Does Fathers' Residency Matter? Paternal Influence on Children's Health and Development

Does Fathers' Residency Matter?
Paternal Influence on Children's Health and Development

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Abstract

This dissertation focuses on the effects of fathers' residency status and father involvement on children's health and development in the United States. The data for this dissertation were obtained from the Fragile Families and Child Wellbeing Study (Fragile Families) and the Early Childhood Longitudinal Study- Birth Cohort (ECLS-B).

Chapter 1 examined the association between fathers' residency status and child BMI. We performed a series of cross-sectional linear regression and propensity score matching analyses using three waves (Years 3, 5, and 9) of the Fragile Families data. We did not find a significant difference in BMI between children who had residential fathers and those with nonresidential fathers at any age.

Chapter 2 assessed item bias in the father involvement scale used on the 24-month ECLS-B questionnaire for resident and nonresident fathers. We used Differential Item Functioning (DIF) to detect whether the 17-item scale measured father involvement fairly for nonresidential and residential fathers. We found that almost half of the items (8 of the 17 items) showed signs of uniform DIF. That is, the eight items were biased in favor of residential fathers. One item showed signs of nonuniform DIF, which indicated the item was not consistently biased in favor of one residential type over the other. The remaining eight items did not show signs of bias, and therefore could be used as anchor items on the father involvement scale.

Chapter 3 examined the intergenerational effects of father involvement on children's social development. We used structural equation modeling (SEM) to analyze father-child interactions across three generations. We found positive 1st generation father-son interactions to be significantly associated with higher levels of 2nd generation father involvement in cognitively-stimulating activities (e.g. reading books, singing songs and telling stories to children), which was also found to be associated with higher teacher reports of externalizing behaviors in children. We stratified the data by child sex and found differential effects for boys and girls. In boys, we found that positive 1st generation father- son interactions was associated with more frequent 2nd generation father involvement in cognitively-stimulating activities and higher teacher reports of internalizing behaviors. However, there were no significant effects for girls.

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Chapter 1: An examination of the effects of fathers' residency status on child BMI

Abstract

Introduction: Childhood overweight and obesity is a significant, yet preventable public health problem that has reached epidemic levels in the United States. Childhood obesity prevention efforts have increasingly focused on parent engagement since parents and caregivers play a central role in shaping, monitoring, and regulating children's lifestyle behaviors. However, mothers and maternal caregivers make up the vast majority of study participants in childhood obesity prevention studies. As a result, we know comparatively less about paternal influences on childhood obesity, especially among children who do not reside in the same household as their biological fathers (i.e. nonresidential fathers).

Objective: The primary aim of this study was to determine whether there is an association between fathers' residency status and child BMI. The secondary aim was to determine whether the effects of fathers' residency status on child BMI is dependent on child age.

Methods: We performed a series of cross-sectional linear regression and propensity score matching analyses using three waves (Years 3, 5 and 9) of data from Fragile Families and Child Wellbeing Study.

Results: The study baseline (Year 3) sample included 1,448 father-child dyads, 16% of fathers were nonresidential. Residential fathers had a mean age of 31.6±7.0, less than half were Black 42.4%, some were unemployed (16.5%) and most had less than HS education (62.2%). Nonresidential fathers in the sample were slightly younger than residential fathers 29.0± 7.4,

almost half were unemployed (47.2%), and the majority had less than HS education (80.4%). Residential fathers were more likely to be overweight or obese in comparison to nonresidential fathers (76.1% vs 67.1%). There was a slightly higher prevalence of overweight and obesity among children who had a residential father compared to children who had nonresidential fathers (37.3% vs 31.3%). However, we did not find a significant difference in BMI between children who had residential fathers and those with nonresidential fathers, after controlling/matching on family sociodemographic characteristics and obesity-related risk factors.

Conclusion: Among fragile families, fathers' residency status does not seem to have an impact on children's BMI at any of the studied age groups. We also found that residential fathers tend to be different from nonresidential fathers on several sociodemographic characteristics; and so, matching is more preferable than regression techniques when comparing estimates for residential and nonresidential fathers.

Introduction

Childhood obesity is a significant, yet preventable public health problem that has reached epidemic levels, globally (World Health Organization, 1999). In the United States, one in every three child is considered to be either overweight or obese (Benjamin, 2010). Body mass index (BMI), calculated as weight divided by height (kg/m^2), is a commonly used measure of body fatness. High body fat indicated by having a high BMI is one of the classification criteria for overweight and obesity. For children, BMI is reported as percentiles or adjusted z-scores (Kuczmarski et al., 2002; Nucara, Pietrafesa, Rizzo, Scaccianoce, & Wang, Youfa & Chen, 2012); and so, children with a BMI at or above the 85^{th} percentile but lower than the 95^{th} percentile are considered to be overweight. Children with a BMI at or above the 95^{th} percentile are considered to be obese. Childhood overweight and obesity are risk factors for chronic diseases such as asthma, Type 2 diabetes, hypertension and cardiovascular disease in adulthood (Attard, Herring, Howard, & Gordon-Larsen, 2013; De Sousa, 2009).

Since the long-term effects of childhood obesity can be especially pernicious, efforts to prevent childhood obesity tend to focus on the modifiable aspects of children's environment and behaviors (De Sousa, 2009; Lloyd, Lubans, Plotnikoff, & Collins, 2013). Since parents and caregivers play a central role in shaping, monitoring, and regulating children's lifestyle behaviors. (e.g. diet, exercise, sleep and screen time) and environment (Gruber & Haldeman, 2009; Lloyd, Lubans, Plotnikoff, Collins, & Morgan, 2014), prevention efforts have also increasingly focused on parent engagement (Ash, Agaronov, Young, Aftosmes-Tobio, & Davison, 2017). However, systematic review studies have noted that mothers and maternal caregivers make up the vast majority of study participants in childhood obesity prevention

interventions (Ash et al., 2017; Davison, Gicevic, et al., 2016). A systematic review of 667 childhood obesity prevention articles published between 2009 and 2015 found that only 1% of studies included fathers as the sole parental participant compared to 36% of studies that included mothers only (Davison, Gicevic, et al., 2016; Gicevic et al., 2016). This review also noted that few childhood obesity prevention studies reported disaggregated results for mothers and fathers (Davison, Gicevic, et al., 2016). A subsequent systematic review of childhood obesity preventions interventions found that none of the published studies between 2008-2015 included nonresidential parents (Ash et al., 2017). As a result of fathers' underrepresentation in the literature, we know comparatively less about paternal influences on childhood obesity, particularly among children who do not live in the same household as their biological fathers (i.e. nonresidential fathers) (Davison, Gicevic, et al., 2016; Khandpur, Charles, Blaine, Blake, & Davison, 2016; Vollmer, Adamsons, Gorin, Foster, & Mobley, 2015).

