



Impact of Parenting Intervention on Observed Aggressive Behaviors in At-Risk Infants

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Abstract

Aggressive behaviors in early childhood persist through childhood and adolescence and result in negative outcomes. However, studies assessing aggressive behaviors in early childhood have focused primarily on parent report. Additionally, the effects of parenting interventions and associated parenting skills on early observed aggression have not been examined. In the present study, we examined the direct effect of a brief, in-home adaptation of Parent–Child Interaction Therapy, the Infant Behavior Program (IBP), on observed frequency of aggressive behaviors and global ratings of aggression in infants ages 12 to 15 months. Additionally, we examined behaviorally-based parenting skills as a mechanism by which the IBP impacted observed infant aggressive behaviors. Sixty infants with elevated levels of behavior problems were randomized to receive the IBP or standard pediatric primary care. Infants receiving the IBP demonstrated a significant decrease in the observed frequency of aggressive behaviors during infant-led play across a 3-month follow-up. Furthermore, the intervention led to decreases in parental use of don't skills (i.e., directive and negative parent statements), which, in turn, led to decreases in the frequency of observed aggressive behaviors at a 3-month follow-up. However, effects were not maintained at a 6-month follow-up. Results provide preliminary evidence for the efficacy of a brief parenting intervention on reducing the frequency of infant aggressive behaviors, including the indirect effect of the IBP on the frequency of aggressive behaviors through reductions in parenting skills. The study highlights the importance of targeting negative parenting practices to decrease subsequent aggressive behaviors in early childhood.

Keywords Parent training · Aggression · Infancy · Early childhood · Parent skills

Highlights

- Parenting intervention resulted in lower levels of observed aggressive behaviors.
- Directive parenting statements mediated the intervention effect on aggression.
- Intervention effect on aggression was not maintained at 6-month follow-up.
- Parenting is an important target to reduce short-term early childhood aggression.

Aggression is moderately stable across childhood and adolescence (Coie and Dodge 1998; Huesman et al. 1996; Reiss and Roth 1993; Shaw et al. 2012) and is associated with negative outcomes later in life, such as high rates of juvenile involvement (Shaw et al. 2012), rejection from peers (Ferris and Grisso 1996), and elevated levels of anxiety, depression and suicidal ideation (Liu et al. 2014;

Rosenberg and Rossman 1998; Shaw et al. 2012). Aggression beginning in early childhood has been associated with more significant and problematic long-term consequences (e.g., antisocial behavior, criminality, conviction of a crime) compared to aggression that begins during late adolescence or early adulthood (Moffitt et al. 1996; Kokko et al. 2009). Given the negative impact of early onset aggressive behaviors on later outcomes, the goal of this paper was to examine the effect of an early behavioral parenting intervention on early childhood aggressive behaviors.

In early childhood, aggression has been defined as frustration that is exhibited by physical actions towards

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others or objects, without considering the intentionality of the action (Alink et al. 2006; Tremblay et al. 2004). While intentionality is considered in the conceptualization of aggression in later childhood (Coie and Dodge 1998), intentionality of aggressive behaviors is not feasible to measure in early childhood (Alink et al. 2006; Tremblay et al. 2004). It is possible that the functionality and operationalization of “aggression” differs in infancy when compared to later childhood and adolescence. However, research on aggressive behaviors during early childhood without consideration of intentionality is still feasible and differs from behaviors of typical infants (Alink et al. 2006, Carter et al. 2004). Specifically, aggressive behaviors that are aimed at objects or people (e.g., throwing objects) have been shown to have longitudinal stability even when examining aggression in 1-year-olds (Keenan and Shaw 1994; Mesman et al. 2008) and do not include behaviors that are accounted for by developmental concerns such as motor limitations (e.g. heavy-handed contact with the floor or a toy as the result of a lack of motor control). Aggression has been identified in children as young as 12 months of age (Alink et al. 2006; Carter et al. 2004; 2003; Cummings et al. 2009) and is moderately stable and related to later frequency of aggressive behaviors (Alink et al. 2006). However, the few studies that have examined aggression in early childhood focused primarily on 18- to 24-month-olds (Mesman et al. 2001; Angold et al. 1999) even though the 12- to 15-month age range can be a unique opportunity for early intervention given feasibility of identifying aggression and its stability at this early age range (Campbell 2002; Zahn-Waxler et al. 1990; Mesman et al. 2008; see below). Furthermore, while aggressive behaviors must be considered in the context of what is developmentally appropriate, the “presence of a pattern or constellation of symptoms,” such as an infant’s consistent display of aggressive behaviors (Campbell 1995), indicates that such behaviors can be measured given the evidence supporting relation of early aggressive behaviors to aggression during later childhood (Alink et al. 2006).

Levels of observed aggression in 2-year-old children have been shown to predict higher levels of parent report of child externalizing problems at 5 years (Zahn-Waxler et al. 1990). However, research on aggression in children under the age of 2 years relies overwhelmingly on parent report of aggressive behaviors (Crick et al. 1997; Tremblay et al. 1999, 2004) rather than observational coding of aggressive behaviors. Observational coding, as compared to parent report, can provide a more objective measure of aggressive behaviors, although research has found discrepancies between parent report and observational coding of aggressive behaviors (Brotman et al. 2008; Webster-Stratton et al. 2001). For example, Brotman et al. (2008) found that a preventive parenting intervention led to significant

decreases in the frequency of observed physical aggression using the child physical negative and child destructive codes from The Dyadic Parent–Child Interaction Coding System-Revised (DPICS-R; Robinson and Eyberg 1981) from baseline to the end of treatment in a high-risk sample of 4- to 6-year-olds. However, there was not a significant intervention effect on parent ratings of child aggression. While Brotman et al. focused on preschool- and kindergarten-aged children, the results nevertheless emphasize the importance of including observational coding measures in the assessment of child aggressive behaviors, as parent report may not capture the entire picture.

