

# Online-delivered parenting intervention for young children with disruptive behavior problems: a noninferiority trial focused on child and parent outcomes

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**Background:** This study evaluated whether an evidence-based parenting intervention, when delivered online, could effectively address disruptive behavior problems in young children and yield outcomes comparable to in-person delivery of the same intervention. **Methods:** Families ( $n = 334$ ) of children (3–7 years; 63% White, 22% African American, 15% other races; 63% male) with disruptive behavior problems were randomized to online-delivered intervention (ODI) or staff-delivered intervention (SDI), resulting in baseline and demographic equivalence. Primary outcome measures for child disruptive behavior (independent observation, parent report) and secondary outcome measures of parenting and family impact were assessed at baseline, postintervention, and follow-up. Conducted using intent-to-treat (ITT) as well as per-protocol (PP) methods, noninferiority analyses, which drew on an HLM framework with repeat measures across three timepoints and on REML to provide unbiased estimates of model parameters, tested whether the outcome-difference CI did not exceed the *a priori* noninferiority margin. **Results:** For ITT and PP analyses, the ODI was found to be noninferior to the SDI on the primary outcome: independently observed child disruptive behavior and parent-reported child behavior problems. The pattern for secondary outcomes was more varied: (a) noninferiority for observed positive and aversive parenting; (b) noninferiority for observed quality of parent–child relationship at post but not follow-up assessment; (c) noninferiority for parent-reported inappropriate/inconsistent discipline for PP but not ITT analyses; and (d) noninferiority not confirmed for parenting daily hassles and adverse family quality of life, despite large effect sizes for the ODI (Cohen's  $d$  .75–1.07). Finally, ODI noninferiority was found for teacher-reported child disruptive behavior. **Conclusions:** The tested online-delivered parenting intervention demonstrated clear noninferiority with the corresponding staff-delivered parenting intervention on the primary outcome, child disruptive behavior problems, and reflected substantial though nonuniform noninferiority and meaningful effect sizes for secondary outcomes related to parenting and family. Future research will guide optimization of online interventions. **Keywords:** Parenting; disruptive behavior; parent–child interaction; intervention; RCT design.

## Introduction

High-prevalence child mental health problems call for efficacious intervention strategies that are also deliverable with sufficient reach in a cost-efficient manner. This is particularly evident with early-onset disruptive behavior problems (DBPs), which left unaddressed heighten risk for adverse outcomes in adolescence and adulthood. One avenue of intervention, namely online delivery, has significant potential to increase reach and contribute to prevalence-rate reduction.

Disruptive behavior problems in young children represent a major public health challenge with significant consequences – elevated risk for subsequent mental health problems, delinquency, substance abuse, academic failure, and risky sexual behavior (Beauchaine & Gatzke-Kopp, 2012; Moffitt, 1993; Patterson, DeBaryshe, & Ramsey, 1989; Prinz

& Connell, 1997). Childhood DBP trajectories not deflected early are much more likely to become chronic disorders in adolescence and less responsive to intervention (Kazdin, 1997; Mesman, Bongers, & Koot, 2001), which makes DBP intervention with young children much preferred (Weisz & Kazdin, 2010). The high-prevalence rates, with 10%–15% of preschoolers and children at school entry showing mild to moderately severe DBPs (Carter et al., 2010), place heavy demands on intervention services and require expansion of intervention strategies and reach beyond traditional delivery methods.

Interventions efficacious in treating DBPs in young children typically involve substantial engagement of parents (Kazdin, 2007; Prinz & Dumas, 2004). Though parenting-program efficacy has replicated across a broad array of contexts and a diverse range of child/family populations (Nowak & Heinrichs, 2008; Weisz & Kazdin, 2010), relatively few parents actually participate in evidence-based parenting programs delivered in person (Kazdin, 2008). Low program availability, strained resources and staff

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time, funding cutbacks, participation barriers experienced by parents (e.g., scheduling, transportation, child-care coverage, and fatigue) substantially limit uptake (Baggett et al., 2010; Spoth & Redmond, 2000), resulting in inadequate program reach and diminished DBP prevalence reduction. Hence, alternate forms of reaching parents with scientifically validated parenting support are needed.

Interventions deliverable via the Internet have the potential to substantially improve reach in a cost-efficient manner (Tate, Finkelstein, Khavjou, & Gustafson, 2009). Internet-based programs can have substantial effects on various health and mental health conditions, including some indication of health-related behavior changes comparable to traditional formats (Nieuwboer, Fukkink, & Hermanns, 2013; Webb, Joseph, Yardley, & Michie, 2010).

