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Differential Effects of a Nurse Home Visiting Intervention on Physically Aggressive Behavior in Children

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Parent training has become a major focus of intervention efforts aimed at preventing or reducing conduct problems (including physically aggressive behavior) and preventing violence among children through the reduction of maladaptive parenting behaviors and an increase in the use of positive parenting strategies (Bor, Sanders, & Markie-Dadds, 2002; Brestan & Eyberg, 1998; Gross et al., 2003; Redmond & Shin, 1998; Reid, Webster-Stratton, & Baybar, 2004; Sanders, 1999; Sanders, Markie-Dadds, Tully, & Bor, 2000a; Sanders, Turner, & Markie-Dadds, 2002; Spoth, Redmond, & Shin, 1998; Taylor & Biglan, 1998; Webster-Stratton & Reid, 2003a; Webster-Stratton & Reid, 2003b; Webster-Stratton, Reid, & Hammond, 2001; Webster-Stratton & Taylor, 2001). Parenting interventions that include language promotion activities as well as parenting skills training may yield the most effective strategies for the prevention or reduction of physical aggression (Arnold, Lonigan, Whitehurst, & Epstein, 1994), through direct effects on physical aggression and indirect effects on physical aggression that are mediated by improved verbal abilities.

Deciding when to implement intervention programs so that they are successful is a challenging task, but crucial if we are to prevent individuals from developing into life-course persistent

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offenders (Moffitt, 1993; Moffitt, Caspi, Dickson, Silva, & Stanton, 1996). Evidence is accumulating that persistent physical aggression leading to adolescent and adult violence develops prior to a child entering school and that the best time to intervene is prior to age 8, before these behaviors become ingrained (Brestan & Eyberg, 1998; Gross et al., 2003; Moffitt, 1993; Reid et al., 2004; Spoth et al., 1998; Taylor & Biglan, 1998; Webster-Stratton & Reid, 2003a; Webster-Stratton & Taylor, 2001; Webster-Stratton et al., 2001; Yoshikawa, 1994). Tremblay (2000) posits that parent training programs during the preschool years which address discipline issues, use of physical punishment, and the regulation of physical aggression help prevent the trajectory towards further behavioral problems such as delinquency, truancy, and adolescent violence.

One challenge to implementing prevention/intervention programs is determining the format for delivering the intervention: group-based versus home-based programs or a combination of these two approaches. The majority of parent training programs are group-based. Brestan & Eyberg (1998) note in their review of 82 studies on psychosocial treatments for conduct disordered children that only 11% of the interventions took place in the home and over ½ were conducted in a group format. Sanders et al. have developed a group-based, comprehensive behavioral family intervention aimed at preventing severe behavioral and emotional disturbances in children through parenting skills training, improving parents' sense of their competency regarding their parenting abilities, increasing parents' communication about parenting issues, and reducing parenting stress (Sanders et al., 2002). This program, known as the Triple P-Positive Parenting Program, has been tested in a wide variety of settings with sample sizes ranging from 16–1615 (Sanders et al., 2002). A unique feature of the Triple P program is the multilevel concentration of the intervention. The intensity level of the intervention can be tailored to meet the needs of the child and family. This program has demonstrated consistent, sustained effects on reductions in children's disruptive behaviors and increased parental confidence over time and across the age continuum from birth through age 12 years (Sanders et al., 2002).

The Incredible Years program is a comprehensive, multi-faceted, developmentally-based preventive intervention, delivered in a group setting, which contains training components for parents, teachers, and children (Webster-Stratton, 1998). This program has been identified as one of 11 model programs under the Blueprints for Violence Prevention initiative (<http://www.colorado.edu/cspv/blueprints/model/overview.html>). The parent training program focuses on teaching effective parenting skills, positive discipline strategies, and methods for parents to enhance their children's social skills, emotional language building, and prosocial behaviors. The teacher training components are designed to reinforce the parent program as well as provide effective strategies for promoting social competence and managing misbehavior in the classroom. The child training program emphasizes skill-building in emotional literacy, empathy, anger management, and inter-personal problem-solving (Webster-Stratton, 1998; Bauer & Webster-Stratton, 2006). This program has demonstrated sustained long-term outcomes in families of children ages 2–10 who are at risk for conduct problems (<http://www.colorado.edu/cspv/blueprints/model/overview.html>).

While these two group-based parent training programs have demonstrated positive outcomes for parents and children, delivering the training program in the home may be more advantageous in that the parents do not have to arrange for transportation, child care or even time off from work which may improve retention in the program. Home visiting programs for first-time parents have garnered attention as effective parent training strategies which impact a host of parent and child outcomes (McNaughton, 2004; Kearney, York, & Deatrck, 2000; Austin & Lemon, 2005; Fetrick, Christensen, & Mitchell, 2003; Olds, Sadler, & Kitzman, 2007) and these programs are typically targeted to those parents at highest risk for poor outcomes. "Bringing the intervention into the home also provides opportunity for more whole

family involvement, personalized service, individual attention, and rapport building” (Sweet & Applebaum, 2004, pg. 1435). A meta-analysis on the effectiveness of home visiting programs revealed that families who were targeted as being “at-risk”, visited by professionals, and who had a larger number of visits over a longer period of time demonstrated greater improvements in child cognition and child abuse outcomes (Sweet & Applebaum, 2004).