The System for Coding Early Physical Aggression (SCEPA; Keenan and Shaw 1994) is a measurement tool for coding observed aggression in early childhood. The SCEPA is an observational measure of aggressive behaviors and includes the observation of the frequency of aggressive behaviors (Keenan and Shaw 1994). The SCEPA has been used with children as young as 18 months and was shown to be moderately stable and reliable and associated with later observed aggressive behaviors and parent-reported externalizing behavior problems at 24 months, particularly in low-stress, naturalistic situations (Keenan and Shaw 1994; Keenan et al. 1998). However, observational coding of aggressive behaviors in infants under 18 months of age has only been examined in one study to our knowledge. Specifically, Mesman et al. (2008) conducted a psychometric study of the SCEPA and found that physical aggression can be reliably observed and coded using the SCEPA with 1- to 4-year-olds. However, the frequency of aggressive behaviors was coded in the clinic during a mother-child snack situation and three frustration tasks (i.e., clean up, a situation in which the child was not allowed to play with toys, and a problem-solving task), and was not examined in response to an intervention. Thus, the current study aimed to extend previous work by examining the effect of a parenting intervention on levels of infant aggressive behaviors in a more naturalistic observation of a positive parent-infant interaction during play in the home.

Parent-infant play interactions are typically the context in which parents learn to follow their child’s lead during the first phase of behavioral parenting interventions, such as the Child Directed Interaction (CDI) phase of Parent–Child Interaction Therapy (PCIT; Eyberg and Funderburk 2011; McNeil et al. 2013). Parenting skills and behaviors, such as those taught in the context of PCIT, have been shown to decrease parent-report of externalizing problem behaviors (McKee et al. 2008), such as aggression, in older children. Given the occurrence of aggressive behaviors in children under 2 years of age (Alink et al. 2006; Kennan et al. 1998; Tremblay et al. 1999, 2004; Van Zeijl et al. 2006) and the effect PCIT has had on parent report of child externalizing and aggressive behaviors (McCart et al. 2006; McMahon

et al. 2006; Pearl 2009), research should examine the extent to which parenting interventions lead to reductions in observed aggressive behaviors in children younger than 2 years. Specifically, a randomized controlled trial of an abbreviated, in-home adaptation of PCIT for high-risk infants, referred to as the Infant Behavior Program (IBP), demonstrated that 12- to 15-month-old infants who received IBP displayed significantly lower levels of aggressive behaviors per parent report across post and 3- and 6-month follow-up assessments, when compared to infants in standard pediatric primary care (Bagner et al. 2016). However, the main outcome paper demonstrating the initial efficacy of the IBP did not report on observed frequency of infant aggressive behaviors due to extensive resources and time needed to code these behaviors (Brotman et al. 2008). Additionally, the primary aims of the federally-funded main outcome study did not include a plan to conduct observations of infant aggression. Thus, in an effort to address the gap in the literature, the primary focus of this secondary data analysis is to examine the effect of the IBP on observed aggressive behaviors.

In addition to main effects on aggressive behaviors, behavioral parenting interventions target changes in parenting behaviors, such as increases in positive parenting behaviors (e.g., praises), which have been shown to be associated with lower levels of parent report of child aggression (Atilli 1989; Pettit et al. 1997; Rothbaum et al. 1995). Similarly, high levels of negative parenting behaviors (e.g., critical statements) have been shown to be associated with higher levels of parent report of child aggressive behaviors (McFadyen-Ketchum et al. 1996; Stover et al. 2016). Despite research on the relation between observed child aggressive behaviors and parenting behaviors (Del Vecchio and O’Leary 2006), studies have not examined the indirect effect of parenting behaviors on subsequent observed child aggression in children. Thus, the current study also included an examination of the extent to which changes in parenting behaviors following the IBP were associated with changes in observed aggressive behaviors.

In the present study, we examined the effect of the IBP on changes in the observed frequency of aggressive behaviors and global ratings of aggression in infants ages 12 to 15 months who were randomly assigned to receive the IBP or standard pediatric primary care. Research has demonstrated a positive impact of the IBP on infant behavior, including parent report of levels of infant aggressive behaviors and observed infant compliance (Bagner et al. 2016), but did not report on the effect of the IBP on observed frequency or global ratings of infant aggressive behaviors. We hypothesized that infants randomized to the IBP would display lower levels of observed frequency of aggressive behaviors and lower global ratings of aggression at a post-intervention and at 3- and 6-month follow-up assessments compared to those randomized to standard care.