Major shifts in family structure in the United States, namely the substantial increase in single-mother households, has led researchers to examine fatherhood and father involvement in children's development more closely over the past few decades (Cabrera, Tamis-Lemonda, Bradley, Hofferth, & Lamb, 2000; Davison, Charles, Khandpur, & Nelson, 2016; Lamb, 2000b). Currently, slightly less than a one-fourth (23%) of US children live in a single-mother household (United States Census Bureau, 2017); however, few studies have examined the implications of residential versus nonresidential fathers on child health. Fathers' residency status is typically classified as nonresidential or residential. Residential fathers live in the same household as their biological child, whereas, nonresidential fathers live apart from their biological child. The majority of the literature on fathers' residency status on child outcomes focus on absent fathers.

Absent fathers live apart from their biological child *and* have little to no contact with their child. The literature clearly shows that father absenteeism is linked to poor child outcomes (McLanahan, Tach, & Schneider, 2013), however, only 1-2% of nonresidential fathers could be considered absent fathers (Yogman, Garfield, & Committee on Psychosocial Aspects of Child and Family Health, 2016). In reality, the majority of nonresidential fathers are involved with their children despite not living in the same households (Jones & Mosher, 2013). Yet, the effects of nonresidential fathers who are involved with their children on children's obesity risk continues to be understudied (Vollmer et al., 2015).

The few studies that have examined residency status focus on maternal family structure such as single-mother versus two parent (e.g. mother with male partner) households on children's obesity risk (Augustine & Kimbro, 2017; Chen & Escarce, 2010, 2014; Strauss & Knight, 1999). The findings from these studies, however, have been mixed. Some studies found single-mother households to be positively associated with child overweight and obesity (Huffman, Kanikireddy, & Patel, 2010; Strauss & Knight, 1999) and others found no association between single parent households and child obesity risk, particularly after adjusting for household sociodemographic characteristics (Augustine & Kimbro, 2013). Differences in findings may be due to differences in the ages of children studied. Findings from past studies suggest that family structure may have a greater influence on older children's risks of becoming overweight and obesity compared to younger children (Chen & Escarce, 2010, 2014). Since the sample for these studies were predominately White middle-class families in the US (Augustine & Kimbro, 2017; Chen & Escarce, 2010, 2014), results for racially and economically diverse households may be different since these populations tend to be at a greater risk of overweight and obesity (Isong et al., 2018; Strauss & Knight, 1999; Wang & Lim, 2012).

In this study, we sought to determine whether there is an association between fathers' residency status and child BMI. The secondary aim of the study was to determine whether the effects of fathers' residency is dependent on child age. We analyzed three waves of data from Fragile Families and Child Wellbeing Study cross-sectionally to identify the presence of critical windows during early and late childhood for fathers' residency status to impact child BMI. Since nonresidential fathers are known to be characteristically different from residential fathers (i.e. nonresidential fathers tend to be younger, less educated, unemployed and have a lower income than residential fathers) (Castillo, Welch, & Sarver, 2011), we used regression and propensity score matching techniques to account for sociodemographic and obesity-related differences in individual and household characteristics.

Methods

Data

The data for this study were obtained from the Fragile Families and Child Wellbeing Study (Fragile Families), which consists of a probability sample of 4,898 recent births in 75 hospitals from 20 US cities with 200,000 or more people in their population (Reichman, Teitler, Garfinkel, & McLanahan, 2001). The Fragile Families study is oversampled for nonmarital child births. As a result, three-quarters of the participants (75%) were unmarried at the time of their child's birth. Four follow-up interviews were completed with birth mothers and fathers between 1999-2010 when study child(ren) were approximately 1, 3, 5, and 9 years, which corresponded to the Year 2, 3, 5, 9 study waves (Princeton University Bendheim-Thoman Center for Research on Child Wellbeing & Columbia Population Research Center, 2008, 2011). A subsample of parents, most of whom were mothers, completed an in-home assessment at the 3-year follow-up (Year 3), 5-year follow-up (Year 5), and 9-year follow-up (Year 9). This supplemental assessment

contains mostly self-reported data on parent-child interactions, the home environment, and anthropometric measures (i.e. height, weight, etc.) (Waldfogel, Craigie, & Brooks-Gunn, 2010). For this study, we predominately drew from the father interviews and in-home assessments collected during the Year 3, 5 and 9 study waves and used the baseline and Year 2 data for information on certain demographic and early obesity-related risk behaviors.

Study Population

Parents were interviewed at the hospital following their child's birth. If the birth father was not available at the hospital, mothers were asked to provide the birth father's contact information so that study staff could complete the interview by phone. A total of 3,830 fathers completed the baseline interview at the child's birth. While non-biological fathers were included in follow-up interviews, we restricted the study sample to biological fathers who completed the baseline interview. The study sample was also limited to father-child dyads that had complete child weight and height measures. This criterion resulted in variations in the study sample across study years. In the Year 3 data, there were 1,448 father-child dyads. In the Year 5 data, there were 1,250 father-child dyads. In the Year 9 data, there were 1,707 father-child dyads.

Measures

Body Mass Index. Mother and child BMI were determined using height and weight measurements taken by trained study staff at the Year 3, 5, 9 in-home visits. Fathers' BMI was calculated using self-reported height and weight measures on the Year 3 interview and self-reported weight on the Year 5 interview. Fathers were not asked about height and weight at Year 9. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2). Children's BMI scores were converted to z-scores using the revised 2000 Centers for Disease

Control and Prevention (CDC) growth charts (Kuczmarski et al., 2002). Parents' BMI was categorized based on CDC classifications for normal weight (18.5-24.9), overweight (25-29.9) and obese (≥ 30). Extreme or implausible weight and height values were removed from the analysis. Also, we did not include mothers who were pregnant at the time of their weight assessment.

Fathers' Residency. During the follow-up interviews, fathers were asked "how much of the time does the child live with you". The response options were "*most, half, some, or none of the time, weekends.* Fathers who reported living with their child "none of the time" were coded as "nonresidential= 1" and those who lived with their child "most of the time" were coded as "residential=0". We did not include father-child dyads who lived together some of the time, half of the time or weekends in the analysis because the sample sizes were too small.

Screen-time and Outdoor Play. During the Year 3, 5, and 9 interviews, mothers reported the typical number of hours their child spent playing outdoors in a yard, park or, playground and watching TV, DVDs, and playing games on the computer on weekdays and weekends. The average number of hours per week of screen time and outdoor play time were calculated by multiplying the typical weekday hours by 5 and the typical weekend hours by the following formula: the sum of the weekend and weekday hours divided by 7.

Sociodemographic Variables. Information on parents' race and education, as well as, child sex was obtained from the baseline mother and father interviews. Mothers self-reported their breastfeeding history at the Year 2 interview. Mother, father and child age were self-reported at each interview. Mothers were also asked whether they received food assistance in the form of

food stamps, EBT, WIC during the previous 12 months. All covariates were dichotomized, and the same covariates were entered in each analysis as control or matching variables. For example, maternal history of receiving food assistance in the past 12 months (yes=1), ever breastfed (yes= 1), and child sex (male=1).

Statistical Analysis

All statistical models were analyzed in Stata 15.1 (StataCorp, 2017a). We performed a series of cross-sectional analyses using data from Year 3, 5 and 9 study waves. First, we examined the descriptive statistics for the selected covariates by conducting chi-square tests for dichotomous variables and t-tests for continuous variables. These covariates consisted of parent and child characteristics that were measured either prior to or at the time of each parents' interview. We retained covariates that were either theoretically or statistically correlated with fathers' residency and child BMI (Rubin, 1997; Rubin & Thomas, 1996). The same list of covariates was used for each study year. Time-dependent covariates were updated in each model to reflect the measure for the specified study year (e.g. Year 5 analysis used parents' age reported during the Year 5 interview).