The Nurse-Family Partnership (NFP), an intensive nurse-home visiting program, targets first-time, low income mothers and begins during pregnancy and continues until the child is two years old. The NFP has demonstrated consistent program effects on parenting behaviors and children’s verbal ability, cognition, and executive function (Kitzman et al., 1997; Kitzman et al., 2000; Olds, Henderson, Tatelbaum, & Chamberlin, 1988; Olds et al., 2004a; Olds et al., 2002; Olds et al., 2004b). The NFP is one of 11 programs identified by the Center for the Study and Prevention of Violence as a model program in its Blueprints for Violence Prevention initiative (<http://www.colorado.edu/cspv/blueprints/model/overview.html>). Results from a 15 year follow-up of adolescents from the Elmira NFP trial revealed that there was a 59% reduction in arrests and a 90% reduction in adjudications as PINS (person in need of supervision) among the nurse-visited group (Olds et al., 1998), outcomes linked to early aggressive behavior during childhood (Broidy et al., 2003; Fergusson & Horwood, 2002; Moffitt & Caspi, 2001; Moffitt, Caspi, Rutter & Silva, 2001; Moffitt et al., 1996; Nagin & Tremblay, 1999, 2001; Reis & Roth, 1993; Tremblay, 2000; 2004).

Differential Effects of Intervention

Studies have shown that males consistently have higher rates of physically aggressive behaviors than females from early childhood to adolescence (Broidy et al., 2003), with early childhood-onset (prior to adolescence) physical aggression having a 10:1 male to female ratio (Moffitt, 1993; Moffitt et al., 2001; Moffitt et al., 1996). Moffitt et al., (2001) found that males scored significantly higher than females on every measure of physically aggressive or violent behavior between ages 5 and 21. Given these gender differences in physically aggressive behavior, surprisingly, few studies were found which examined the effectiveness of prevention/intervention programs for conduct disorder and aggression by gender, which begs the question, why not? In fact, our original analyses of the NFP revealed that the intervention did not significantly impact overall externalizing behaviors in either the Memphis or Denver trials at ages 2 and 4 years (Kitzman et al., 1997; Kitzman et al., 2000; Olds et al., 2002; Olds et al., 2004b). However, neither gender effects nor the subset of physically aggressive behaviors were examined. Webster-Stratton (1996), in her study of the predictors of treatment outcomes by gender, found that while externalizing behavior, as reported by mothers and teachers, differed by gender at baseline (males exhibited higher levels of hostile-aggressive behaviors than females), male and female responses to the intervention were very similar. Both groups demonstrated significant reductions in aggressive behavior and these results remained stable at 1 and 2 year follow-up assessments. Williams and colleagues (2004) found no gender differences in the treatment effects of a children’s temper-taming program, however, there were only 12 females included in the final sample of 56 children (Williams, Waymouth, Lipman, Mills, & Evans, 2004). Among a sample of adolescents (N=61, 34 males and 27 females), Campbell (2005) demonstrated that while males and females presented with similar symptoms and underlying difficulties upon entry to treatment, the females exhibited significantly more improvements due to treatment than the males. Given the few studies found which examined intervention effects by gender and the known developmental differences which exist in physical aggression between males and females, Webster-Stratton summarizes by stating “it is time to remedy this gap in the research to determine whether there are different behavioral symptoms, developmental pathways, etiological factors, and treatment outcomes for girls and boys” (1996, p. 541).

This study builds on our previous analyses of the control group from the Memphis NFP trial which demonstrated gender differences in the relationship between verbal ability and physical aggression (Anson, Sidora-Arcoleo, Cole, Kitzman, & Olds, 2007) by examining the differential effects of the NFP on verbal ability and the development of physically aggressive behavior in children from 2 through 12 years.

Theoretical Framework for Analytical Model

The theoretical framework used for the secondary analyses is known as the “language-aggression hypothesis”. Boone & Montare (1976) devised the language-aggression hypothesis which states that language is inversely related to aggression: low levels of language proficiency are associated with high levels of aggressive behavior. The language-aggression hypothesis was derived from Pavlov’s excitation-inhibition model. In this model, “it is proposed that excitatory and inhibitory processes operate on abstract language processes to direct and control behavioral activities” (Pavlov, 1927, 1955, as cited in Boone & Montare, 1976, p 851). The language-aggression hypothesis is theoretically centered on the premise that higher language proficiency leads to greater control of aggressive impulses, leading to a reduction in aggressive behavior. Many researchers have shown a link between language and aggressive behavior across the age continuum (Estrem, 2001; Dionne et al., 2003; Cohen et al., 1993; Gualtieri, et al., 1982; Stowe, Arnold & Ortiz, 2000; Cook, Greenberg & Kusche, 1994; Mack & Warr-Leeper, 1992; Cohen et al., 1993; Beitchman et al., 1985; Stevenson & Richman, 1978; Stattin & Klackenberg, 1993).