In addition to the primary aim to examine the direct effect of IBP on observed aggression, we examined, as an exploratory aim, the indirect effect of behaviorally-based parenting skills as a potential mechanism by which the IBP impacted observed infant aggressive behaviors. Specifically, research demonstrated the IBP led to significant increases in “do” skills and significant decreases in “don’t” skills, which parents learn to use and avoid, respectively, during infant-led play (Bagner et al. 2016). Do skills include praises, behavioral descriptions, and reflections, whereas don’t skills include questions, commands and criticisms. We hypothesized: (a) parenting do skills would mediate the effect of the IBP on the observed frequency and global rating of aggressive behaviors, such that higher levels of do skills at post-intervention would be associated with lower levels of observed frequency and lower global rating of infant aggressive behaviors at follow-up and (b) parenting don’t skills would mediate the effect of the IBP on the observed frequency and global rating of aggressive behaviors, such that higher levels of don’t skills at post-intervention will result in higher levels of observed frequency and global rating of infant aggressive behaviors at follow-up.

Method

The current study is a secondary data analysis of a randomized controlled trial of the IBP. The primary outcome data on the IBP are reported elsewhere (Bagner et al. 2016) and demonstrated that infants receiving the IBP displayed significantly lower levels of aggressive behavior per maternal report across post and 3- and 6-month follow-up assessments. Infants were also significantly more compliant to maternal commands at the 6-month follow-up when compared to infants in standard care. In addition, mothers showed significantly higher levels of behaviorally-based parenting do skills and lower levels of behaviorally-based parenting don’t skills during an infant-directed play situation compared to mothers in the standard care group. The present study expanded on these findings by examining the effect of the IBP on the observed frequency of infant aggressive behavior and severity of infant aggressive behaviors through a global rating of aggression, as well as the indirect effect of parenting skills on the observed frequency and global rating of infant aggression. Study procedures were approved by the university and hospital Institutional Review Boards.

Participants

Mother-infant dyads with a 12- to 15-month-old were recruited during wellness visits at a pediatric primary care clinic in a large children’s hospital in South Florida. The

Table 1 Participant baseline demographic variables and outcome variables

	Total Sample (<i>n</i> = 60)		Intervention Group (<i>n</i> = 31)		Standard Care Group (<i>n</i> = 29)		<i>p</i> value
	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	
Child sex (male)	55	33	58	18	52	15	0.62
Child minority status	98	59	97	30	100	29	0.70
Mother minority status	95	57	94	29	97	28	0.54
Mother English speaking (vs. Spanish)	43	26	55	17	31	9	0.07
High school graduate or less	70	42	65	20	76	22	0.34
Below poverty line	60	35	58	18	63	17	0.70
	Mean	SD	Mean	SD	Mean	SD	<i>p</i> value
Child age (months)	13.49	1.31	13.71	1.40	13.25	1.18	0.18
Mother age (years)	29.66	5.49	30.03	5.50	29.25	5.56	0.59
Mother IQ T-Score ^a	46.35	12.55	47.21	12.17	45.43	13.09	0.59
Observed Aggression Total	6.86	6.64	7.43	7.66	6.29	5.53	0.53
Global Aggression Rating	1.79	0.91	1.70	0.95	1.88	0.86	0.47
“Do” Skills	4.19	3.95	4.35	4.10	4.02	3.85	0.75
“Don’t” Skills	23.96	19.96	24.83	19.00	23.02	21.26	0.73

IQ intellectual quotient

^aT-scores were combined between the WASI and EIWA-III Vocabulary and Matrix Reasoning subtests

mother was the identified primary caregiver in all families that participated in the study. Study inclusion criteria included: a) infants above the 75th percentile on the Brief Infant-Toddler Social and Emotional Assessment (Briggs-Gowan and Carter 2006), a screener of infant behavior problems, b) mothers were required to speak English or Spanish. English-speaking mothers were required to receive an estimated IQ score of 70 or higher on two subtests (the Vocabulary and Matrix Reasoning subtests) of the Wechsler Abbreviated Scale of Intelligence (Wechsler 1999), and Spanish-speaking mothers were required to receive an average scaled score of 4 or higher on the Vocabulary and Matrix Reasoning subtests of the Escala de Inteligencia Wechsler Para Adultos-Third Edition (Pons et al. 2008), if they chose to complete the assessment in Spanish.

Data for the current study include the 58 families that were randomized to the IBP or standard pediatric primary care. There were no significant differences on demographic variables between families in the standard care or IBP group. Infants were between 12 and 15 months, with an average age of 13.52 months ($SD = 1.31$). The majority of infants were reported to be of Hispanic ethnicity (94.8%) and White race (82.8%). Mothers were on average 29.9 years ($SD = 5.3$), and the majority of mothers (90%) reported a Hispanic ethnicity. The mean IQ *T*-score for mothers was 46.35 ($SD = 12.55$), which was derived from an average of the *T*-scores on the vocabulary and matrix reasoning subtests of the WASI and following the conversion of scaled scores to *T*-scores and subsequent average of the *T*-scores on the vocabulary and matrix reasoning

subtests of the EIWA-III. A majority of the families (60%) reported incomes below the poverty line. Spanish was the primary language spoken by the majority of caregivers (56.7%). Table 1 provides participant demographic and outcome variable information at baseline.