We examined the linear relationship between fathers' residency and child BMI, with "residential fathers" as the reference group. We conducted bivariate and multiple regression models that adjusted for the selected parent and child characteristics. We examined the effects of fathers' residency status on child BMI in a series of propensity score matching (PSM) analyses. Figure 1.1 presents the equation for the propensity score function in which e(x) is equal to the conditional probability of being assigned to the treatment group (D), given a set of observed covariates (x) (Rosenbaum & Rubin, 1983).

$$e(x) = p\ (D = 1|x)$$

Figure 1.1 Equation for the propensity score function

For our analysis, nonresidential fathers were designated as the "treatment" group (D=1) with residential fathers coded as the comparison group (D=0). We matched nonresidential fathers to residential fathers based on the selected covariates using the calculated propensity scores. We completed the procedure using the propensity score estimator with calipers set to 0.20 in the "teffects psmatch" STATA module (StataCorp, 2017a). The algorithm calculates the propensity scores and regressions in one step, which was designed to match all ties, account for the matching in the standard errors (Abadie & Imbens, 2006, 2008), and provides estimates for the average treatment effects by default (Social Science Computing Cooperative, 2015). Since the true propensity score is a balancing score in which the treatment group and comparison group have the same distribution of measured covariates, balance, which indicates treatment assignment is strongly ignorable (Rosenbaum & Rubin, 1983; Rubin, 1978). When balance has been achieved the estimates are considered to mimic randomization (Austin & Mamdani, 2006). However, when covariate balance is not achieved this imbalance has been shown to introduce bias (King & Nielsen, 2015; Rosenbaum & Rubin, 1983, 1985). We employed the two balance diagnostics that were appropriate for caliper matching, which were to check for balance numerically and graphically. First, we evaluated the reduction in the standardized mean difference and variance for covariates before and after matching and then visually inspected kernel density plots for each covariate. The Harvard T.H. Chan School of Public Health, Office of Human Research Administration provided ethical approval for this study.

Results

Descriptive Statistics

Table 1.1 presents the sociodemographic characteristics and obesity-related risk factors for fathers, mothers, and children across study waves A total of 3,830 biological fathers participated in the baseline interview, however less than half of the fathers completed the follow-up interviews. The analytic sample for the Year 3 data consisted of 1,448 fathers, 231(16%) of whom were nonresidential. The Year 5 data contained 1,250 fathers, 289 (23%) were nonresidential. In the Year 9 data, the analytic sample consisted of 1,707 fathers, 406 (23.8%) were nonresidential. Furthermore, the percentage of overweight and obese children at each study year ranged from 35.3 to 42.5 percent.

Table 1.1 Sociodemographic characteristics and obesity-related risk factors for fathers, mothers, and children across study waves

	Year 3 (N=1,448)		Year 5 (N=1,250)		Year 9 (N=1,702)	
Variables	N	%	N	%	N	%
			Father			
Residency						
Residential	1,217	84.1	961	76.9	1,296	76.1
Nonresidential	231	16.0	289	23.1	406	23.8
Age	31.2± 7.1	18-64	33.1± 7.0	20-53	38.0± 7.3	25-76
Race/Ethnicity						
Black	696	48.1	593	47.5	759	44.7
White	315	21.8	273	21.9	406	23.9
Hispanic	378	26.2	327	26.2	455	27.4
Employment Status						
Unemployed	490	19.0	273	21.9	414	24.4
Education						
HS/GED	938	65.1	609	61.5	717	62.8
BMI	33.5± 6.9	17.6-68.3	33.9± 6.9	17.6- 63.5	34.0± 6.9	17.6-60.5
			Mother			
Age	29.2 ± 6.1	17-48	30.5 ± 6.0	20-50	35.3± 6.1	23-54
Race/Ethnicity						
Black	650	45.0	566	45.4	502	39.1
White	353	24.4	314	25.2	383	29.8
Hispanic	386	26.7	326	26.1	347	27.0
Education						
HS/GED	894	61.8	589	59.2	994	58.5
Maternal Poverty						
Food Assistance (i.e. food stamps, WIC, EBT)	408	28.2	487	39.9	637	38.7
BMI	29.4 ± 7.3	13.9-59.7	29.7± 7.4	16.6-63.2	30.8± 7.7	16.1-66.3
			Child			
Sex						
Girl	709	51.0	620	51.4	816	47.9
Boy	739	49.0	586	48.6	886	52.1
Age	36.3 ± 2.9	30-52 mo.	61.1± 2.8	57-72mo	9.25± .33y	8.7-10.8y
Ever Breastfed	837	59.3	662	57.1	995	61.8
Avg. Outdoor Play Per Day	2.9 ± 2.0	0-16	3.6± 2.4	0-18.3	2.5± 1.5	0-8.1
Avg. Screen Time Per Day	3.2 ± 2.3	0-12	2.3± 1.7	0-10	2.6± 1.6	0-10
BMI			.			
Normal	874	63.6	781	64.6	961	57.5
Overweight	249	18.1	221	18.3	281	16.8
Obese	251	18.3	206	17.0	429	25.7

Table 1.2 presents the sociodemographic characteristics and obesity-related risk factors for fathers, mothers, and children, by fathers' residency status and study waves. In general, nonresidential fathers were younger, had higher rates of unemployment, and lower educational attainment when compared to residential fathers. Although the majority of the sample (40%) were Black. Noticeably, there was a higher proportion of Black fathers and mothers in the nonresidential father group compared to residential father group. For example, in Year 3, 77.9% of the nonresidential fathers were Black compared to 42.4% of the residential fathers in the same year. Among mothers in the nonresidential father group, 74.5% were Black compared to 39.4 % of mothers in the residential father group. We also found that nonresidential fathers had a slightly lower mean BMI compared to residential fathers at each study year, except for in Year 9. In Year 3, the mean BMI for nonresidential fathers was 32.6± 6.6, whereas, the mean BMI for residential fathers was 33.7± 7.0. In Year 9, however, the mean BMI for nonresidential fathers was 34.1± 6.7, whereas, the mean BMI for residential fathers was 32.0± 8.5.

Similarly, children with nonresidential fathers followed the same pattern of having a slightly lower mean BMI z-scores compared to children with residential fathers for each study year except for in Year 9. Mothers whose child's father were nonresidential tended to be younger (Year 3: 29.2± 6.1 vs 30.5± 6.0) and less educated than mothers whose child's father were residential. They were also more likely to receive food assistance (Year 3: 39.9% vs 28.2%). There were no meaningful differences in the mean BMI for mothers in the residential father group and the nonresidential father group, except for Year 9 (30.4± 7.5 vs 32.4± 8.5).