Dionne and colleagues posit that this language-aggression association usually falls under two developmental models. (Dionne, 2005; Dionne, et al., 2003). The first model, referred to as the shared etiological model, suggests that aggression and language problems share similar origins, including either biological origins or shared environmental origins (e.g., harsh, restrictive parenting and poverty). The second model focuses on a causal pathway from low language proficiency to increased aggression. It is theorized that children with language deficits may have difficulty with negotiation and problem-solving skills. Children with limited communication skills may be more easily frustrated and thus, social interactions may present more conflict episodes (Dionne, 2005).

Utilizing the language-aggression hypothesis, the specific study questions examined were:

1. Was the nurse home visiting intervention effective in reducing physically aggressive behaviors through age 12 years?
2. Did the intervention effects on the development of physical aggression over time differ by gender?
3. Did maternal psychological resources mediate the relationship between the intervention and physical aggression?
4. Were the effects of the intervention on physical aggression mediated by children’s verbal ability?

Methods

Design

The data for these secondary analyses were derived from a longitudinal randomized, controlled trial evaluating the impact of a nurse home visiting intervention (NFP) on pregnancy outcomes, parenting, and a wide array of maternal and child life course outcomes. A full description of the study design has been reported earlier but is summarized here (Kitzman et al, 1997). Office and home interviews and assessments were conducted at registration and post-partum when

the target child was 6 months old, and 1, 2, 4, 6, 9 and 12 years of age. Data from the 2, 6, and 12 year assessment periods were used for these analyses since these were the only time periods when verbal ability and/or physical aggression was assessed. Data collection for the 12 year assessment period was conducted from 7/03–3/06. All women randomized to the post-partum intervention groups and who had a live birth were included in these analyses ($N=721$); 22 women did not have live births.

Sample

Women less than 29 weeks pregnant were recruited from the obstetrical clinic at the Regional Medical Center in Memphis, Tennessee if they had no previous live births, no specific chronic illnesses thought to contribute to fetal growth retardation or preterm delivery, and at least 2 of the following sociodemographic risk conditions: unmarried, less than 12 years of education, and unemployed. All women who were enrolled signed consent forms approved by the Research Subjects Review Board at The University of Rochester and the University of Tennessee.

Intervention Groups

Women were randomized to intervention groups by a computer program using methods that are extensions of those given by Soares and Wu (Soares & Wu, 1983). Randomization was conducted within strata from a model with 5 classification factors: maternal race, maternal age, gestational age at enrollment, head of household employment status, and geographic region of residence. Women assigned to the home visitation groups were subsequently randomly assigned to a nurse home visitor.

Women in intervention group 1 ($N=166$) were provided free-roundtrip taxicab transportation for scheduled prenatal care appointments; they did not receive any postpartum services or assessments. Women in intervention group 2 ($N=515$) were provided free transportation for scheduled prenatal care and developmental screening and referral services for the child at ages 6, 12, and 24 months. Women in intervention group 3 ($N=230$) were provided the free transportation and screening services offered in group 2 and also intensive nurse home visitation services during pregnancy, 1 postpartum visit in the hospital before discharge, and 1 postpartum visit in the home. Women in intervention group 4 ($N=228$) were provided the same services as those in group 3 but also were visited by nurses until the child's second birthday. For the evaluation of postnatal outcomes, intervention group 2 was contrasted with intervention group 4, since only these groups were assessed after delivery of the child.

Nurse Home Visiting Intervention

The experimental home visitation program was carried out by the Memphis/Shelby County Health Department. The nurses completed an average of 7 home visits (range 0–18) during pregnancy and 26 home visits (range 0–71) during the first 2 years postpartum. The nurses followed a detailed visit-by-visit protocol to help women improve their health-related behaviors, care of their children, and life-course development (pregnancy planning, educational achievement, and participation in the workforce). The postpartum program protocols focused on helping mothers and other caregivers improve the physical and emotional care of their children. Specific curricula were integrated into the program to promote parent-child interaction by facilitating parents' understanding of their infants' and toddlers' communicative signals (NCAST, 1994; Sumner, Barnard, Johnson-Crowley, & Spietz, 1990) and enhancing interest in playing with their children in ways that promoted emotional and cognitive development (Sparling & Lewis, 1984). A more detailed description of the nurse home visitation program can be found in Kitzman et al. (1997).

Measures

Mediating Variable

Maternal Psychological Resources—A variable was created to index women's psychological resources measured at registration. It was based upon the mean z-scores of their intelligence (Shibley, 1940), mental health (Ware, Veit, & Donald, 1985), sense of mastery (Pearlin & Schooler, 1967), plus self-efficacy (Bandura, 1977). Unpublished confirmatory factor analysis showed that the 4 components of the psychological resources variable form a single latent variable ($\alpha = 0.61$). The psychological resource variable was standardized to a mean of 100 and standard deviation of 10 and then dichotomized at values ≤ 100 vs. > 100 , creating a median split. The dichotomous variable was created because in our previous analyses where maternal psychological resources was analyzed as a continuous variable, it was found that treatment differences occurred in the tails of the distribution. Thus, for ease of examination of interaction effects and interpretation of results, this classification variable based on a median split was used.