Procedure

Families that met study criteria at the time of screening were scheduled for a baseline assessment, during which questionnaires and behavioral observations of mother-infant interactions were administered in the family’s home. Sixty eligible mother-infant dyads consented to participate and were randomly assigned using a computer-generated random numbers list to receive the IBP or standard pediatric primary care, in which the infant received care as usual (i.e., sick and well visits at the pediatric primary care clinic) but did not receive the IBP. Of the sixty randomized mother-infant dyads, 58 families completed the baseline assessment. A second assessment was conducted approximately 2 months following the baseline assessment and represented the post-intervention assessment. Follow-up assessments were conducted 3 and 6 months after the post-intervention assessment. Families were compensated \$50 for completion of each assessment. Of the 58 families that completed the baseline assessment, 48 families completed the post-intervention assessment (83% retention), and 46 families complete the 3- and 6-month follow-up assessments (79% retention). Videotaped observations between the mother and infant were conducted at each home assessment. Levels of

infant aggressive behaviors were observed and coded during a 10-min infant-led play situation, which included a 5-min warm-up period at each assessment time-point. Infant aggressive behaviors were observed and coded during 10 min of infant-led play to allow for a more naturalistic observation of infant behaviors, consistent with previous use of the SCEPA measure (Mesman et al. 2008). Levels of behaviorally-based parenting skills were observed and measured over a 5-min period, consistent with recommendations for coding DPICS during child-led play (Shanley and Niec 2011).

Measures

Aggressive Behaviors

The first and second authors, who are both bilingual and were masked to intervention group, coded five aggressive frequency behaviors in infants using the SCEPA measure created by Kennan and Shaw (1994): socially appropriate aggression (usually directed at objects, but fulfills the goals of the task), aggressive intent (must have visible force, but with no evaluation of intent to harm), game playing (actions, such as knocking over a tower of blocks), temper tantrums (forceful contact with ground), and banging toys together (repetitive banging with force). Given the relatively low frequency of aggressive behaviors in each individual category, we created a cumulative or total aggressive behavior frequency variable for all analyses consistent with Mesman et al. (2008). Thus, frequency of aggressive behaviors refers to the sum of aggressive behaviors each child exhibited during the 10-min observation period. Additionally, each child was rated on a scale from 1 (unaggressive) to 4 (severely aggressive), based on the Global Aggression Rating Scale defined by Keenan and Shaw (1994). The intent to hurt or harm someone or something is not taken into consideration on the Global Aggression Rating Scale or frequency of aggressive behaviors codes, as intentions are difficult to assess at any age (Hartup 2005). Coders in the current study completed training videos and coded 20% of the videos for interrater reliability. Consistent with intraclass correlations reported by Mesman et al. (2008), intraclass correlations in the present study ranged from .90 to .99 for the five individual aggressive behavior codes, and were .99 for both the overall frequency of infant aggressive behaviors code and the global aggression rating.

Behaviorally-Based Parenting Skills

The DPICS (Eyberg et al. 2005) was utilized to measure behaviorally-based parenting skills. The DPICS-III has demonstrated reliability and validity with parents of

infants and children from predominately Hispanic backgrounds and among Spanish-speaking families (Bagner et al. 2016; McCabe et al. 2012). For the current study, parent codes were categorized into behaviorally-based do skills and don't skills (defined above). Undergraduate student coders were trained to meet 80% reliability using a DPICS criterion tape and were masked to intervention condition. Overall, kappa for the DPICS codes used in the current study was .89.

Intervention

The IBP is a home-based adaptation of the CDI phase of PCIT for high-risk infants and their families. Parents in IBP are taught to follow their infant's lead in play by increasing their use of behaviorally-based parenting do skills and decreasing their use of behaviorally-based parenting don't skills. Parents are also taught to ignore any safe, but disruptive behaviors, such as temper tantrums. Consistent with standard PCIT, the first session is a teach session during which the parents are taught the do and don't skills and role-play these skills with the therapist. The sessions following the teach session are coaching sessions, during which the therapist provided live coaching to parents while they played with their infant. Doctoral students in clinical psychology served as therapists for the intervention and were supervised by a PCIT Master Trainer (senior author). Sessions took place weekly in the parents' home for approximately 1 to 1.5 hours. Outside of sessions, parents were instructed to practice the skills they learned in session with their infant for 5 min each day of "special time." Families were offered a maximum of seven sessions, including the teach session, and completed the intervention in an average of 6.1 sessions. All sessions were videotaped in the home. Adherence to the IBP protocol was assessed and coded for 63% of randomly selected sessions based on the percentage with which the therapists implemented key intervention elements, such as checking in with parents and teaching the parenting skills. The adherence of the intervention of each session was 97%.

Data Analysis

Analyses were conducted in SPSS version 24. Linear mixed models (Verbeke and Molenberghs 2011) were used to examine the effect of group on the observed frequency of aggressive behaviors and global aggression rating scores over a continuous time variable. For all models, the natural log of months elapsed since the baseline visit was used as the time predictor to linearize the relation between time and the outcomes. We proposed that infants randomized to IBP would display greater decreases in the overall frequency of aggressive behaviors code and global

aggression rating scores across time compared to those randomized to standard care.

Furthermore, we used the PROCESS macro (Hayes 2012) in SPSS to explore potential mechanisms by which the IBP led to decreases in observed aggressive behaviors. Specifically, we examined the effect of group on levels of behaviorally-based parenting skills at post-intervention (controlling for parenting skills at baseline) and the effect of behaviorally-based parenting skills on levels of infant aggressive behaviors at 3- and 6-month follow-ups (controlling for infant aggressive behaviors at baseline). Consistent with previous research (Garcia et al. 2015; Blizzard et al. 2017), do and don't skills were treated as continuous variables. The change in both mediators (i.e., behaviorally-based parenting do and don't skills) was represented by frequencies at the post-intervention assessment. We proposed that increases in behaviorally-based parenting do skills and decreases in behaviorally based parenting don't skills from baseline to post-intervention would predict lower levels of the frequency of infant aggressive behavior and global aggression rating scores at 3- and 6-month follow-ups.