The present study tested whether an evidence-based parenting intervention, when delivered online, could effectively address DBPs in young children and yield outcomes comparable to those achieved by the same intervention delivered in-person. This RCT drew on the noninferiority research design, which is deployed more often in pharmaceutical than psychosocial-intervention trials for reasons beyond the focus of this article. This design asks whether a target intervention performs at least as well as (i.e., noninferior to) an established intervention. Such designs are particularly relevant when testing whether a novel treatment with certain benefits, such as greater accessibility, lower cost, or ease of delivery, yields clinical outcomes similar to those for the standard treatment. Successful conduct of the present study was dependent on several criteria: (a) the standard treatment, in this instance staff-delivered, must have an established record of efficacy; (b) the novel treatment, in this instance online-delivered, must have the same goals and content as the standard treatment; (c) all families in the sample must have children who clearly exhibit the problem that necessitates the treatment (i.e., children with demonstrable DBPs); (d) assignment to the two treatments must be equally probable through randomization; (e) the standard treatment must be well implemented with fidelity, since it is the benchmark for gauging the novel treatment; and (f) methodological rigor must be bolstered by conducting baseline assessment before randomization and by utilizing multi-method primary and secondary outcome measures, including behavioral observations coded by 'blind' observers.

This study's standard treatment was staff-delivered Standard Level 4 Triple P – Positive Parenting Program (Sanders, 1999, 2008). Prior to undertaking the study, the efficacy of staff-delivered Level-4 Triple P for reduction of childhood DBPs was established in nine controlled outcome studies (Bodenmann, Cina, Ledermann, & Sanders, 2008; Bor, Sanders, & Markie-Dadds, 2002; Gallart & Matthey, 2005; Hahlweg, Heinrichs, Kuschel, Bertram, &

Naumann, 2010; Leung, Sanders, Leung, Mak, & Lau, 2003; Matsumoto, Sofronoff, & Sanders, 2007; Sanders, Markie-Dadds, Tully, & Bor, 2000; Turner, Richards, & Sanders, 2007; Zubrick et al., 2005), yielding an average effect size (Cohen's *d*) of 0.71 for impact on child DBPs (0.30–1.03) and 0.91 for impact on parenting difficulties (0.19–1.58).

The online-delivered intervention (i.e., the novel treatment) was the online-delivered variant of Level 4 Triple P, which preserves the goals and content of the standard staff-delivered version. Triple P Online had shown promise in a prior RCT with 116 families of 2- to 9-year-old children with disruptive behavior problems: effect sizes (Cohen's *d*) for child DBPs and parenting were 1.04 and 0.75, respectively, at postintervention and 0.85 and 1.0 at 9-month follow-up (Sanders, Baker, & Turner, 2012).

Using a randomized noninferiority design, this trial sought to determine whether the online version of the selected intervention (i.e., Level 4 Triple P) was 'as good as' the standard staff-delivered version of the same intervention. To answer this question, the study focused on child disruptive behavior as the primary outcome and parenting as the secondary outcome, with baseline, postintervention, and follow-up assessments tapping multiple sources (independent observers, parents, and teachers).

## Methods

### Participants

The sample consisted of 334 families of children ages 3–7 years where parents self-identified on the basis of experiencing difficulty handling their children's oppositional and disruptive behaviors. Inclusion/exclusion criteria were as follows: (a) the child scored above the clinical cutoff on the Eyberg Child Behavior Inventory (Eyberg & Pincus, 1999) in a screening interview; (b) the parents had regular access to the Internet (at home, in a relative's home, or in the community); (c) the family spoke English; and, (d) the family was not receiving a parenting intervention or child psychosocial treatment for behavioral difficulties. At study entry, 100% of the children in both conditions met the ECBI clinical cutoff ( $\geq 132$ , which is 2 standard deviations above the established mean).

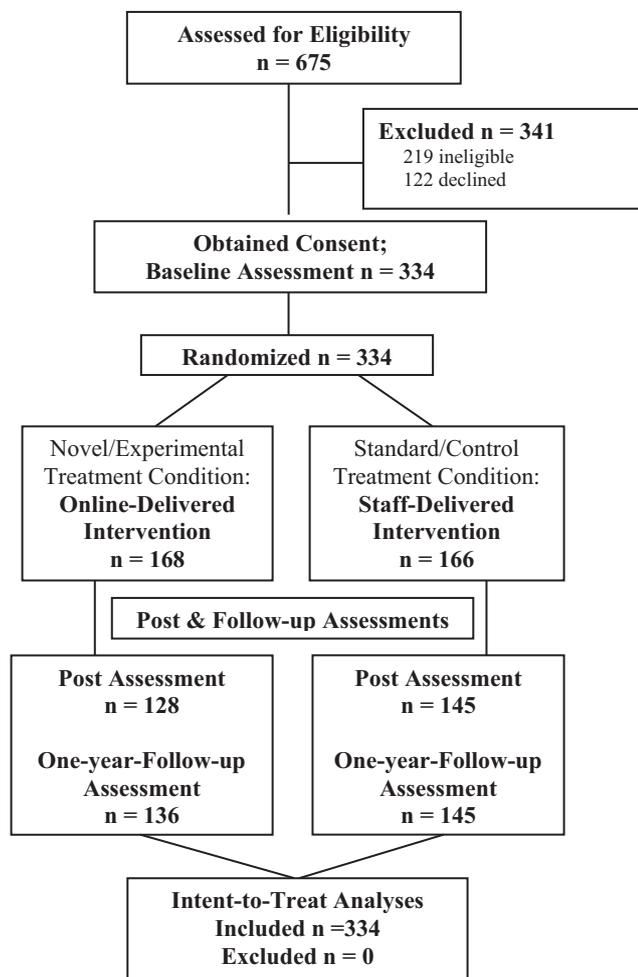
Participants were recruited in Columbia (SC) and Eugene (OR), and their surrounding communities, through multiple sources: 30% preschools, childcare, and elementary schools; 28% print/electronic advertisement; 22% pediatric offices; 8% social media; 7% faith communities and word-of-mouth; and 5% TV–radio–newspaper publicity. The sample consisted of 212 boys (63%) and 122 girls (37%) with a mean age of 57.5 months ( $SD = 14.9$ ); 230 (69%) two-parent and 104 (31%) one-parent households; parental race distribution of 71% White, 21% African American, and 8% other races (and 8% Hispanic across the sample); and parental education of 3% less than high-school graduation, 12% high-school graduation, 28% some college, and 57% college graduation. At the time of enrollment, 4.5% of the children (3.6% ODI, 5.4% SDI) were taking medication for hyperactivity or related problems.