Covariates

Household Poverty—A single index of household poverty at registration was created based upon the averaged z-scores of the following variables: household discretionary income, whether the head of the household was employed, and household density (number of persons per room), standardized to a mean of 100 and a standard deviation of 10. It also formed a single latent variable ($\alpha = 0.54$). This variable is included as a covariate in the analytical models because there were baseline differences between the intervention groups.

Negative Parenting Attitudes—At intake, mothers completed the Adult-Adolescent Parenting Inventory (Bavolek, 1984), a measure of parenting attitudes that indicate a high-risk for child maltreatment. The four scales derived from this measure are: parental lack of empathy, role reversal, unrealistic expectations for the child and a belief in physical punishment. Higher scores are indicative of negative parenting attitudes. This instrument has been widely utilized in a variety of settings and demonstrated good psychometric properties in this sample ($\alpha = .91$). This variable is included as a covariate in the analytical models because previous research has demonstrated that harsh, restrictive parenting leads to increased aggressive behavior among children (Coté, Vaillancourt, LeBlanc, Nagin, & Tremblay, 2006; Loeber et al., 2005; Reid et al., 2004, Taylor & Biglan, 1998) and this was a targeted outcome of the intervention that we wanted to control for.

Dependent Variables

Child's Verbal Ability – Age 2—The Mental Development Index (MDI) from the Bayley Scales of Infant Development (BSID) (Bayley, 1993) was used as a proxy for verbal ability at age 2 since we had no direct assessment of verbal ability at this age. The BSID measures the developmental functioning of infants ages 1 to 42 months and yields a mental development index (MDI) and a motor scale. The MDI measures a variety of abilities including vocalization and verbal communication, memory, sensory-perceptual acuities and discrimination, object constancy, learning and problem-solving abilities. Higher scores indicate better functioning. While the MDI subscale of the BSID is an overall measure of infant cognitive development and not a direct assessment of verbal ability, other researchers have shown significant correlations between the BSID and various language assessments during infancy and toddlerhood (Costarides & Shulman, 1998; Molfese & Acheson, 1997; Siegal, Cooper, Fitzhardinge, & Ash 1995). Scores on the MDI are standardized to $M = 100$ and $SD = 15$.

Child's Verbal ability – Age 6—The Peabody Picture Vocabulary Test – Revised (PPVT-R; Dunn & Dunn, 1981) was used to assess verbal ability at age 6. The PPVT-R measures a

child's receptive vocabulary and is used as a screening tool for verbal ability. Higher scores indicate better verbal ability. Scores on the PPVT-R are standardized ($M = 100$, $SD = 15$), have large normative data sample, and demonstrate adequate reliability and validity (Dunn & Dunn, 1981).

Physical Aggression – Age 2—Three items from the aggression subscale of the Child Behavior Checklist (CBCL, ages 2–3; Achenbach, 1992) were selected as the measure of physical aggression: “physically attacks others;” “hits others;” and “gets into fights,” consistent with previous research (Broidy et al., 2003; Tremblay & Nagin, 1999). For each behavior, mothers were asked to think about the past 6 months and report how true or untrue each statement was about her child with response choices consisting of: 0 (*not true*), 1 (*somewhat or sometimes true*), and 2 (*very true or often true*). A latent variable for age 2 physical aggression was estimated as the shared variance among these three indicators. Standardized loadings ranged from .60 to .70, $ps < .01$.

Physical Aggression - Ages 6 and 12—Items from the CBCL (ages 4–16; Achenbach, 1991) aggression subscale were used as the measure of physical aggression at ages 6 and 12 years. “Physically attacks others” and “gets into many fights” were used for the measure of physical aggression, similar with the age 2 measure of physical aggression. The item “hits others” was not included in the CBCL for this age group. Latent variables for physical aggression at 6 and 12 years were estimated as the shared variance among these two indicators at each age. Standardized loadings ranged from .64 to .67 at age 6 and from .57 to .64 at age 12, $ps < .01$.

Statistical Analysis

All women randomized to intervention group (excluding cases where a miscarriage, abortion or stillbirth occurred) were included in these analyses. Descriptive statistics were computed for all study variables. Structural equation modeling was used to examine the influence of the intervention on children's verbal ability and physically aggressive behaviors. Analyses were conducted simultaneously for all verbal ability and aggression measures. Research questions 1–3 were tested in four primary models, respectively focusing on: (1) intervention main effects, (2) intervention X child gender effects, (3) intervention X maternal psychological resources effects, and (4) intervention x gender x maternal psychological resources effects. Significant interactions were further probed to determine the nature of the interactions.