Results

Missing Values Analysis and Covariates

Fifty-eight families completed the baseline assessment and were included in the analyses (30 families in the intervention group and 28 families in standard care). Missing value analysis showed that missingness on outcome variables was consistent with a missing at random pattern (Rubin 1976). The groups did not significantly differ on any demographic characteristics, parenting do and don't skills at baseline, or observed frequency and global aggression rating scores of aggressive behaviors at baseline (as shown in Table 1). Thus, no covariates were included in the models except outcome variables at baseline to model change over time in the mediation analyses.

Descriptive Analyses

Descriptive statistics were conducted to examine the distribution of the frequency of aggressive behaviors and global aggression rating scores at baseline. We conducted tests to examine the normality and homoscedasticity of the residuals, which indicated that assumptions were met. The minimum total frequency of aggressive behaviors was 0 and the maximum was 43, indicating that the highest number of aggressive behaviors at any time point from a single child was 43. The minimum global aggression rating item was 1 and the maximum was 4 for all children at all time points.

Table 2 Means and standard deviations of observed aggression coding schema across time points

	Total Sample		Intervention Group		Standard Care Group	
	Mean	SD	Mean	SD	Mean	SD
Aggression Total Time 1	6.86	6.64	7.43	7.66	6.29	5.53
GRS Time 1	1.79	0.91	1.70	0.95	1.88	0.86
Aggression Total Time 2	6.56	6.67	5.16	5.58	7.58	7.28
GRS Time 2	1.84	1.04	1.57	0.93	2.08	1.10
Aggression Total Time 3	6.05	8.97	2.94	3.33	8.38	11.05
GRS T3	1.44	0.78	1.30	0.73	1.57	0.81
Aggression Total Time 4	3.19	4.45	3.89	5.70	2.67	3.27
GRS T4	1.53	0.64	1.65	0.67	1.40	0.60

GRS Global Rating Scale of Aggression

The modal rating for global aggression was 1 at baseline. Table 2 presents means and standard deviations for the observed frequency and global rating of aggressive behavior by group (standard care vs. intervention) at each time point. Table 3 presents correlations between the proposed mediator, parenting do and don't skills, and aggression at each time point.

Effect of IBP on Observed Frequency and Global Ratings of Infant Aggressive Behavior

A mixed model was tested to investigate differences in change between the IBP and control groups in the frequency of aggressive behaviors over time. Both linear and quadratic components were included in the model. The time variable was centered to reduce collinearity between the linear and quadratic components, and centered at the baseline to make the results more interpretable. At the baseline of the study, the mean frequency of aggressive behaviors for infants in the control group was 6.29 and the mean frequency of aggressive behaviors for infants in the IBP group was 7.43 ($p = 0.53$), indicating the groups did not differ significantly in frequency of aggressive behaviors at baseline. There was a significant negative linear decline, $b = -1.87$, $F(1,175.21) = -2.55$, $p = 0.01$, and a significant quadratic trend, $b = 0.20$, $F(1,154.37) = 2.64$, $p = 0.009$, in the observed frequency of aggressive behaviors between groups over the four time points, such that findings suggest that infants randomized to receive the IBP displayed a decrease in the slope of the frequency of aggressive behaviors across baseline through 6-month follow-up compared to infants randomized to standard care.

Based on the means across time for observed frequency of aggressive behaviors (see Fig. 1), follow-up probing was conducted by re-centering the time variable at 6-month follow-up. At the 6-month follow-up, there was a

Table 3 Correlations among parenting skills and outcome variables

Variables	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Aggr T1	0.22	-0.09	0.004	0.21	-0.08	0.24	0.01	0.23	0.02	0.34*	-0.02	0.17	0.19	0.28	0.02
2 GRS T1	-	0.11	0.44**	0.22	0.46**	-0.08	0.17	0.15	-0.02	-0.05	0.15	-0.06	0.00	0.03	0.22
3 Do T1	-	-	0.46**	-0.17	0.01	0.10	0.17	-0.22	-0.18	0.20	0.38*	-0.23	0.02	0.16	0.27
4 Don't T1	-	-	-	-0.11	0.17	0.10	0.46**	0.05	-0.001	0.18	0.54**	-0.17	0.06	0.21	0.53**
5 Aggr T2	-	-	-	-	0.52**	-0.18	0.15	0.26	0.15	-0.07	-0.08	0.27	-0.17	-0.05	-0.03
6 GRS T2	-	-	-	-	-	-0.24	0.18	0.17	0.29	-0.24	0.00	0.21	0.12	-0.20	0.14
7 Do T2	-	-	-	-	-	-	-0.09	-0.12	-0.28	0.85**	-0.07	0.03	0.05	0.75**	-0.02
8 Don't T2	-	-	-	-	-	-	-	0.60**	0.03	-0.08	0.74**	0.01	0.04	-0.15	0.76**
9 Aggr T3	-	-	-	-	-	-	-	-	0.38*	-0.12	0.52**	0.12	-0.02	-0.17	0.55**
10 GRS T3	-	-	-	-	-	-	-	-	-	-0.19	0.03	0.50**	0.35*	-0.23	0.02
11 Do T3	-	-	-	-	-	-	-	-	-	-	0.01	0.13	0.08	0.82**	-0.05
12 Don't T3	-	-	-	-	-	-	-	-	-	-	-	-0.10	-0.08	-0.12	0.71**
13 Aggr T4	-	-	-	-	-	-	-	-	-	-	-	-	0.33	-0.03	-0.09
14 GRS T4	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	0.05
15 Do T4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.01
16 Don't T4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* $p < 0.05$; ** $p < 0.01$