One-parent and two-parent households were included. Both parents in two-parent households were invited but no family was turned away if only one parent participated. However, analysis of outcomes made use of only one parent per family to standardize across cases and avoid statistical dependence associated with data from two parents in the same family.

## Design and procedures

The University of South Carolina Institutional Review Board approved the study, and written consent was obtained from all subjects. The design chosen for this comparison was a noninferiority trial, which differs from the more traditional superiority-trial RCT (Rothmann, Wiens, & Chan, 2012). The target sample size given the noninferiority margin and related parameters yielded a power estimate over 80% (Julius, 2004). Enrolled families were randomized to either online-delivered (ODI) or staff-delivered (SDI) intervention to evaluate whether to reject the null hypothesis that the ODI was inferior to the SDI. The CONSORT diagram (Figure 1) depicts the flow of recruitment, consent, baseline assessment, randomization, postintervention and follow-up assessments, and analysis.

Interested parents were screened by telephone for child/family eligibility and then met on site with assessment personnel who thoroughly described the study and answered all questions. At the same visit, consenting families participated in baseline assessment prior to randomization, with assessors and parents blind to the ultimate randomized assignment while this assessment was transpiring. Stratified random assignment was used to counterbalance conditions with respect to racial/ethnic minority status and single-parent household. Families in both conditions were given 4 months for intervention participation, immediately followed by postassessment and then by follow-up assessment 12 months after baseline.



**Figure 1** CONSORT Diagram: online-delivered intervention versus staff-delivered intervention in noninferiority trial

## Measures

The primary and secondary outcomes were derived from observational and parental report measures administered at baseline, postassessment, and follow-up. The primary outcomes focused on DBPs assessed by direct observation of child behavior during parent–child interaction play tasks and by parental report of DBPs. The secondary outcomes focused on direct observation of parenting, parental report of discipline practices, and parental report of parenting stress and family quality of life. A teacher-report measure of child DBPs was deemed ‘additional’ because it could only be administered to only 68% of the ODI group and 70% of the SDI group at baseline (i.e., excluding children not yet in a school setting or during summer vacation).

**Observation of parent–child interaction.** Parent–child interactions were video-recorded during a 45-minute Parent–Child Play Task (Rusby, Metzler, Sanders, & Crowley, 2015) designed to capture child and parent behavior across a variety of scenarios (parent otherwise engaged; parent interrupted; clean-up and waiting task, teaching task). Recordings were systematically coded using the Parent–Child Play Task Observation System (PCPTOS; Rusby et al., 2015) by trained observers masked (i.e., blinded) to intervention condition. Inter-observer reliability was .82 (Kappa) for child and parent behavior codes, and ranged from .77 to .92 (intra-class correlations) for composite codes. Preselected outcomes from the PCPTOS included three micro-coded variables (child disruptive behavior, positive parenting, and aversive parenting) and two macro-ratings (parent–child relationship quality rating and parent positive strategies rating). Observational task and coding details are found in Rusby, Prinz, Metzler, and Crowley (under review).

**Parental report.** The 36-item Eyberg Child Behavior Inventory (ECBI; Eyberg & Pincus, 1999), which assessed child behavior problems via parental report, has shown high internal consistency, discriminant validity, treatment sensitivity, and acceptable psychometric properties with diverse populations (Gross et al., 2007; Querido, Warner, & Eyberg, 2002). The parent-reported Parenting Practices Inventory (Metzler, Taylor, & Foster, 2006), informed by Capaldi and Patterson (1989) and Sanders, Markie-Dadds, Rinaldis, Firman, and Baig (2003), yielded two scores for this study – inappropriate discipline and inconsistent discipline. Parents rated the likelihood of inappropriate discipline (23 items; Cronbach’s alpha = .81) and the frequency of inconsistent discipline (4 items; Cronbach’s alpha = .77) on a 7-point frequency scale (‘Never’ to ‘Always’). The 20-item Parenting Daily Hassles Scale (Crnic & Greenberg, 1990) assessed the frequency of daily stressors in parenting, based on parental report. The 10-item parent-report Impact on Family Questionnaire (Cannon, Pelham, Sallee, Pelham, & Sallee, 2009) assessed adverse impact of child behavior problems on family quality of life.