Mediation analyses (research question 4) were conducted independently for each outcome. Mediation tests examine whether the relationship between a predictor (X) and criterion (Y) can be explained by the effect of X on an interceding variable, the mediator (M). Mediation is tested through first showing that X (e.g., intervention) is associated with both M (e.g., verbal ability) and Y (e.g., physical aggression). Second, a path model is estimated by simultaneously regressing (a) Y on M and X, and (b) M on X. Mackinnon, Lockwood, Hoffman, West, and Sheets (2002) suggest that two criteria be met when using such tests for mediation in intervention research. The first criterion, known as the joint test, requires statistically significant paths from intervention to mediator and mediator to outcome. The second criterion is a statistically significant result of a test that takes each of these paths into account simultaneously, such as the asymmetric confidence limits test. Accordingly, both joint tests and asymmetric confidence limits tests were used for all tests of mediation.

Due to the skewed distributions for the physical aggression variables, two steps were taken in order to guard against misleading results due to violated statistical assumptions. First, all hypothesis tests were evaluated with adjusted standard errors and model fit indices computed using the Robust Maximum Likelihood (MLR) estimation method in Mplus version 4.0

(Muthén & Muthén, 2006). Second, we ran parallel analyses using bias-corrected bootstrapped estimates, which yielded highly similar results to the robust estimation method (available from the first author). Due to the exploratory nature of these simultaneous equations models, a *p*-value of .10 was selected as the cut-off for determining statistical significance.

Following conventions outlined by Kline (1998), Byrne (2001), and Cudeck & Browne (1993), our criteria for assessing adequacy of fit were as follows: χ^2 to *df* ratio of less than 2, comparative fit index (CFI) and Tucker-Lewis Index (TLI) at or above .90, and a root mean square error approximation (RMSEA) at or below .08. All models comfortably exceeded the fit criteria and specific fit index values are available from the first author upon request.

Results

Background characteristics of the sample at randomization are presented in Table 1. The intervention groups were equivalent on background characteristics with one exception: the composite household poverty variable. Women in the nurse-visited group resided in households with higher poverty. Therefore, as stated previously, this variable was included as a covariate in the model.

Model 1: Main Effects of Intervention

Figure 1 presents the results for the simultaneous equation model for the main effects of nurse home visitation on verbal ability and physical aggression measures, controlling for household poverty and negative parenting beliefs. There were no statistically significant effects of the intervention on cognitive development at age 2, but at age 6, there was a trend towards significance with the nurse-visited children demonstrating higher MDI scores than the comparison group children ($t=1.66, p<.10$). Additionally, nurse-visited children exhibited significantly lower physical aggression scores at age 2 than their comparison group counterparts ($t=-2.59, p<.01$). This finding, however, was attenuated by ages 6 and 12 years.

Model 2: Intervention x Gender Effects

Model 2 built on Model 1 by testing whether the effects of nurse home visitation differed for males and females. Gender and the interaction of intervention x gender were added as predictors of verbal ability and physical aggression (Figure 2). By and large, intervention effects did not significantly interact by child gender. The sole exception involved age 2 aggression, for which the intervention X gender interaction term was marginally significant ($t=1.95, p < .10$, not shown). Follow-up analyses of this interaction revealed that nurse home visitation significantly protected against age 2 aggression in females ($t = -3.43, p < .01$), but not males ($t = -0.23, n.s.$). As in Model 1, however, a significant reduction in aggression linked to nurse home visitation was not evident at ages 6 and 12 years for either gender.

Model 3: Intervention x Maternal Psychological Resources

Model 3 also built on Model 1 by testing whether the effects of nurse home visitation differed for children of high vs. low psychological resource mothers. Maternal psychological resources and the interaction of intervention x maternal psychological resources were added as predictors of verbal ability and physical aggression (Figure 3). There were no statistically significant interactions of intervention x maternal psychological in predicting verbal ability at ages 2 or 6, or physical aggression at 2 years of age. By age 6, however, the intervention x maternal psychological resources interaction on physical aggression was significant ($t=-2.49, p<.05$, not shown) and was sustained through age 12 ($t=-2.35, p<.05$, not shown). Probing the interaction effect further, children of nurse-visited, high psychological resource mothers demonstrated significantly lower physical aggression scores compared to children of high psychological resource control mothers (age 6 years $t = -1.79, p<.10$ and age 12 years $t =$

-2.50, $p < .05$). In contrast, the intervention had no significant effect on aggression among 6 and 12-year-old children of low psychological resource mothers.

Model 4: Intervention x Gender x Maternal Psychological Resources

The presence of 2-way interactions of child gender and maternal psychological resources with intervention suggested the possibility of three-way interactions. Model 4 added gender and intervention x gender terms to Model 3, which enabled the testing of the three-way interaction involving intervention X gender x maternal psychological resources. There were no significant 3-way interactions in the prediction of verbal ability and physically aggressive behavior.