Aggr. T1 Aggression Frequency Total at Time 1; GRS T1 Global Rating Scale of Aggression at Time 1; Do T1 Behaviorally Based Parenting “Do” Skills at Time 1; Don't T1 Behaviorally Based Parenting “Don't” Skills at Time 1; same abbreviations used for follow-up time points

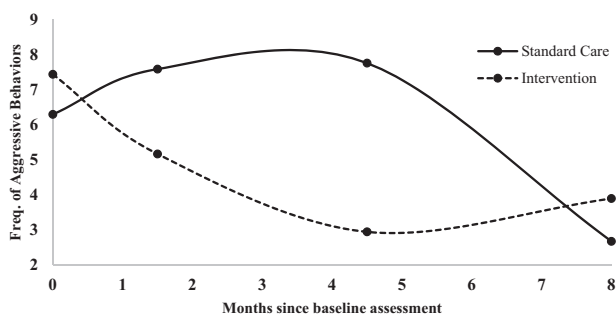


Fig. 1 Group means across time for observed frequency of aggressive behaviors

non-significant negative linear decline, $b = 0.94$, $F(1,43.96) = 1.50$, $p = 0.14$, and a non-significant difference in frequency of aggressive behaviors between groups, $b = -1.45$, $F(1,36.40) = -1.06$, $p = 0.30$, such that the rate of change in the observed frequency of aggression at the 6-month follow-up did not significantly differ between the IBP and the standard care groups. This probing indicated that while the quadratic model was significant and the rate of change in and frequency of observed aggression differed between groups at post and the 3-month follow-up, the rate of change in observed aggression or the frequency of observed aggressive behaviors did not differentially change between groups at the 6-month follow-up. Table 4 presents the results of the overall mixed model analysis as centered at baseline with observed frequency of aggressive behaviors over time.

A mixed model was also used to test nonlinear change differences between the IBP and control groups in global

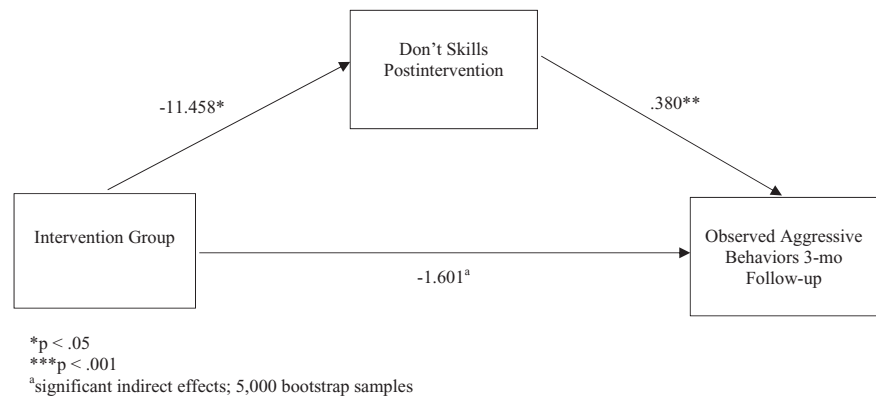
Table 4 Mixed model effects of IBP on frequency of observed aggressive behaviors over time

Variable	Frequency of aggressive behaviors					
	<i>b</i>	SE	<i>t</i>	<i>p</i>	LLCI	ULCI
Time	0.68	0.40	1.68	0.10	-0.12	10.47
Time*Time	-0.11	0.04	-2.55	0.01	-0.20	-0.02
Group	0.74	1.54	0.48	0.63	-2.33	3.81
Interaction (Time*Group)	-1.87	0.73	-2.55	0.01	-3.31	-0.42
Quadratic (Time*Time*Group)	0.20	0.07	2.64	0.009	0.05	0.34

LLCI lower level confidence interval, ULCI upper level confidence interval

aggression rating scores over time. Both linear and quadratic components were included in the model with the time variable centered at baseline to reduce collinearity between the linear and quadratic components. At baseline, the mean global aggression rating score for standard care was 1.88 and the mean global aggression rating score for the IBP was 1.70 ($p = 0.47$). There was not a significant difference between groups in linear decline, $b = -0.003$, $F(1,129.69) = -0.77$, $p = 0.44$ or in quadratic trend, $b = 0.00002$, $F(1,129.95) = 1.20$, $p = 0.23$ in global aggression rating scores over the four time points. There was also no significant difference in the global aggression rating scores between groups, $b = -0.23$, $F(1,129.90) = -1.04$, $p = 0.30$.