**Teacher report.** DBPs in a school setting were assessed through teacher report on the Child and Adolescent Disruptive Behavior Inventory (CADBI), which has shown acceptable internal consistency and multiple facets of validity (Burns, Taylor, & Rusby, 2001; Taylor, Burns, Rusby, & Foster, 2006) on the selected scales: conduct problems, oppositional to adults, oppositional to peers, and hyperactivity.

## Interventions

**Common content of the two interventions.** The ODI and SDI vary in mode of delivery but share the same conceptual content. Both are based on the Level 4 intensity of the

Triple P system and aim to assist parents of children with DBPs and co-occurring problems in preventing the progression of problem behavior. The ODI and SDI draw on 17 core Triple P positive parenting skills (Sanders, 2008) and promote parental self-regulation. Topics include understanding the causes of children's behavior problems, defining positive parenting, strategies for encouraging children's development and skill acquisition, strategies for managing misbehavior, preventing problems by planning ahead, and preparing for maintenance and potential 'relapse' episodes. Specific skills include behavioral monitoring; brief contingent attention following desirable behavior; arranging engaging activities in high-risk situations; directed discussion and planned ignoring for minor problem behavior; clear, calm instructions; backing up instructions with logical consequences, quiet time (nonexclusionary time-out), and time-out. Both interventions incorporate video modeling from the *Every Parent's Survival Guide Video* to illustrate principles and specific strategies of positive parenting, specific tasks for parents to undertake with their children, and constructive feedback generated by prompted self-evaluation.

**Online-delivered intervention (ODI).** The ODI was Triple P Online (Sanders et al., 2012). After a brief system tutorial, the ODI consists of eight sequenced modules on positive parenting and child behavior management, each taking approximately 45–60 min. The online program includes parent-friendly navigation, video-based modeling of parenting skills and parental perspectives, personalized content (e.g., for goal setting, content review, and feedback), interactive exercises, downloadable worksheets and podcasts, and a customizable and printable workbook to record program content, parents' goals, and their responses to exercises. The ODI protocol in this study included four brief phone calls to offer technical assistance and general encouragement but not content coaching or clinical assistance.

**Staff-Delivered Intervention (SDI).** The 10-session SDI, which was Standard Level 4 Triple P, consisted of information provision, active skills training and support, and practice sessions in which parents selected goals, were observed implementing parenting skills, and reviewed their performance with the SDI specialist. Delivered in person, session duration was 60–75 min. Seven masters-level mental health professionals served as SDI specialists. All sessions were video-recorded and 27% were randomly sampled, without SDI specialists' advance knowledge, for fidelity coding by independent coders at a remote site (viz., the University of Queensland Parenting and Family Support Centre). Across staff, families, and sessions, content/process fidelity was high: 81.98% mean adherence, 3.64 mean process-quality (4-point scale). See Sanders et al., (2020) for details about fidelity coding/reliability and SDI-specialist training, supervision, and feedback process.

### Data analysis

Noninferiority (NI) analyses on all preselected outcomes were conducted within a hierarchical linear modeling (HLM) framework to draw on repeated measures (T1, T2, and T3) in the design (Mascha & Sessler, 2011; Rothmann et al., 2012). This analytic approach evaluated the ODI-SDI outcome difference through linear mixed model analysis with random intercept on participant level and using an unstructured covariance matrix. The model included time, intervention, interaction between time and intervention, and baseline measurement of the outcome variable. The null hypothesis presumed that the experimental intervention (i.e., the ODI) was inferior to the more established comparison intervention (i.e., the SDI). For each outcome, the analysis determined whether the ODI had an impact similar to that from the SDI based on a zone of

indifference called the *NI margin*, based on a one-sided confidence interval (Mascha & Sessler, 2011).

Prior to starting the study, the *NI margin* was preset at 0.28 times the population Standard Deviation for each outcome measure. This parameter was based on prior studies of the online intervention with comparable samples (Sanders et al., 2012; Sanders, Dittman, Farruggia, & Keown, 2014). An *NI margin* of 0.28SD is clearly smaller than the observed online intervention findings in standard deviation units for child behavior problems (Mdn = 1.32SD; range 0.60SD to 1.92SD) and parenting difficulties (Mdn = 0.80SD; range 0.54SD to 1.43SD). More importantly, the *NI margin* is well below the average effect sizes, and below the average lower bound of the 95% confidence interval, established for the staff-delivered intervention: .71 (lower bound .38) for child behavior problems and .91 (lower bound .35) for parenting difficulties. Calculation of the *NI margin* was based on the standard deviation pooled across the two groups at T1 for each outcome variable.

The Type I error rate (alpha) was set at .05. Noninferiority is confirmed for an outcome when the confidence-interval upper limit is lower than the *NI margin*. The analysis adopted an intent-to-treat (ITT) approach, which excluded no participants from the analyses, and for missing data used restricted maximum likelihood (REML) to preserve power and provide unbiased statistical estimates of model parameters (Enders, 2010).