Table 1.2 Sociodemographic characteristics and obesity-related risk factors for fathers, mothers, and children, by fathers' residency status across study waves

Variable	Year 3 (N=1,448)		Year 5 (N=1,250)		Year 9 (N=1,702)	
	Residential (n=1,217)	Nonresidential (n=231)	Residential (n=961)	Nonresidential (n=289)	Residential (n=1,296)	Nonresidential (n=406)
	%	%	%	%	%	%
			Father			
Age	31.6± 7.0 18-64y	29.0±7.4 19-62y	31.1±6.8 21-53y	31.0±7.3 21-53y	38.7± 7.4 25-76y	35.8± 6.7 25-62y
Under 35	69.1	81.4	58.4	73.8	34.0	52.6
35+ yrs.	30.9	18.6	41.6	26.2	66.0	47.4
Race/ Ethnicity						
Black	42.4	77.9	41.3	68.2	37.0	69.4
White	24.3	8.7	26.5	6.6	28.7	8.6
Hispanic	29.0	11.3	28.1	19.7	30.0	19.3
Unemployed	16.5	47.2	15.9	42.3	18.6	42.9
(HS/GED)	62.2	80.4	62.1	82.0	58.0	78.4
BMI	33.7± 7.0 17.6-68.3	32.6± 6.6 21.0-54.7	33.9± 7.0 17.6-60.5	33.4± 6.9 20.3-63.5	32.0± 8.5 16.9-70.4	34.1± 6.7 19.7-60.5
Overweight	43.6	39.7	22.6	25.2	21.6	20.5
Obese	32.5	30.8	69.4	67.4	71.2	72.6
			Mother			
Age	29.4± 7.2 17-48y	26.5± 5.9 18-46y	31.1± 6.0 21-53y	28.8± 5.8 20-47y	36.0± 6.1 23-53y	33.1± 5.4 24-54y
Under 35	79.9	88.7	76.8	86.2	45.1	68.4
Race/ Ethnicity						
Black	39.4	74.5	38.9	67.0	32.9	14.8
White	26.8	12.1	28.8	13.2	33.8	65.0
Hispanic	29.4	12.6	28.3	18.8	28.9	18.0
HS/GED	59.1	76.2	56.0	66.3	56.0	66.3
Food Assistance Recipient	25.1	44.6	31.3	64.4	31.7	60.8
Ever Breastfed	62.6	41.4	60.8	44.4	65.3	50.5
BMI	29.4± 7.2 15.2-57.4	29.8± 7.5 16.3-53.1	29.7± 7.6 16.6-63.2	29.7± 7.3 20.3-63.5	30.4± 7.5 15.3-61.1	32.0±8.5 16.9-70.4
Overweight	28.2	27.3	31.2	28.2	28.2	27.9
Obese	42.6	45.9	41.3	43.2	46.7	54.3
			Child			
Age	36.1±2.9 30-52m	37.5±3.0 33-48m	60.9±2.7 57-72m	61.6± 2.9 57-72m	9.26± .34 8.7-10-7y	9.22±.34 8.7-10.8y
BMI						
Normal	62.7	68.7	64.3	65.7	57.9	56.3
Overweight	18.8	14.3	18.9	16.3	17.4	15.1
Obese	18.5	17.0	16.8	18.0	24.7	28.6

Regression Analyses

The regression output for the association between fathers' residency status and child BMI by study year are presented in Table 1.3. Findings from the Year 3 analysis indicated a marginal association between fathers' residency status and BMI for children between the ages of 2.5-4 years old. Specifically, the BMI of children with nonresidential fathers was .15 points lower than children with residential fathers ($\beta = -.15;\ p = .09$), however, after adjusting for covariates the estimate attenuated further toward the null ($\beta = -.10;\ p = .34$). Next, we examined the Year 5 data, which comprised of children between the ages of 4.8-6 years old. We did not find a statistically significant relationship in either the univariate model ($\beta = -.09;\ p = .24$) or the adjusted-regression model ($\beta = -.06;\ p = .57$). Similarly, we did not find evidence for a statistical relationship between fathers' residency and BMI for children between the ages of 8-11 years old. The results for the univariate model ($\beta = .08;\ p = .20$) and the adjusted-model ($\beta = -.03;\ p = .75$) were not statistically significant.

Table 1.3 Regression output for the association between fathers' residency status and child BMI, by study year

	Year 3		Year 5		Year 9	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
Paternal Variables						
Nonresidential (v. residential)	-.152†	-.101	-.092	-.064	.081	-.033
Age		-.034		-.106		-.002
Race						
Black		-.098		-.273		.082
Hispanic		.143		-.013		.110
Education (≤HS/GED)		.195*		.135		.161†
Employment Status (Employed=1)		-.216*		-.013		.063
BMI						
Overweight		.058		.167		-.0007
Obese		.275**		.329*		.176
Maternal Variables						
Age		-.158		-.055		.0009
Race						
Black		-.029		-.047		.105
Hispanic		.056		.145		.185
Education (≤HS/GED)		.049		.024		.110
Employment Status (Employed=1)		-.046		-.002		.010
Food Assistance		.022		-.116		-.157†
Ever Breastfed		.029		-.121		-.195*
BMI						
Overweight		.136		.150		.208*
Obese		.357***		.579***		.584***
Child Variables						
Age		.207		.021		.032
Sex						
Male		-.045		.114		.022
Obesity-related Behaviors						
Screen time		.063		.037*		.102
Outdoor Play		-.093		-.165*		.078
β	.557	-.211	.600	-.011	.740	-.097
N	1,448	1,101	1,250	837	1,706	956
R^2	0.002	0.065	0.001	.104	.001	.133

* p<0.05, ** p<0.01, *** p<0.001 † p<0.10

Propensity Score Matching Analyses

For the last stage of the analysis, we matched residential and nonresidential fathers based on their estimated propensity scores. Table 1.4 displays the results from the propensity score matching output for the effects of fathers' residency status on child BMI-z scores by study year. We found no differences in BMI among children with nonresidential fathers and those with residential fathers. Covariate balance checks were performed after each analysis, visual inspection of the kernel density plot indicated that balance improved after matching.

Table 1.4 Propensity score matching output for the effects of fathers' residency status on child BMI-z scores by study year

	Year 3	Year 5	Year 9
β Nonresidential v residential	-.141	-.055	-.040
p	.359	.764	.735
se	.154	.184	.118
95% CI	(-.443, .161)	(-.306, .417)	(-.271, .192)
N	354	282	290

* The model is adjusted for parent and child socio-demographic characteristics, maternal and child health risk factors, parental BMI,

Discussion

Over the past fifty years, the US has experienced a substantial increase in the number of children being raised by single-parents, mainly single-mothers. This shift in family structure has brought forth a need for more research on the effects of fathers' residency status (i.e. nonresidential vs residential) on children's health outcomes. During this same time period, childhood obesity more than tripled (Centers for Disease Control and Prevention, 2018) and has since become one of the leading causes of childhood morbidity (National Center for Health Statistics, 2017). Children from racial and ethnic minority groups and those from low-income

households, in particular, are at an increased risk of becoming overweight and obese (De Sousa, 2009; Huffman et al., 2010; Isong et al., 2018). We analyzed three-waves of the Fragile Families and Child Wellbeing Study data to determine whether there is an association between fathers' residency status and child BMI and did not find a significant difference in BMI between children who had residential fathers and those with nonresidential fathers, after controlling/matching on family sociodemographic characteristics and obesity-related risk factors. We also examined our results by child age and did not find any differences by child age groups.