Fig. 2 Mediating effect of parenting don't skills at post-intervention on relation between intervention and frequency of infant observed aggressive behaviors at 3-month follow-up. Model controlled for baseline levels of parenting skills and infant observed aggressive behaviors



Indirect Effect of IBP on Observed Frequency and Global Ratings of Infant Aggressive Behaviors Via Behaviorally-Based Parenting Skills

We used the PROCESS macro for mediation (Hayes 2012) to test the exploratory hypothesis that the association between intervention group and observed frequency of infant aggressive behaviors and global aggression rating scores at 3- and 6-month follow-ups would be accounted for by behaviorally-based parenting skills at post-intervention. The significance of the total and mediator-specific indirect effects was determined using bias-corrected bootstrapped 95% confidence intervals (CIs) based on 5000 bootstrapped samples.

Indices of model fit for the indirect effect of group membership on observed frequency of aggressive behaviors through behaviorally-based parenting don't skills demonstrated good model fit (Bollen and Long 1993) for the 3-month follow-up model. The direct effect of intervention group membership (i.e., IBP or standard care) on observed frequency of infant aggressive behaviors at the 3-month follow-up was significant, $b = -5.95$, $p = 0.044$, CI $[-11.74, -0.16]$. The effect of intervention group membership on the mediator, behaviorally-based parenting don't skills at post-intervention, was also significant, $b = -11.46$, $p = 0.01$, 95% CI $[-20.266, -2.650]$, such that mothers randomized to the IBP significantly decreased their use of parenting don't skills from pre- to post-intervention compared to mothers randomized to standard care. The effect of behaviorally-based parenting don't skills at post-intervention on observed frequency of infant aggressive behaviors at the 3-month follow-up when controlling for intervention group membership was also significant, $b = 0.38$, 95%, $p < 0.001$, CI $[0.195, 0.564]$, such that higher levels of parenting don't skills at post-intervention were associated with a higher frequency of infant aggressive behaviors at the 3-month follow-up. Total effects revealed that when controlling for behaviorally-based parenting don't skills at post-intervention, intervention group

membership was not a significant predictor of observed frequency of infant aggressive behaviors at the 3-month follow-up, $b = -1.60$, $p = 0.54$, 95% CI $[-6.84, 3.63]$. The standardized indirect effect (MacKinnon 2008) for the path from intervention group membership to frequency of aggressive behaviors through behaviorally based parenting don't skills was -0.476 , indicating a medium effect. Figure 2 displays the regression coefficients for the 3-month follow-up model.

A similar model assessing the indirect effect of intervention group membership on observed frequency of infant aggressive behaviors at the 6-month follow-up through behaviorally-based parenting don't skills at post-intervention was not significant, as don't skills were not significant in predicting aggression at the 6-month follow-up. Models assessing the effect of intervention group membership on global aggression rating scores at 3- and 6-month follow-ups through behaviorally-based parenting don't skills at post-intervention were also not significant. Similar models were conducted to assess the effect of intervention group membership on the observed frequency and global ratings of infant aggressive behaviors at 3-and-6-month follow-ups through behaviorally-based parenting do skills at post-intervention. No models including behaviorally-based parenting do skills as the mediator were significant for either observed frequency of aggressive behaviors or global aggression rating scores outcomes, as the indirect effects in these models were not significant.

Discussion

The current study examined the direct effect of the IBP, a brief and home-based behavioral parenting intervention, on decreasing observed infant aggressive behaviors. Despite research supporting that aggression can be measured in children as young as 12 months of age (Alink et al. 2006; Carter et al. 2004, 2003; Cummings et al. 2009), little empirical work has examined the effect of interventions on

observed aggressive behaviors in infants. Consistent with our hypothesis, findings revealed a significant group effect on the observed frequency of aggressive behaviors during infant-led play across time points, such that infants in the intervention group displayed statistically significant decreases in observed frequency of aggressive behaviors compared to infants in the standard care group. However, follow-up probing of the data indicated the rate of this change at the 6-month follow-up was not significant, which suggests the direct effect of the IBP on the observed frequency of aggressive behavior was not maintained in the long term.

Research has demonstrated the continuity of aggressive behaviors from early childhood into adulthood (Olweus 1979; Tremblay 2000; Piquero et al. 2012). However, theory also suggests that children's ability to learn to regulate their emotions and aggression may result in peak levels of aggressive behaviors in toddlerhood that decline in later childhood (Tremblay 2000). Nevertheless, research has not focused on the long-term stability of aggression in children as young as 12-months and has not examined the impact of parenting interventions on the long-term stability of aggressive behavior in comparison to a control group. Thus, future research is needed to assess the stability of aggressive behaviors from infancy across early and later childhood, the differences present in the function and display of aggressive behaviors across age, and the potential impact of parenting interventions during these time periods.

Despite the lack of direct effects at the 6-month-follow-up, these findings provide support that the SCEPA (Mesman et al. 2008) was sensitive to changes in observed aggression in infants under 18 months of age following an intervention and is the first study to demonstrate decreases in the frequency of observed aggressive behaviors in infants from predominately low-income and underserved ethnic minority families. Despite significant findings on the frequency of observed aggressive behaviors, there was no significant group effect on global ratings of aggression across time points. The lack of significant effects on the global rating scale may be due to the limited range in scores (i.e., 1 to 4), as well as low variability across time points and within groups. The overall low global ratings in the sample was not surprising given the very young children included in the current sample. Nevertheless, future research should examine global ratings of aggression to assess whether this measure of aggression may be more relevant with older children, who may exhibit a greater intensity of aggressive behaviors. Specifically, the overlap between phenomenology and type of aggression during infancy and during later childhood may differ, as intentionality can be measured in older children (Coie and Dodge 1998). Future research could examine differences in global ratings of aggression across different child ages, which may

inform the need for adaptations to ensure the measure is more sensitive to aggressive behaviors that occur during infancy.