Mediated Effects of Intervention

It was hypothesized that the effects of nurse home visitation on child aggression would be mediated by the effect of nurse home visitation on child verbal ability. So as not to violate the temporal precedence criterion in establishing causality, this pattern of mediation was only evaluated for cases in which a measure of the child's verbal ability was assessed at the same time as or before the measure of the child's physical aggression. Mediation models were tested controlling for the possible effects of household poverty and negative parenting beliefs on both the mediator and outcome. Based on the results of Models 1 through 4, and their associated follow-up tests, we further restricted our analyses to the subgroup of the sample in which intervention effects on physical aggression were concentrated: 2-year-old females.

The hypothesized intervention→verbal ability→aggression mediated effect was not supported by the data. In the case of 2-year-old females' physical aggression, the joint significance test criterion was not met because the intervention had no significant effect on age 2 verbal ability ($t = 0.715$).

An alternate direction of mediation was suggested by the data. There was a significant intervention effect on physical aggression at age 2 and a marginal effect on verbal ability at age 6 (see Figure 1). Accordingly, it seemed possible that the effect of nurse home visiting on age 6 verbal ability was mediated by the effect on toddler aggression. Tests of this alternate direction of mediation were limited to females, since the protective effect of nurse home visitation on age 2 physical aggression was concentrated in females. The joint significance criterion was met.

The path from intervention to age 2 aggression ($t = -3.149, p < .01$) was significant; the path from age 2 aggression to age 6 verbal ability was marginally significant ($t = -1.826$) (Figure 4). Moreover, the asymmetric 95% confidence interval around the unstandardized estimate of the indirect (i.e., mediated) effect of 0.301 did not include zero (95% CI=0.001, 0.786). Finally, the effect of nurse home visitation on age 6 verbal ability dropped to a non-significant level ($t = 0.661$), controlling for age 2 physical aggression. Thus, the positive effect of nurse home visitation on females' verbal ability at age 6 appeared to have been mediated by a protective effect on their physical aggression at age 2.

Discussion

Many of the effective parenting programs are based on social learning theories which stress the role that parenting style and discipline strategies play in shaping children's social competence and reducing conduct problems such as physically aggressive behavior. Few studies found during the literature review examined the effectiveness of prevention/intervention programs for physical aggression by gender (or other sub-groups) or whether the observed effects were sustained over time. The findings from this study add to the literature in several important areas. While our previous analyses revealed no intervention effects when the

general constellation of externalizing behaviors was examined, these analyses demonstrated that the nurse home visiting intervention significantly reduced the subset of physically aggressive behaviors among 2-year old children. Subsequent analyses demonstrated a differential impact of the nurse home visitation intervention by gender and mother's psychological resources with the program's effects concentrated among females and children of high psychological resource mothers. The nurse home visiting intervention successfully interrupted the early development of physically aggressive behavior in females, however, by age 6 and through age 12, the intervention effects were attenuated. In light of the fact that both intervention groups demonstrated decreases in physically aggressive behavior over time and were equivalent by 6 years of age, some might question the necessity of the intervention in the first place if, over time, the children ultimately end up in the same place. Our response to this challenge would be that the nurse-visited females exhibited a significantly lower peak value for physical aggression than the comparison group females at age 2 which may have inhibited the development of many of the negative outcomes which have been associated with early conduct problems (e.g., violence, school failure, substance abuse, and delinquency) (Webster-Stratton & Taylor, 2001) placing the nurse visited females on a different trajectory. Subsequent analyses are planned to examine these trajectories of physical aggression and their relationship to children's academic and behavioral outcomes.

The lack of intervention impact among the males was unexpected. The results of these analyses suggest etiological factors other than verbal ability may be important in the prediction of physically aggressive behavior among males. Previous research has suggested that maternal characteristics (e.g., depression, harsh parenting) are important predictors of physical aggression among females (Keenan & Shaw, 1994, Webster-Stratton, 1996) while difficult temperament and non-compliance are key predictors for males (Keenan & Shaw, 1994), thus potentially requiring modification of current intervention programs. It may be that "one intervention does not fit all."

Another key finding was that the nurse home visiting intervention had a significant and sustained impact on physically aggressive behaviors from age 6 through 12 years among children of mothers with high psychological resources. In previous publications (Kitzman et al., 1997; Kitman et al., 2000; Olds et al, 2004a; Olds et al., 2002; Olds et al., 2004b), we demonstrated impacts on children's cognitive and language development which we hypothesized to be a result of improvements in parental caregiving (e.g., quality of the home environment, reduction in harsh parenting beliefs) and maternal life course (e.g., increased birth interval between first and second child, less reliance on welfare). We theorize that these high psychological resource mothers were better able to handle the demands involved in providing sustained, competent care of their children due to the improvements noted above.

An interesting finding was that the verbal ability→aggression hypothesis was not supported by these data for either gender. An alternative hypothesis was tested based on Patterson's theory of coercion (Patterson, DeBaryshe, & Ramsey, 1989) which was supported by our data for females. These findings suggest that the nurse home visiting intervention worked by reducing physical aggression at age 2 and this reduction in physical aggression led to increased verbal ability scores at age 6. Dionne (2005) posits that children's disruptive behavior may interfere with linguistic stimulation creating language deficits. She states, however, that overt aggression is rarely assessed at the same time as, or prior to, language development indicating that we cannot rule out this pathway of influence.