This study contributes to the small, but growing body of literature on the influence of family structure on children's obesity risks. Our study provides insights on contributing risk factors for obesity among children living in fragile families and the findings suggest that fathers' residency status is not determining factor for their obesity risk for children between the ages of 3 and 9 years. Specifically, children in fragile families who have nonresidential fathers are not at a greater risk of having a higher BMI than children with residential fathers due to their father not living in the same household. These results are consistent with previous study findings (Augustine & Kimbro, 2013; Chen & Escarce, 2010, 2014). Similar to Augustine & Kimbro (2013), we found a marginally significant bivariate relationship between having a nonresidential father and higher child BMI at Year 3, which further attenuated after controlling for family characteristics. Otherwise, this study represents an important departure from past studies due to our focus on paternal family structures, which is inclusive of single- father households, while previous studies solely examine maternal family structures, and in some cases, intentionally excluded single-father households. In comparison to single mother households, there a substantially fewer single-father led households in the US (23% to 5%) (United States Census

Bureau, 2017), however, the single-father household is expected to rise exponentially over the next few decades (Livingston, 2013). Because of this, we wanted to make sure our study was inclusive of paternal family structures. The number of children living in single-father households in our sample was not large enough to conduct sub-analyses. We also used paternal self-reports, rather than maternal reports of fathers' parenting, which has been a trend for previous studies (Bronte-Tinkew, Moore, & Halle, 2004). While some researchers argue maternal reports are valid proxies for fathers' self-report, there have been several studies that have shown fathers' self-reports to be preferable to maternal reports (Hawkins & Palkovitz, 1999; Hernandez & Coley, 2007; Wical & Doherty, 2005).

Our study also extends on the methodology used in previous studies. Although the previous studies on family structure and childhood obesity used a nationally representative sample (Augustine & Kimbro, 2013; Chen & Escarce, 2010, 2014), these studies were not able to account for diverse racial and economic families. We used the Fragile Families data, similar to Nepomnyaschy (2016), in order to obtain results from a more diverse sample of fathers and families. Also similar to previous studies, we used regression to adjust for familial characteristics in our models. However, we also conducted analyses in which we matched residential and nonresidential fathers based on family socio-demographic and childhood obesity risk factors (e.g. outdoor play, screen time, parental BMI), in order to account for observed differences between nonresidential and residential fathers, as well as, household characteristics related to two-parent and single- parent homes. We found propensity score matching to be a preferable statistical technique to use rather than regression when comparing estimates for residential fathers to nonresidential fathers. Nonresidential fathers in our sample were quite different from

residential fathers on several key characteristics, which meant that we had to use fairly wide calipers (0.2) in order to find sufficient matches. As a reference, another propensity score matching study on father involvement used a caliper width of 0.05 (Jackson, Newsome, & Beaver, 2016). To address the differences between groups, we made all covariates binary so that the caliper width had less of an effect on our estimation (Austin, 2011). Despite these technical issues, all of our analyses were sufficiently powered. We conducted post hoc power analyses using G*Power (Windows 3.1.9.3; 2017) (Faul, Erdfelder, Lang, & Buchner, 2007) to ensure that we had a sufficient sample size. The sample sizes in each analysis exceeded the minimum sample of 128 fathers and matched sample size of 256 to have an effect size of 0.3- 0.4 (medium). We also intended to compare the results of our propensity score matching analyses to the coarsened exact matching analyses (CEM) we conducted (results not shown). CEM is a statistical technique that prioritize balance in covariate by exact matching treatment and comparison groups on all measured covariates. We were not able to obtain a large enough number of matches between nonresidential and residential fathers to adequately power the CEM analyses. Results from CEM are thought to more closely simulates randomization than PSM, since PSM models can still have imbalance in the covariates (Blackwell, Iacus, King, & Porro, 2009; Iacus, King, & Porro, 2012; King & Nielsen, 2015). Still, our PSM analyses were adequately and the covariate balance checks increased our confidence in the results from the PSM analyses.

While we attempted to address limitations of past studies, our study is not without its own limitations. First, because we were not able to randomize fathers to residential conditions and instead used statistical matching to account for confounding and bias, we had to restrict fathers'

residency to binary categories of residential and nonresidential, in which residential was defined as fathers who lived with their biological children most or all of the time and those who lived with their child none of the time were coded as nonresidential. Our analysis leaves out fathers with joint custody agreements in which fathers live with their child upwards of 50% of the time because the sample sizes were too small and so the matched analyses would have been underpowered. However, we did run the regression analysis for each study year (not shown) and did not find a significant difference in child BMI for fathers who lived with their child part of the time and those who lived with their children either full-time or none of the time. Additionally, our study may have some issues with bias due to inconsistent measurement of fathers' weight. Fathers were not asked to self-report their weight at Year 9 and so we used self-reported weight at Year 5 to estimate fathers' Year 9 BMI. The effect of the differences in weight between Year 5 and Year 9 is likely to be minimal. We also were not able to account for father involvement in child feeding, physical activity and sedentary behaviors since fathers were not consistently asked to report on their parenting behaviors across study years. Although this is not a limitation, it should be noted that data used for the analyses were not weighted. We were primarily interested in the effects of fathers' residency status and child BMI among fragile families, and so, we prioritized covariate balance in order to identify well-matched treatment and comparison father groups (Zanutto, 2006) and comparing effect estimates between the regression and propensity score matching analyses.

Conclusion

As one of the first studies to examine the effects of fathers' residency status on child BMI from the paternal family structure perspective, this study makes an important contribution to the literature by showing that despite being in a fragile family arrangement, children with

nonresidential fathers did not have a significantly different BMI than children with residential fathers at any period during early and late childhood. Future studies may want to consider examining the effects of changes in fathers' residency throughout childhood, since fragile families are more likely to experience fluctuations in fathers' residency status over time. These fluctuations oftentimes emotionally, financially, and physically destabilizes children and their households (Cabrera, Fagan, & Farrie, 2010; Shannon, Cabrera, Tamis-LeMonda, & Lamb, 2009) and should be examined for its effect on childhood obesity risks. Follow-up studies should also examine whether fathers' residency status and father involvement have independent effects on children's obesity risk, specifically whether father involvement offsets any negative effects of fathers' absence from the household. Findings from this study and future studies on this topic are needed to discern the ways in which children may become at-risk for obesity because of their family structure, which could be beneficial for developing and informing childhood obesity prevention interventions.

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Chapter 2: Detecting differential item functioning (DIF) in the ECLS-B father involvement scale

Abstract

Introduction: Social expectations of fathers and their involvement in childrearing has been largely shaped by shifts in the social and economic climate in the United States. While the primary role of fathers used to be the "breadwinner" in the family, contemporary perspectives of father involvement have expanded to demand that fathers be actively engaged in childrearing. In the 1990s, the DADs project developed fathering scales to measure father involvement. The concept of these scales was to measure and compare father involvement among different subgroups of fathers (e.g. residential and nonresidential fathers). However, few studies have assessed the psychometric properties of these commonly used father involvement scales or its validity among subgroups of fathers, namely residential and nonresidential fathers and none have examined whether the scale items fairly measure father involvement among nonresidential and residential fathers.