Finally, to augment the ITT analyses, per-protocol (PP) noninferiority analyses were conducted based on 82 ODI and 116 SDI families.

## Results

### Baseline comparability

The ODI and SDI groups were quite comparable on demographics and baseline outcomes (see Table 1). Using *p*-values from *t* and chi-square statistics as descriptive heuristics (and not significance testing), the median *p*-value was .818 (ranging from .228 to .947).

### Program exposure for online and staff-delivered interventions

Parent participation in the ODI was tracked electronically through the web platform. Of the 168 cases, 47.6% completed half or more of the online program, 38.7% participated in some but less than half of the program, and 13.7% did not participate at all. Parent participation in the SDI was documented from attendance records. Of the 166 cases, 69.8% completed half or more of the program, 15.1% participated in some but less than half of the program, and 15.1% participated in none or at most one session.

### Noninferiority findings

Noninferiority results for the ITT analyses are detailed in Table 2. For the primary outcomes, the ODI was found to be noninferior to the SDI with respect to observation of child disruptive behavior at both postintervention and follow-up, and with respect to parent-reported child behavior problems

**Table 1** Baseline equivalence of child and family characteristics for online-delivered and staff-delivered intervention groups

Variable	ODI ( <i>n</i> = 168)	SDI ( <i>n</i> = 166)	<i>Chi Sq</i>	<i>p</i>
Child gender (male)	105 (62.5%)	107 (64.5%)	.138	.710
Marital status				
1-parent household	51 (30.4%)	52 (31.3%)	.052	.819
2-parent household	117 (69.6%)	113 (68.1%)		
Unknown	0 (.000%)	1 (.006%)		
Race of parent				
American Indian/Alaska Native	0 (0.0%)	1 (0.60%)	1.77	.881
Asian American	4 (2.4%)	2 (1.2%)		
African American	34 (20.2%)	35 (21.1%)		
White	120 (71.4%)	117 (70.5%)		
More than one race or unknown	10 (6.0%)	11 (6.6%)		
Parent Hispanic/non-Hispanic	13 (7.7%)	14 (8.4%)	.054	.816
Parent education				
Did not finish high school	3 (1.8%)	5 (3.0%)	.875	.831
High-school graduate (or GED)	19 (11.3%)	20 (12.0%)		
Some college	45 (26.8%)	47 (28.3%)		
College graduate	100 (59.5%)	92 (55.4%)		
Annual household income				
Under \$20,000	29 (17.3%)	30 (18.1%)	1.44	.837
\$20,000 to \$40,000	0 (0.0%)	0 (0.0%)		
\$40,000 to \$80,000	32 (19.1%)	38 (22.9%)		
\$80,000 to \$100,000	67 (39.9%)	60 (36.14%)		
Over \$100,000	34 (20.24%)	30 (18.07%)		
Not reported	6 (3.57%)	8 (4.82%)		
Relationship to child				
Biological or natural parent	148 (88.1%)	151 (91.0%)	5.637	.228
Adoptive parent	17 (10.1%)	11 (6.6%)		
Stepparent	0 (0.0%)	2 (1.2%)		
Adult relative	1 (0.6%)	2 (1.2%)		
Foster parent or guardian	2 (1.2%)	0 (0.0%)		

			<i>t</i>	<i>p</i>
Child age (months)	57.4 (15.2)	57.6 (14.5)	.17	.866
Observed Child Disruptive Behavior (rate per minute)	.663 (.406)	.660 (.370)	-.07	.947
Parent-reported Child Behavior Problems	167 (21.8)	167 (23.5)	-.07	.943
Observed Positive Parenting (rate per minute)	3.37 (.827)	3.41 (.805)	.40	.690
Observed Aversive Parenting (rate per minute)	.038 (.058)	.047 (.089)	1.11	.267
Observer-rated Quality of Parent-Child Relationship	4.03 (.832)	4.01 (.781)	-.20	.841
Observer-rated Parent Positive Strategies	3.49 (.520)	3.46 (.518)	.54	.589
Parent-reported Inappropriate Discipline	2.39 (.828)	2.33 (.720)	-.70	.485
Parent-reported Inconsistent Discipline	3.42 (1.03)	3.33 (1.04)	-.75	.455
Parenting Daily Hassles	57.3 (10.3)	46.1 (10.0)	-1.12	.262
Impact on Family (adverse Quality of Life)	2.29 (.640)	2.31 (.686)	.19	.850

at follow-up only. For secondary outcomes in the ITT analyses, the ODI was shown to be noninferior to the SDI for seven out of the eight analyses for directly observed parenting outcomes. Analyses of the parent-reported facets of parenting and family impact did not indicate noninferiority. Additional outcomes from teacher-reported variables (conduct problems, oppositional to adults, oppositional to peers, and hyperactivity) yielded noninferiority for seven of the eight analyses.

For parent-report child behavior problems, post hoc examination revealed that 53% of the children in the ODI condition and 63% of the children in the SDI condition dropped below the clinical cutoff on the ECBI after intervention.

Per-protocol NI analyses were repeated for all of the outcome variables, with results displayed in Table 3.