Given these findings, additional analyses are planned utilizing more complex models which will include the known predictors for males and females in order to better understand whether there are different etiological pathways by gender which lead to physically aggressive behavior.

There are several limitations to these analyses. Due to the fact that these were secondary analyses and we did not have a specific verbal ability measure at 2 years, we used the Bayley Mental Developmental Index (Bayley 1993), a broader cognitive measure. It's possible that since this measure included memory, sensory-perceptual acuities and discrimination, object constancy, learning and problem-solving abilities (in addition to vocalization and verbal communication) that any specific impact on verbal ability may have been masked. Another limitation concerns our measure of physically aggressive behaviors. There were three items that assessed physical aggression age at 2 but only two of these items were included in the 6 and 12 year CBCL. We ran the analyses using all three indicators at age 2 and then removed "Hits others" so that all three time periods had the same items as indicators of physical aggression and the results were essentially unchanged. Maternal reports were used to obtain assessments of children's behavior. We did obtain CBCL data from children's teachers at age 12 years but did not have corresponding measurements at the earlier data gathering periods to corroborate mothers' reports and, therefore, were not able to include these data (another limitation of secondary data analyses). Previous research has demonstrated that parent's reports of their children's aggressive behavior are reliable and valid (Kingston & Prior, 1995; Soussignan et al., 1992).

These limitations notwithstanding, this study has highlighted the importance of examining various pathways for the development of physically aggressive behavior in children and suggests that these pathways may differ by gender and other maternal or child characteristics. It is critical that gender is included in future analytical models examining intervention effects on physically aggressive behavior. Had we just limited our analyses to intervention x time effects, we would have missed the fact that all of the program effects were concentrated among the females.

Future research efforts should focus on analyzing more complex models which include previously identified predictors and potentially important subgroups. Gaining a better understanding of differing etiological pathways and responses to prevention and intervention programs will allow us to tailor these interventions to improve effectiveness.

Implications for Nursing Practice

The findings from this study can help nurses working with mothers understand the developmental differences in physical aggression between males and females and that the effectiveness of education and intervention strategies may differ by child's gender. Nurses who provide well-child care are in a position to screen and identify children and families who may be at risk for conduct problems and provide referral to a parenting skills training program, if available in the community in which the family lives. Even if no formal program exists, nurses can incorporate several key components of these parenting skills training programs in their face-to-face contacts with families. Teaching parents the use of positive discipline strategies (e.g., use of time out instead of spanking) and how to interact with their child in ways that promote the child's social and emotional development will lead to positive sociobehavioral outcomes for the child. By providing parents these skills, nurses can enhance parents' confidence in their ability to parent their child in ways that promote optimal social, emotional, and behavioral development.