Objective: The overall purpose of this study was to identify and determine the extent of item bias in the 24-month ECLS-B father involvement scale used for nonresidential and residential fathers.

Methods: Differential Item Functioning (DIF) was used to detect item bias in the 17-item father involvement scale on the 24-month ECLS-B. Items that were found to be biased were further analyzed to determine the magnitude of the bias.

Results: We found that 8 of the 17 items showed signs of uniform DIF. That is, these items were consistently biased in favor of residential fathers. One item showed signs on non-uniform DIF,

and the remaining eight items did not show signs of bias, statistically; and therefore, these items could be considered anchored items for father involvement scales.

Conclusion: The uniform DIF items were primarily related to caregiving activities that happen in the home on a daily/nightly basis. These items included putting their child to bed, helping to brush their teeth, and dressing their child. Our findings suggest that the uniform DIF items should not be used to assess nonresidential father involvement. More research is needed to develop father involvement scales that are more inclusive and reflect the diverse ways in which fathers interact with their children whether or not he lives in the same household as his child. Future modifications to the father involvement scale need to factor in the amount of time nonresidential fathers have physical access to their children.

Historical Context of Fatherhood and Father Involvement in the United States

The social expectation of fathers and their involvement in childrearing in the United States has been shaped by shifts in the social and economic climate of American society (Williams, 2008). From America's beginnings until the 19th century, the family-unit predominately consisted of a mother, a father, their children, and other adult family members (e.g. grandparents) who each shared in domestic chores and childrearing. In this family dynamic, fathers were involved in childrearing and were primarily responsible for providing moral oversight, religious teachings and educating their children (Lamb, 2000b). Societal expectations of the "moral father" role was that he would serve as a "model of good Christian living" for his children and provide a solid understanding of the Bible (Lamb, 2000b). The industrial revolution that began at the turn of the 19th century had a momentous impact on America's economy and society, and subsequently family formation and father involvement (Dowd, 2000b, 2000a). During this period, the nation transitioned from a rural and agrarian society in which families lived and worked on family farms to an industrialized nation in which people work outside their communities, in factories and in urban areas (Pleck, 1998; Puschmann & Solli, 2014). This period not only brought on advancements in various industries and transportation, but also, brought changes to the family dynamic with the advent of the nuclear family, which was comprised of two biological parents and their children. The nuclear family gave rise to the "traditional father" role, in which fathers were the family breadwinner whose primary responsibility was to provide financially for his wife and children (Cabrera et al., 2000; Lamb, 2000b). In this role, fathers worked outside the home and had limited involvement in childrearing; and consequently, childcare primarily became the responsibility of mothers, who

rarely worked outside of the home so they could stay home with the children (Cabrera et al., 2000; Lamb, 2000b).

The role of fathers would again be affected, starting in the late 1960s, when the US experienced another societal shift due to economic declines that were attributed to deindustrialization, de-unionization, the globalization of jobs and urbanization (Lu et al., 2010; Zinn, 2015). Though family formation for Black families had historically taken a different trajectory than White families because of slavery and post-slavery oppression of Black people (Lu et al., 2010), both Black and White families experienced the erosion of the nuclear family with some couples separated, divorced or widowed for a number of reasons including the Vietnam War; mass incarcerations, especially of Black men; and the onset neighborhood violence, particularly in poor and urban areas (Cabrera et al., 2000; Lamb, 2000b; Settersten & Cancel-Tirado, 2010). During this period, the number of single-female headed households increased, mainly due to divorce and non-marital child births. For White families, the prevalence of single- mother headed households was approximately 8.4%, a figure that was disproportionately higher for Black families at 20.6% (Lu et al., 2010; Ricketts, 1989; Sandefur & Tienda, 1988). Poverty became a major issue for some families (Orthner, 1996) and many fathers, particularly young dads and minority dads, struggled to meet society's expectations of the traditional father role as the sole provider (Cabrera et al., 2000; Lamb, 2000b; Lu et al., 2010; Settersten & Cancel-Tirado, 2010). As a consequence, there was an increase in father absenteeism. The "absent father" role, characterized as father who have little to no interactions with their children, has been widely documented in popular culture and the media, as well as, in the child development and parenting literature. In fact, much of what is known is about the

importance of father involvement on child health and development is from the literature on the detrimental effects of father absence (Lamb, 2000b; McLanahan et al., 2013). The dissolution of the nuclear family brought on the restructuring of the American household in which children lived in a variety of household arrangements, including two-biological parent, single biological parent, one biological and one non-biological parent, and completely non-biological parent homes. This shift in household composition led to the need for broader definition of fathers to reflect the relationship between father/father figures and children.

By the late 1970s, women entered the labor force in larger numbers than previous decades, which created a need for fathers to play a more active role in parenting and share in the responsibilities of childrearing. This shift in societal expectations of fathers brought about the "nurturant father" role which extended the scope of the fathering role from that of financial provider (i.e., breadwinner) or a distant parent (absentee father) to being involved in the emotional, physical and financial care of his children (Lamb, 2000b; Wall & Arnold, 2007). The nurturant father is described as a father who assists in hands-on childcare, providing his children with warmth and support, and actively engaging in the parenting activities such as bathing, dressing, and feeding his children, with were once considered the responsibility of mothers. In fact, the nurturing fathers' identity as a paternal caregiver is often likened to mothering (Newland, Coyl-Shepherd, & Paquette, 2013), in spite of, research showing that fathers have a manner of playing, disciplining, socializing and speaking with their children that is distinct from maternal-child interactions and has an independent positive contribution to children's development (Doherty, Kouneski, Erickson, Journal, & May, 1998; Newland et al., 2013; Pleck, 2012).

Introduction

Contemporary Research on Father Involvement

While past studies have noted the positive contributions fathers make to children's development, father involvement did not receive mass attention until the 1990s. In the mid-1990s, Executive Order No. 13045 created an interagency federal workgroup called The Forum, which was tasked with collecting, coordinating and reporting federal data on children and families. The Forum convened a series of conferences attended by academic researchers, funders, and policy-makers to assess the state of reproductive and child health and well-being in the United States (Federal Interagency Forum on Child and Family Statistics, 2004). The conference highlighted important gaps in the parenting literature and the paucity of child and family data that could be shared across agencies. In response, The Forum developed six nationally-representative longitudinal surveys with the intentions of collecting information from racially, geographically and economically diverse groups of children and families (Federal Interagency Forum on Child and Family Statistics, 2004). A subcommittee of Forum member agencies and academic researchers started the Developing a Daddy Survey (DADs) Project, which prioritized the study of fathers and their children (Bronte-Tinkew et al., 2004). The Forum identified four gaps in the existing literature: (1) the lack of representation of fathers in parenting research, (2) the widespread use of maternal reports as proxies for fathers' self- report, (3) the lack of data on father specific parenting behaviors and (4) the absence of fatherhood data that could be compared across different groups of fathers (e.g., residential/nonresidential fathers, wed/unwed fathers, etc.) and the DADs Project designed fatherhood questionnaires to address these gaps (Bronte-Tinkew et al., 2004; Federal Interagency Forum on Child and Family Statistics, 2004; West, 2007). These fatherhood questionnaires were included as supplements on

several nationally representative cohort studies, including the Fragile Families and Child Wellbeing Study (Fragile Families), the Early Head Start Research and Evaluation Study (EHS) and the Early Childhood Longitudinal Study (ECLS).