Means and variances (standard deviations and standard errors) are available in Appendix S1.

To further aid in the interpretation of the noninferiority results, effect sizes (Cohen's *d*) for ODI and SDI, under both ITT and PP specifications, were calculated (see Table 4). Cohen's *d* for repeated measures was calculated as the mean difference (T1-T2 or T1-T3), divided by the standard deviation of the difference derived from the estimated standard error of the difference. For the primary outcomes, the effect sizes for both ODI and SDI conditions were all in the medium-to-large range. With respect to the secondary outcomes, of particular note is that the parent-reported outcomes (i.e., discipline, daily hassles, and adverse quality of family life) reflected medium-to-large ODI effect sizes that were comparable but slightly lower than those for the SDI. For

**Table 2** Noninferiority (intent-to-treat) of online-delivered intervention versus staff-delivered intervention for primary, secondary, and additional outcomes with children and families

Outcome variables	Postintervention (T2) Assessment			Follow-Up (T3) Assessment		
	Confidence Limit	NI Margin	Noninferiority?	Confidence Limit	NI Margin	Noninferiority?
<b>Primary outcomes</b>						
Observed child disruptive behavior (rate per minute)	0.006	0.11	Yes	0.03	0.11	Yes
Parent-reported child behavior problems	11.72	6.35	No	4.89	6.35	Yes
<b>Secondary outcomes</b>						
*Observed positive parenting (rate per minute)	-0.10	0.23	Yes	-0.17	-0.23	Yes
Observed aversive parenting (rate per minute)	-0.003	0.02	Yes	0.008	0.02	Yes
*Observer-rated quality parent-child relationship	-0.03	0.23	Yes	-0.22	-0.23	Yes
*Observer-rated parent positive strategies	-0.07	0.15	Yes	-0.17	-0.15	No
Parent-reported inappropriate discipline	0.25	0.22	No	0.24	0.22	No
Parent-reported inconsistent discipline	0.36	0.29	No	0.35	0.29	No
Parenting daily hassles	4.35	2.85	No	4.27	2.85	No
Impact on family (adverse Quality of Life)	0.33	0.18	No	0.27	0.18	No
<b>Additional outcomes</b>						
Teacher-reported conduct problems	0.04	0.44	Yes	0.14	0.44	Yes
Teacher-reported oppositional to adults	-0.04	0.47	Yes	0.39	0.47	Yes
Teacher-reported oppositional to peers	-0.11	0.55	Yes	-0.47	0.55	Yes
Teacher-reported hyperactivity	0.05	0.57	Yes	0.58	0.57	No

For the three outcome variables marked with an asterisk, noninferiority was confirmed when the lower confidence limit (for the ODI-SDI difference) was higher than (-)(NI Margin). For all of the other outcome variables, noninferiority was confirmed when the upper confidence limit (for the ODI-SDI difference) was lower than the NI Margin.

**Table 3** Noninferiority (per protocol) of online-delivered intervention versus staff-delivered intervention for primary, secondary, and additional outcomes with children and families

Outcome variables	Postintervention (T2) Assessment			Follow-Up (T3) Assessment		
	Confidence Limit	NI Margin	Noninferiority?	Confidence Limit	NI Margin	Noninferiority?
<b>Primary Outcomes</b>						
Observed Child Disruptive Behavior (rate per minute)	0.03	0.11	Yes	0.10	0.11	Yes
Parent-reported Child Behavior Problems	8.51	5.58	No	0.17	5.58	Yes
<b>Secondary Outcomes</b>						
*Observed Parenting Positive (rate per minute)	-0.13	0.22	Yes	-0.13	-0.22	Yes
Observed Aversive Parenting (rate per minute)	0.003	0.02	Yes	0.02	0.02	No
*Observer-rated Quality Parent-Child Relationship	-0.13	0.22	Yes	-0.25	-0.22	No
*Observer-rated Parent Positive Strategies	-0.08	0.14	Yes	-0.19	-0.14	No
Parent-reported Inappropriate Discipline	0.12	0.19	Yes	0.18	0.19	Yes
Parent-reported Inconsistent Discipline	0.22	0.26	Yes	0.13	0.26	Yes
Parenting Daily Hassles	3.58	2.72	No	3.60	2.72	No
Impact on Family (adverse Quality of Life)	0.29	0.19	No	0.19	0.19	No
<b>Additional Outcomes</b>						
Teacher-reported Conduct Problems	0.20	0.43	Yes	0.37	0.43	Yes
Teacher-reported Oppositional to Adults	0.22	0.43	Yes	0.44	0.43	No
Teacher-reported Oppositional to Peers	0.07	0.53	Yes	0.64	0.53	No
Teacher-reported Hyperactivity	0.25	0.57	Yes	0.58	0.57	No

For the three outcome variables marked with an asterisk (\*), noninferiority was confirmed when the lower confidence limit (for the ODI-SDI difference) was higher than (-)(NI Margin). For all of the other outcome variables, noninferiority was confirmed when the upper confidence limit (for the ODI-SDI difference) was lower than the NI Margin.

independent-observation outcomes, the micro-coded positive and aversive parenting variables showed only very small ODI effects, while the

macro-rated parent-child relationship quality and overall positive parenting strategies reflected small-to-medium effects.

