority group as the majority of the sample: Chinese, Asian/Pacific Islander, Native American, and African American. Seven studies included some Latinx participants and four studies included some participants with mixed race/ethnicity. Only three interventions that had diverse samples included cultural adaptations. The cultural adaptations consisted of diverse actors in video models, using goals informed by parents' values and traditions, and using measures validated with the target population. Ironically, none of the studies that were explicitly targeting racial/ethnic minorities culturally adapted the intervention. Coaching was a component for just over half (52%) of the interventions. Email was the most common medium for coaching (53.8% of studies reported coaching via email), followed by websites and forums (30.8%), video conferencing and in-person meetings (23.1%), and telephone (15.4%). Some interventions used a combination of media for coaching (e.g., email for one on one coaching and a forum for coaching with other parents). Coaches were

research assistants, graduate students, community professionals, certified professionals, and faculty members.

Feasibility studies also primarily assessed interventions targeting externalizing behaviors (four of six studies). The other two targeted parent-infant dyads and children diagnosed with ADHD. While the authors of feasibility studies mostly highlighted differing strengths of their interventions, parents across three studies reported satisfaction with the technology-based intervention. Barriers had a theme of lacking universal effectiveness and buy-in. See Table 6 for more study-specific findings.

Discussion

This systematic review provides an up-to-date summary of the current research on technology-based parenting interventions. We coded several important components of outcome research, including demographics, platform of the intervention, follow up points, outcome measures, magnitude of effect for parent and child outcomes, and clinical significance. Our focus on cultural adaptations and the use of coaching provided additional information that has not been covered in previous reviews.

The overall findings from this review reflect the ubiquitous use of technology to deliver evidence-based parenting interventions. These treatments came in several formats, the most common being websites and computer programs. Tablets, podcasts, and DVDs were also used. Parent outcomes were more commonly reported than child behavior outcomes, perhaps because parent knowledge and behavior must change in order to effect change in child behavior. While the majority of interventions targeted some form of child externalizing behavior, there were a handful of interventions that targeted other issues, such as asthma and

Table 6 Findings gathered from feasibility studies of technology-based parenting interventions

Authors	Program Used	Target Population	What worked/pros of intervention	Challenges/Barriers	Parent feedback	Unanswered Research Questions
Breitenstein and Gross (2013)	Chicago Parent Program	Externalizing bxs in preschoolers	<ul style="list-style-type: none"> - Most parents found the tablet easy to use (transportable was benefit), completed HW, and felt they learned something. - High completion rates, practice assignment completion, and parent reported satisfaction, ease of use, and usefulness. 	<ul style="list-style-type: none"> - One parent said intervention did not help. - Engagement data were self-reported. - All measures used self-report. - Authors believe not all parents will find web-based learning motivating or helpful. 	<ul style="list-style-type: none"> - Should spend two weeks on each content session instead of one week. - Reflection questions very helpful and the intervention very easy to use (89%). - Found the intervention very helpful (78%). - Positive qualitative feedback. 	<ul style="list-style-type: none"> - Would coaching help the parent who felt the intervention did not help? - Would an introduction to the program and tablet be helpful before measuring engagement? - What parent characteristics predict responsiveness to web-based interventions? What impact might this approach have on clinical and preventative care?
Feil et al. (2008)	The Playing and Learning Strategies (PALS) program; Infant-net	Parent-infant dyads	<ul style="list-style-type: none"> - Adapted from an evidence-based program. - Utilized videos from the original program. - All text information was also narrated. - The program required little keyboarding skills. - Parents submitted videos. 	<ul style="list-style-type: none"> - Low income and/or rural families have limited access to medical coverage, transportation, preventative care, and other parenting interventions in general. 	<ul style="list-style-type: none"> - Reported mean satisfaction ranging from 4.7–5 across items on a five-point Likert scale satisfaction questionnaire. 	<ul style="list-style-type: none"> - How can costs of the intervention be reduced? - How can we increase the perceived acceptability of internet-based treatments?
Gordon (2000)	Parenting Wisely	Externalizing behaviors	<ul style="list-style-type: none"> - Sought to integrate into already existing services. - Feedback presented by a computer is potentially less threatening. - Using a CD-ROM takes less commitment than attending groups. - Clinically significant changes occurred in one study for 42% of the Parenting Wisely group as opposed to 27% in a comparison group 	<ul style="list-style-type: none"> - Lack of equipment, funding, technological expertise, and interventionist training. - Resistance from mental health providers who worry about therapeutic integrity. Need experimental designs to demonstrate causality. - Method isn't widely publicized. 	Not reported	<ul style="list-style-type: none"> - Do the costs of this program outweigh the benefits? - Would including other family members enhance the intervention? - Is this intervention appropriate and effective for other cultures? - Can effects be enhanced through maintenance sessions or adding brief therapist consultation? - What are the predictors of parent resistance and how do practitioners address resistance? - Will insurance reimburse this type of treatment?
Gordon and Stanar (2003)	Parenting Wisely	Externalizing behaviors	<ul style="list-style-type: none"> - Disseminated interventions at conferences. - Tracked treatment fidelity as time spent on program. - Low cost - Ease of dissemination - High completion rates - Large effect sizes 	<ul style="list-style-type: none"> - Method isn't widely accepted by clinical/medical communities. - Therapists need to be trained in the use of technology. - Parents don't always see the link between their parenting methods and their children's behavior. 	Not reported	
Metzler et al. (2012)	Triple-P	Externalizing behaviors	<ul style="list-style-type: none"> - Videos can be dubbed/subtitled in different languages. - Examples of universal situations results in high acceptability for multiple ethnic groups. 	<ul style="list-style-type: none"> - The sample was recruited online, biasing recruitment towards "tech savvy" - parents. 	<ul style="list-style-type: none"> - Preferred delivery modality: TV and other self-administered programs. Clinical-level families preferred a therapist. Home visit least preferred. - Trend of lower income families rating higher watchability. 	<ul style="list-style-type: none"> - Would the parents' treatment preferences change after being exposed to the different formats?
Tse et al. (2015)	Manualized Caregiver Behavior Training Intervention;	ADHD		<ul style="list-style-type: none"> - No significant treatment differences in child outcomes. 		