The father involvement scale developed by the DADs Project was based on theories of father involvement (e.g. Lamb et al's model of father involvement) and were designed to compare father involvement across diverse groups of fathers (Bronte-Tinkew et al., 2004); namely, residential fathers (i.e. fathers who live in the same households as their biological child(ren)) and nonresidential fathers (Cabrera et al., 2004; Jones & Mosher, 2013; Shannon, Tamis-Lemonda, & Cabrera, 2006). While a gold standard measures of father involvement has yet to be developed, the father involvement scales on the Fragile Families, EHS and ECLS studies are among the most widely used measures of father involvement in the literature. Yet, only one author has reported on the psychometric properties for the father involvement scale developed by the DADs Project. Bronte-Tinkew et al (2006, 2007) reported on the dimensionality and reliability of the father involvement scale for the 9-month ECLS-B fatherhood questionnaire (Bronte-Tinkew, Carrano, & Guzman, 2006; Bronte-Tinkew, Ryan, Carrano, & Moore, 2007). They found that the 19-item scale consisted of five constructs of father involvement (i.e. cognitively-stimulating activities, caregiving activities, nurturing activities paternal warmth and physical care) with Cronbach's alpha coefficients ranging from 0.64 to 0.87 (Bronte-Tinkew et al., 2006, 2007). However, their study sample only included residential fathers, so the results among nonresidential fathers are unknown.

To date, there are no published studies that have validated the DADs Project's father involvement scales among nonresidential fathers (Fagan & Kaufman, 2014; West, 2007), despite its use on nonresidential father questionnaires on the ECLS, Fragile Families, EHS and other fatherhood studies. Testing for measurement equivalence in father involvement scales is important because inaccuracies in measures can lead to biased effect estimates (Teresi & Fleishman, 2007), which can then skew interpretations of nonresidential father involvement. Furthermore, biases in father involvement estimates that compare nonresidential fathers to residential fathers can lead to inaccurate conclusions about nonresidential fathers' commitment to their children. Since studies tend to selectively use items from the DADs Project's father involvement scale rather than the full scale, it is important to determine whether the scale items contain bias against father subgroups.

In this study, we tested item bias on the father involvement scale used on the 24-month ECLS-B fatherhood questionnaire using Differential Item Functioning (DIF). DIF helps to statistically assess for bias in individual scale items, rather than bias on the entire scale as is the procedure in classical measurement theory approaches such as factor analysis (DeVellis, 2016; Kline, 2011). DIF is used to evaluate differences in the probability of endorsing an item across subgroups, despite observing the same score on the underlying construct (Woods, 2009). Items can either show consistent bias across the latent trait (i.e. uniform DIF), bias across the latent trait that varies between subgroups (i.e. non-uniform DIF), or no statistical significant bias across the latent trait or subgroups (i.e. anchor items) (Maller & Pei, 2017; Osterlind & Everson, 2009). When individual items are found to favor one group over another at every level of the latent trait, that item is considered to have uniform DIF. Individual items that vary across the latent trait based on subgroup membership is considered to have non-uniform DIF. Items that show little to

no bias statistical are known as anchor items. After reviewing the father involvement items on the 24-month ECLS-B resident and nonresident father questionnaires, as well as, the frequency response scale (e.g. daily, multiple times in week, weekly), we hypothesized that items that require fathers to have regular physical contact with their child at night or early mornings to perform the behavior would be biased against nonresidential fathers. These items include bathing and dressing their child, helping their child brush his or her teeth, among others. If item bias is present, the effects of the bias may be further compounded by the frequency response scale used to asses father involvement. Since most nonresidential fathers are involved with their children, but tend to have less physical contact with their child in contrast to residential fathers (Jones & Mosher, 2013), it is plausible that nonresidential fathers could be classified as having low father involvement if they are only able to endorse a limited number of childcare activities because they have limited physical access to their children during the week or month.

Methods

Theoretical Framework

The father involvement scales developed by the DADs Project were based on contemporary theories of father involvement, namely Lamb, Pleck, Charnov, and Levine's model of father involvement (Bronte-Tinkew et al., 2004). Lamb et al's (1985, 1987) tripartite model of father involvement is made up of three constructs: (1) interaction, (2) availability, and (3) responsibility that reflect the multidimensional nature of father involvement (Bronte-Tinkew et al., 2004; Lamb, Pleck, Charnov, & Levine, 1985, 1987). According to the theory, interaction refers to fathers' direct contact with their child through caregiving and shared activities, availability refers to fathers' presence or accessibility to engage in direct interactions, and responsibility is related to the actions fathers take to ensure that their child's needs are care for

(Lamb, 2000a; Lamb et al., 1985, 1987). Table 2.1 presents the father involvement items on the 24-month ECLS-B resident and nonresident father questionnaire. Broadly, these items correspond with the constructs developed by Lamb et al (1985, 1987), however, items #2, 3, 6,7,8,11,12 seem to be specific to the Lamb et al's interaction construct and, specifically, father involvement in direct caregiving.

Data

The data for this study were obtained from Early Longitudinal Study- Birth Cohort (ECLS-B). The ECLS-B is a nationally representative probability sample of 10,700 children born in 2001 (National Center for Education Statistics, 2005). The purpose of the study was to prospectively assess children's early life experiences, cognitive and emotional development, as well as, early school experiences. Data were collected through direct observations, interviews, and questionnaires from primary caregivers (mostly mothers), residential and nonresidential fathers, teachers and school administrators at multiple stages in children's development: 9-months (Wave I), 24-months (Wave II), preschool /48-months (Wave III), and kindergarten (Wave IV) (National Center for Education Statistics, 2005).

Sample

The study sample comprised of 6,800 residential and nonresidential fathers who completed a self-administered questionnaires (SAQs) based on their residency status at Wave I (baseline). Residential fathers included biological, adoptive, foster, and stepfathers. Nonresidential fathers were biological fathers who met the eligibility criteria for the ECLS-B study. In order for nonresidential fathers to be eligible for the study, they could not live in the same household as the study child, they had to have visited the study child at least once in the

previous month or have seen the study child at least seven days in the previous three months. Alternatively, nonresidential fathers who were in contact with the child's birth mother at least once a month over the previous three months leading up to the parent interview. Additionally, mothers had to provide consent for fathers' participation in the study, as well as, facilitate contact between study staff and nonresidential fathers (National Center for Education Statistics, 2005). Residential fathers completed questionnaires at Wave I-III and nonresidential fathers completed the questionnaire at Wave I and Wave II. This study used data drawn from residential and nonresidential biological fathers who completed the father questionnaire at Wave II (N= 5100). Sample sizes were rounded to the nearest 50 or 100 to comply with ECLS confidentiality rules.