**Table 4** Estimated effect sizes (intent-to-treat/per-protocol) for primary, secondary, and additional outcomes as a function of online-delivered and staff-delivered interventions

Outcome variables	Postintervention (T2) Assessment		Follow-Up (T3) Assessment	
	ODI Cohen's <i>d</i>	SDI Cohen's <i>d</i>	ODI Cohen's <i>d</i>	SDI Cohen's <i>d</i>
<b>Primary outcomes</b>				
Observed Child Disruptive Behavior (rate per min.)	.523/.592	.376/.462	.567/.576	.512/.595
Parent-reported Child Behavior Problems	1.07/1.47	1.30/1.63	1.19/1.48	1.17/1.31
<b>Secondary Outcomes</b>				
Observed Positive Parenting (rate per min.)	.228/.357	.118/.069	.045/.240	.018/.041
Observed Aversive Parenting (rate per min.)	.110/.077	.033/.010	.051/.086	.116/.093
Observer-rated Quality Parent-Child Relationship	.333/.390	.240/.245	.224/.375	.311/.352
Observer-rated Parent Positive Strategies	.404/.504	.417/.435	.406/.513	.566/.613
Parent-reported Inappropriate Discipline	.654/.902	.784/1.05	.539/.654	.618/.819
Parent-reported Inconsistent Discipline	.681/.963	.818/1.05	.622/.925	.723/.900
Parenting Daily Hassles	.858/.977	1.01/1.36	.931/.992	1.05/1.15
Impact on Family (adverse Quality of Life)	.746/.934	1.07/1.23	.808/1.07	1.02/1.12
<b>Additional outcomes</b>				
Teacher-reported Conduct Problems	.122/.104	.224/.215	.179/.159	.300/.279
Teacher-reported Oppositional to Adults	.160/.047	.069/.008	.116/.122	.193/.169
Teacher-reported Oppositional to Peers	.086/.057	.088/.087	.075/.087	.288/.311
Teacher-reported Hyperactivity	.064/.133	.078/.035	.066/.136	.244/.252

## Discussion

This study examined whether an online-delivered parenting intervention was noninferior to its more traditional staff-delivered (in-person) counterpart for child and parent outcomes. Several study features contributed to a clear answer: (a) The SDI, previously established as efficacious, was implemented with high fidelity by properly trained personnel; (b) only families with children clearly experiencing DBPs were included; (c) the large sample ( $N = 334$ ) was randomized to ODI/SDI after baseline assessment to preserve sample intactness and completion of baseline measures without a threat from parent pre-knowledge of condition assignment; (d) baseline equivalence was clearly achieved; (e) outcome evaluation used both independent observation of child behaviors and parenting, by intervention-masked observers, and parent-report measures, supplemented by a teacher-report measure of child conduct problems; (f) noninferiority was tested using both intent-to-treat and per-protocol analytic methods; and (g) effect sizes associated with each intervention were calculated to examine all outcomes in greater depth.

The study results clearly demonstrated that the ODI was noninferior to (i.e., 'as good as') the SDI in significantly reducing child DBPs, the primary outcome. This finding was robust across data sources (i.e., independent observation, parent report, and teacher report of conduct problems), ITT and PP analytic method, and postintervention and follow-up assessments, with one exception, namely parent report at postintervention. Examination of the effect sizes revealed that the ODI consistently produced medium effects on observed child disruptive behavior (.523–.592) and large effects on parent-reported DBPs (1.07–1.48).

The secondary outcomes, which pertained to parenting and parental/familial stress, reflected a more complex pattern of noninferiority and intervention effects. For independent observation of parenting and parent-child interaction, the two outcomes from observational micro-coding, namely positive and aversive parenting, reflected noninferiority for seven of the eight tests across post/follow-up and ITT/PP evaluations, and yielded modest ODI and SDI effect sizes. The two outcomes from observational macro-coding, namely parent positive strategies and quality of parent-child interaction, reflected noninferiority for postintervention assessment with ITT and PP analyses (four out of four tests) but not so for follow-up (only one out of four tests), and produced small-to-medium ODI and SDI effect sizes.

Regarding parent-report inappropriate and inconsistent discipline, noninferiority of the ODI was not found for the ITT analyses but was found for the PP analyses at both post and follow-up (4 out of 4 tests); however, all of the effect sizes across timepoints and ITT/PP were medium to large for ODI and SDI. Despite no confirmation of ODI noninferiority for parent-reported parenting daily hassles and adverse impact on family quality of life, these outcomes showed substantial reductions for both the ODI and SDI at post and follow-up for ITT and PP analyses.

Finally, the additional outcome of teacher-reported conduct problems, based on approximately 70% of the sample, confirmed noninferiority of the online-delivered intervention at postintervention and follow-up across ITT and PP, and yielded modest effect sizes. Unlike the systematic observation and parental report variables for which the reporter (i.e., observer, parent) is held constant for every case, it is more likely than not for most cases that different teachers provided data across the timepoints, which

might have added measurement variability and decreased the detectability of effects.