In addition to examining the direct effect of the IBP on infant aggressive behaviors, we conducted an exploratory examination of the indirect effect of behaviorally-based parenting skills as a mechanism by which the IBP led to decreases in observed infant aggressive behaviors. Despite research demonstrating the direct effect of behavioral parenting interventions on parenting skill acquisition (Blizzard et al. 2017; Hanisch et al. 2014) and the indirect effect of changes in parenting behaviors on parent-reported child aggressive behaviors (Hoeve et al. 2009; Rothbaum and Weisz 1994; Patterson 1982), no study to our knowledge has examined the indirect effect of parenting skills on the relation between a parenting intervention and observed aggressive behaviors. The current findings supported our hypothesis that levels of behaviorally-based parenting don't skills at post-intervention mediated the effect of the IBP on the observed frequency of aggressive behaviors at the 3-month follow-up assessment, such that decreases in use of don't skills were associated with decreases in the observed frequency of aggressive behaviors. Thus, therapists should target reductions in negative parenting behaviors to reduce aggressive behaviors in the short term. However, behaviorally-based parenting don't skills did not mediate the effect of the IBP on observed frequency of aggressive behaviors at the 6-month follow-up, which may be due to the lack of a significant direct effect of the IBP on infant aggression at the 6-month follow-up.

In contrast to behaviorally-based parenting don't skills, results suggested behaviorally-based parenting do skills did not mediate the effect of the IBP on the observed frequency of aggressive behaviors at the 3- or 6-month follow-ups. Research has documented the impact do skills have on other outcomes, such as child prosocial behaviors (Hanisch et al. 2014) and language (Garcia et al. 2018; 2015; Tannock et al. 1992). Studies have found that parents who exhibit negative parenting skills, such as decreased responsiveness to child's needs (Hart et al. 1998), increased use of harsh verbal and physical discipline (McKee et al. 2007), and more criticism towards their children (Campbell 1995; Hoeve et al. 2009), are more likely to have children who display higher rates of aggressive behaviors. Thus, it is possible that decreasing don't skills is more important in reducing aggressive behaviors than the promotion of do skills, as don't parenting behaviors may lead to the maintenance and escalation of aggressive behaviors. Future research should further assess the differential impact of do and don't skills on observed aggressive behaviors, as well as potential mechanisms by which changes in parenting behaviors lead to changes in observed infant aggressive behavior.

We also examined the indirect effect of behaviorally-based parenting do and don't skills on the relation between group and global ratings of aggression. However, findings demonstrated that neither do or don't skills had a significant indirect effect between group and global ratings of infant aggression at the 3- or 6-month follow-ups. Given that there was no significant direct effect of the IBP on global ratings of aggression, it is not surprising that parenting skills was not a significant mediator. Additionally, global ratings of aggression only ranged from 1 to 4, so it is possible that these ratings did not capture variability among participants.

The current study included a predominantly ethnic minority sample, which was both a strength and a limitation, as the study targets an underserved and under-represented population but one that limits generalizability of findings. Additionally, the relatively small sample size and limited timeline for follow-up (6 months) does not provide the opportunity to examine long-term effects of the IBP on observed aggression. Thus, future research should examine the relation between behavioral parenting interventions and observed aggressive behaviors in a more heterogeneous sample and over a longer period of time, such as following children when they enter school and have more opportunity to display aggression with peers (Barth et al. 2004). Additionally, while adherence in intervention delivery was measured in the present study, competence of therapists was not measured. Thus, future research should also examine how well therapists delivered the intervention content, as their competence with the delivery of the intervention may impact study outcomes.

A second limitation is the that we did not combine parent report and observational measures of aggression in our analyses. Previous research showed the IBP had a significant effect on parent-reported levels of infant aggression (Bagner et al. 2016), whereas the current study focused on observational coding of aggressive behaviors. Ad hoc analyses revealed that parent-reported levels of infant aggression were not correlated with observed infant aggression used in the current study. The lack of association between parent report of aggression and observed infant aggression has been previously reported (Brotman et al. 2008) and highlights the need for future research to incorporate a multimethod approach to measuring infant aggression. Additionally, future research should assess infant observed aggression in other contexts, such as with peers or siblings. Finally, although we demonstrated support for the indirect effect of behaviorally-based don't skills, we did not consider other variables that may have mediated or moderated the effect of IBP on observed aggressive behaviors, such as intervention engagement (e.g., homework practice, session attendance) or parental psychopathology, which could impact the parent's ability to incorporate the parenting skills taught during IBP.

Despite these limitations, the current study extends the literature by examining the effect of a brief, behavioral parenting intervention on observed aggressive behaviors in infants aged 12 to 15 months. The study findings provide initial support for the use of a behavioral parenting intervention to decrease the frequency of observed aggressive behaviors. Furthermore, results suggest decreasing negative parenting behaviors may be a mechanism by which parenting interventions can affect infant observed aggression and highlight the importance of specifically targeting a decrease in these negative behaviors. Findings could have broader implications for prevention, such as providing psychoeducation to parents about the importance of reducing directive verbalizations during play to reduce infant aggression in other settings (e.g., pediatric primary care), and should be explored in future research.

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Compliance with Ethical Standards

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

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