Table 6 (continued)

Authors	Program Used	Target Population	What worked/pros of intervention	Challenges/Barriers	Parent feedback	Unanswered Research Questions
	Children's attention-deficit hyperactivity disorder telemental health treatment study (CATTIS)		- This study lays foundation for future randomized experiments with larger samples.	- Caregiver outcomes showed less impact in teletherapy group than in person.		- Why did these results differ from previous two studies on caregiver outcomes?

children born into at-risk contexts. We found few studies with ethnic and culturally representative samples and even fewer reporting on programs adapted for those populations. The use of coaching in the interventions was fairly common, with just over half of the interventions including a coaching component. Interestingly, none of the studies compared interventions with and without coaching.

Feasibility studies pointed to the promising prospect of technology-based interventions in terms of parent satisfaction, transportability, and adaptability of existing interventions for individuals with varying educational and ethnic backgrounds. Questions that remain to be answered pertain to cost-benefit analysis, parent propensity for success with a technology platform, additive effects of coaching or therapist consultation, and insurance coverage of technology-based interventions.

Our research approach has some limitations. While meta-analysis would have provided more statistical support than a systematic review, our purpose was broader than identifying impact or a specific effect but rather to understand the state of knowledge regarding study design, feasibility, and cultural diversity. Researchers can draw from the information learned/strengths and weaknesses/content of the studies reviewed here in order to continue advancing and improving research in the realm of technology-based interventions.

The number of technology-based interventions is increasing rapidly. Such interventions provide several potential benefits, such as cost reductions, flexible hours and location, and widespread reach. The Triple-P Positive Parenting Program, for example, uses a public health approach to dissemination, which is greatly facilitated by the use of several forms of media and technology (Sanders 2012). When given the option of in-person or self-delivered Triple-P interventions, the majority of parents chose self-delivered methods (Metzler et al. 2012). Mental health disparities could be targeted through technology-based interventions, however as of yet few culturally and linguistically adapted versions of such programs exist. The most common form of cultural adaptation found in this review was a surface-level adaptation: diverse actors for video models. The two other types of adaptations found in this review were the use of a measure specifically designed for the participant population and parent-developed goals based on cultural values and traditions.

Now that the basic effectiveness of technology-based parenting interventions has been demonstrated across a variety of emphasis areas (e.g., pediatric care, young children, children diagnosed with autism, externalizing behaviors), researchers should focus their efforts on refining interventions and increasing reach. Our review of feasibility studies revealed methodological strengths and limitations of developing and implementing technology-based interventions. These findings should serve as a guide for future

research seeking to evaluate new interventions or improve existing programs. Specific areas that may be of interest include cost-benefit analysis, differential effectiveness across populations, predictors of success in technology-based interventions, and the effect of adding a coaching component to the intervention.

With the growing number of racial and ethnic minorities in the United States, more research should be dedicated to interventions aiming to benefit these vulnerable populations. Cultural adaptations exist in many forms and are well researched (Bernal and Domenech Rodriguez 2012; Hall et al. 2016); research with technology-based interventions should consider adaptations beyond hiring diverse actors to better serve diverse communities. As stated in the introduction, the number of racial and ethnic minorities is rising while mental health disparities remain an issue. Technology-based interventions are an ideal means of addressing such disparities, especially given the widespread access to technology across racial and ethnic minorities and in rural communities.

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Compliance with ethical standards

Conflict of Interest The authors declare that they have no conflicts of interest.

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

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