The findings are consistent with other Triple P Online (TPO) studies: an RCT with 193 parents of 3- to 8-year-old children with DBPs found parity between TPO and established workbook-delivered Self-Directed Triple P (Sanders et al., 2014); an RCT involving 52 ethnically diverse mothers with 2- to 6-year-old children found TPO yield improved parenting over a wait-list control (Ehrensaft, Knous-Westfall, & Alonso, 2016); and Love et al., (2016) applied TPO enhanced by social media and gamification adjuncts to 155 disadvantaged, high-risk parents and documented child/parent gains with an 85% TPO completion rate. The findings in the present study are consistent more generally with meta-analytic reviews of online/technology-supported parenting interventions (Spencer, Topham, & King, 2020) and associated efforts to reach disadvantaged populations (Harris, Andrews, Gonzalez, Prime, & Atkinson, 2020).

### *Issues and study limitations*

Attrition from treatment warrants discussion. With respect to pretreatment attrition (i.e., enrolling in the study but dropping out at the beginning of treatment), the rates were 13.7% for the ODI and 15.1% for the SDI. These rates are comparable to each other but also to a review by Chacko et al., (2016) that found a mean pretreatment attrition rate of 13% (SD 15%) for 54 studies of face-to-face parenting interventions, although the average for online parenting interventions is not known. With respect to program completion, it was observed in the present study that only 47.6% of the sample completed half or more of the ODI program. This observed completion rate for the ODI compares quite favorably to the disappointingly low 2%–10% completion rates typically observed for massive open online courses (MOOCs) across thousands of data points (Reich, 2014; Reich & Ruiperez-Valiente, 2019), but is lower than the 69.8% rate observed for the SDI. One potential explanation is that random assignment to program format, rather than being able to actively choose online or staff delivery, might have affected parents who wanted or needed more interpersonal support. Bearing on this issue, a study by Day and Sanders (2018) demonstrated that coupling the online program with practitioner telephone support resulted in only 6% nonparticipation, compared with 28% nonparticipation without practitioner support. Undoubtedly, a greater ODI participation rate in the current study, had it occurred, might have led to even stronger effects, but other studies will need to test tailoring strategies to optimize engagement.

Given that a study-wide statistical correction was not applied for the multiple tests conducted, it is

important to discuss the issue of potential false-positive inflation. For primary, secondary, and additional outcomes, across sources (i.e., observation, parent report, and teacher report) postintervention, follow-up, ITT, and PP, 55 tests of noninferiority were conducted. With an alpha of .05, one would expect by chance for 5%, or 3 of the 55, tests to be significant even if noninferiority is not the true state of affairs. In fact, 60%, or 33 of the 55, tests reached significance, which is well above chance. Examination of data patterns revealed that almost all of the outcome trends and effect sizes for the ODI showed positive impact across the board, providing a broader context for interpreting the noninferiority test results.

Potential limitations are worth noting: (a) The sample was reasonably heterogeneous but did not include a large number of parents with very low educational attainment; (b) recruitment depended on multiple strategies, which is a potential strength for broad reach but might be a limitation when trying to compare outcomes to study samples that only include clinical referrals; (c) the study did not include documentation of process variations in how parents made use of the online program from day to day nor how two parents/caregivers operated within a household; and (d) the study has not yet analyzed putative predictors, moderators, or mediators of either ODI adherence or outcomes. The plan is to examine some of these factors to be able to relate the present study to recent studies predicting outcomes and completion for online programming (e.g., Day, Baker, Dittman et al., under review), with the goal of enhancing engagement and impact.

In conclusion, the online-delivered parenting intervention demonstrated clear noninferiority with the corresponding staff-delivered parenting intervention with respect to the primary outcome, child disruptive behavior problems. The secondary outcomes related to parenting and the family reflected substantial though not uniform noninferiority and effect sizes. As such, the online intervention is an efficacious alternative to traditional staff-delivered intervention that can efficiently serve many parents, especially those residing in rural/remote areas or who for any reason are not able to access direct services, and that might also lend itself to serving parents supplemented with only a modest amount of live support.

### **Supporting information**

Additional supporting information may be found online in the Supporting Information section at the end of the article:

**Appendix S1.** Means and standard deviations (T1) and estimated means and standard errors (T2 & T3) for online-delivered and staff-delivered intervention groups.

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## Key points

- Childhood disruptive-behavior problems threaten public health because of high prevalence, serious life consequences without early intervention, and inadequate reach of evidence-based interventions.
- To substantially improve population reach, online programming offers a viable alternative to staff-delivered intervention, especially for evidence-based parenting intervention, the indicated/preferred treatment.
- Using a randomized non-inferiority design, online delivery of a parenting intervention, grounded in the well-researched Triple P – Positive Parenting Program, reduced child disruptive behaviour to a comparable extent as the staff-delivered version of the same intervention, confirmed by independent observers and parents with corroboration by teachers, and bolstered by positive family and parenting impact.
- For public policy, online-delivered parenting intervention is a promising approach to be further strengthened by strategic enhancements to increase parental engagement and follow-through.

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