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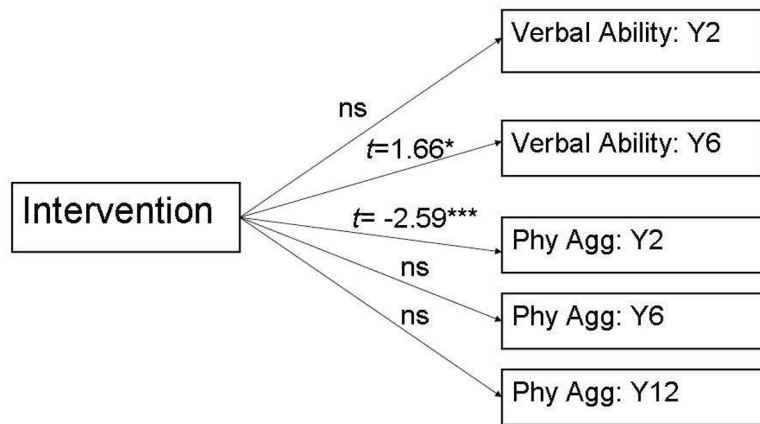
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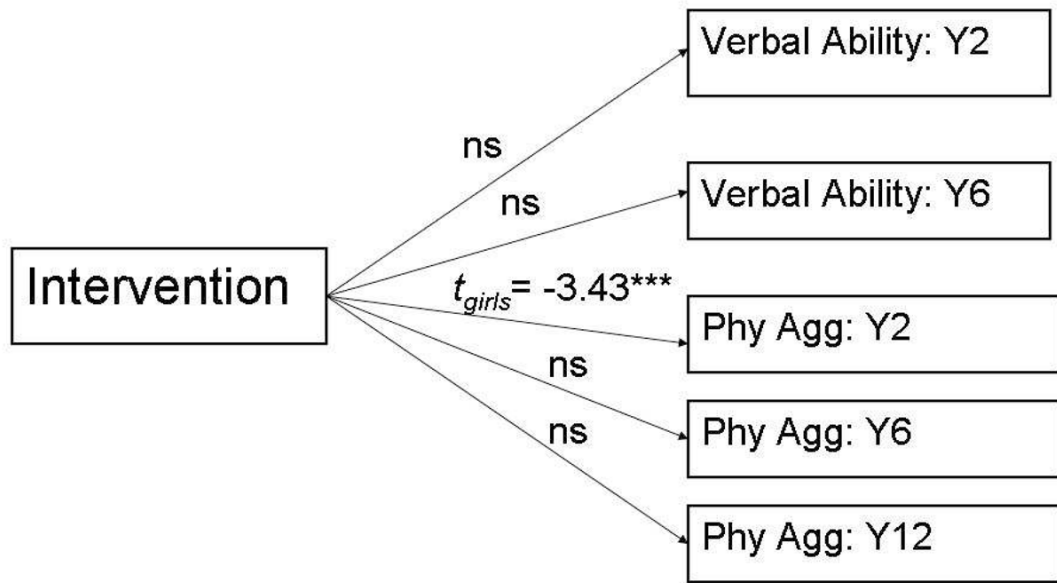
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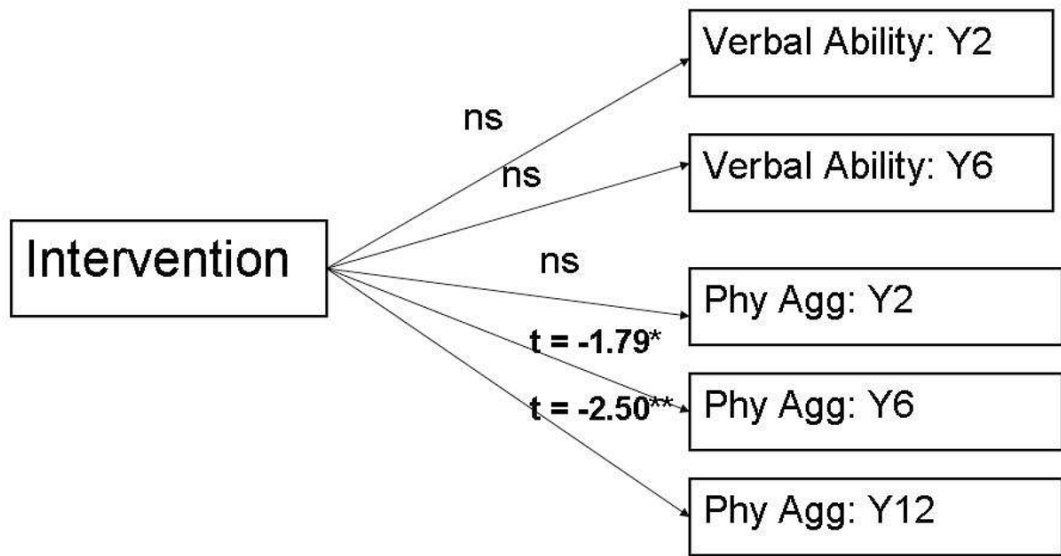
* $p < .10$ ** $p < .05$ *** $p < .01$

Figure 1.
Model 1- Main effects of intervention



* $p < .10$ ** $p < .05$ *** $p < .01$

Figure 2.
Model 2- Intervention x Gender



* $p < .10$ ** $p < .05$ *** $p < .01$

Figure 3.
Model 3- Intervention x Psychological Resources

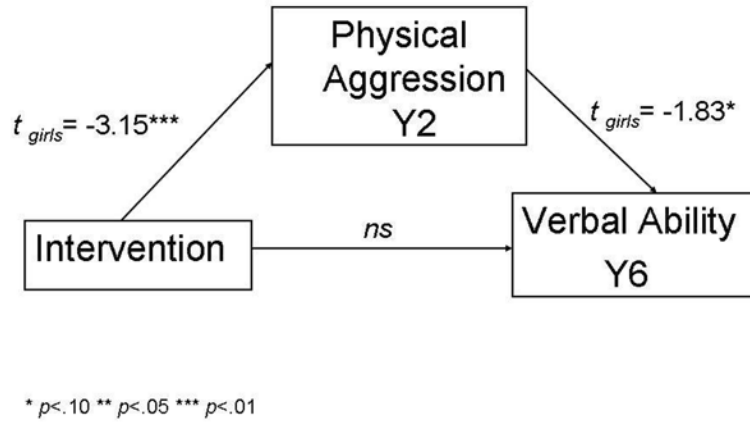


Figure 4.
Mediation effects -alternative hypothesis

Table 1

Background Characteristics of Sample at Randomization

	Treatment Group	
	Comparison %	Nurse-visited %
African-American	92	89
Married	2	1
% Male Children	50	51
Low Psychological Resources	51	55
	Mean (SD)	Mean (SD)
Age	18.1 (3.2)	18.1 (3.3)
Education (yrs. completed)	10.3 (1.9)	10.1 (2.0)
% Census tract below poverty	34.5 (21.3)	35.8 (20.5)
Household poverty	99.5 (10.1)	101.9 (10.0)
Negative Parenting Beliefs	99.8 (7.6)	100.7 (8.5)