Measures

The father involvement scale on the ECLS-B is made up of 17-items covering multiple domains of fathers' direct involvement with their children including four forms of activities: caregiving activities (e.g. prepare meals, change diapers, bathe child), cognitively stimulating activities (e.g. read books, tell stories, sing songs), taking children on outings (e.g. go to restaurants, take child on errands), and play-based activities (e.g. play chasing games, put child on shoulder). Table 2.1 displays the father involvement items from the 24-month ECLS-B father involvement scale. For first set of questions on the 17-item scale, (item 1-13), fathers reported the number of times per month they engaged in the listed parenting activity using a 6-point frequency scale: "5-more than once a day, about once a day, 4- a few times a week, 3-a few times a month, 2-rarely, 1-not at all". In the second set of questions (items 14-17), fathers reported the number of times in a week they engaged in specific parenting activities on a four-point response scale- 1-not at all, 2-once or twice, 3-3 to 6 times, 4- every day. Variables were

recoded so that higher scores indicated a higher frequency of involvement in the given activity. Because of sparse responses for "rarely" and "a few times a month" on items 1-13, the categories were collapsed resulting in four response categories for all items. Observations with more than 5 missing items were dropped from the analysis.

Statistical Analysis

We conducted DIF analyses on the self-reported father involvement scale associated with fathers' residency status (i.e. residential or nonresidential fathers) using the logistic regression procedure in STATA version 15 (StataCorp, 2017b, 2017a). Residential fathers served as the reference group and nonresidential fathers were the focal group in the analyses. DIF occurs when scale items perform differently between groups given the same level of latent score for father involvement, resulting in an increased probability of endorsing an item response based on group membership (Osterlind & Everson, 2009). We tested for the two forms of DIF: uniform and non-uniform. Uniform DIF occurs when an item favors one group over another across all levels of the latent construct; whereas, non-uniform DIF occurs when there is an interaction effect in which an item performs differently for groups across the levels of the latent construct (Maller & Pei, 2017; Osterlind & Everson, 2009). Anchor items are items that show no signs of DIF, meaning there is little to no bias in the item.

Unlike other DIF procedures such as item response theory, multi-indicators, multiple cause models, and Mantel- Haenszel procedures that are more effective in detecting uniform DIF, logistic regression is powerful in detect both uniform and non-uniform DIF (Swaminathan & Rogers, 1990).

Figure 2.1 presents the formula for the DIF logistic regression model adapted for this study is as follows:

$$P\,(u=1)=\frac{e^{z}}{[1+e^{z}]}$$

, where $z=\ \tau_0+\tau_1\theta+\tau_2 g+\tau_3(\theta g)$ $\quad g=\begin{cases}1\ if\ nonresidential\\0\ if\ residential\end{cases}$

Figure 2.1 Formula for the DIF logistic regression model

In the formula, u represents the response to the item, θ is the observed score for an individual father, $\tau_2 g$ reflects group difference in involvement on a specified item, and $\tau_3(\theta g)$ reflects the interaction between group and involvement. Uniform DIF is shown when $\tau_2 \neq 0$ and $\tau_3=0$ and non-uniform DIF if $\tau_3 \neq 0$ (regardless of if $\tau_2= 0$) (Swaminathan & Rogers, 1990). The logistic regression model tests the hypothesis $\tau_2 =\tau_3=0$ and follows a chi-squared distribution with 2 degrees of freedom (df). The null hypothesis that there is no DIF is rejected when estimates exceed the $X_{a:2}$ (Rogers & Swaminathan, 1993; Swaminathan & Rogers, 1990). DIF type was assessed based on the p-value associated with the chi-square estimate.

Results

The final sample consisted of approximately 5100 fathers, roughly 10% of whom were nonresidential and more than half (52.3%) were White. The summary score for the father involvement scale amounted to a total of 68, with each of the 17-items ranging from 0 and 4. The mean father involvement score was 35.9 ± 7.3. The percentage distribution of item responses by fathers' residency status can be found in Table 2.2. Most responses were skewed towards the more frequent values of father involvement. The internal consistency reliability based on Cronbach's alpha for the items reflecting caregiving activities (assisting child with eating,

dressing, and brushing teeth) was 0.84, cognitively stimulating activities (e.g. reading books, telling stories) was 0.68, children on outings (e.g. errands, religious services) was 0.55, and play-based activities (e.g. playing indoors) was 0.67.

Table 2.2 Percentage distribution of item responses by fathers' residency status (N=5100)

	Residential Fathers (n=4600)						Nonresidential Fathers (n=500)					
	Responses Options (%)						Responses Options (%)					
Items	**More than once a day**	**About once a day**	**A few times a week**	**A few times a month**	**Rarely**	**Not at all**	**More than once a day**	**About once a day**	**A few times a week**	**A few times a month**	**Rarely**	**Not at all**
1. Play chasing games	25.9	30.0	31.9	7.8	2.7	1.8	21.0	18.7	31.3	18.3	6.5	4.4
2. Prepare meals for your child	24.1	24.0	29.2	12.0	7.8	2.9	21.6	12.7	28.3	17.6	11.0	8.9
3. Change child's diapers or help child use the toilet?	46.1	23.4	18.1	5.4	4.6	2.4	29.1	13.8	28.0	15.3	7.2	6.6
4. Take child for a ride on your shoulders or back	18.0	24.6	35.4	13.7	5.9	2.4	16.7	13,9	32.7	20.9	9.9	5.9
5.Play games or toys indoors with your child	36.6	32.3	23.9	5.3	1.4	0.6	25.1	16.7	32.3	19.4	3.8	2.7
6.Help child to bed	20.4	42.4	26.2	6.1	3.5	1.5	16.7	17.3	30.1	16.9	9.4	9.6
7.Give child a bath	7.6	20.3	37.3	17.9	11.5	5.5	10.6	14.6	27.3	19.3	15.0	13.1
8.Take child outside for a walk or to play in the yard, a park, or a playground	12.3	21.2	42.8	18.3	4.3	1.1	13.3	16.6	36.0	21.1	8.8	4.2
9.Help child get dressed	19.4	30.6	36.4	8.7	3.6	1.3	16.5	18.6	30.0	19.6	9.1	6.3
10. Go to a restaurant or out to eat with child	3.4	3.5	27.5	50.2	13.2	2.2	4.0	5.5	27.9	38.9	14.4	9.3
11.Assist child with eating?	19.3	31.7	29.3	7.5	9.4	2.8	19.3	14.1	28.5	19.3	13.2	5.7
12.Help child brush his or her teeth?	9.6	26,6	28,4	12.7	14.6	8.0	11.2	16.7	24.1	15.8	16.2	16.0
13.Take him or her with you to a religious service or event?	1.9	1.8	14.2	29.5	24.3	28.4	1.9	1.9	7.4	20.2	27.4	41.3
	Everyday		**3 to 6 times**		**Once or twice**	**Not at all**	**Everyday**		**3 to 6 times**		**Once or twice**	**Not at all**
14. Read books to your child	11.3		47.3		26.9	14.5	20.3		52.7		18.8	8.2
15.Tell stories to your child	19.3		47.3		21.5	11.9	28.0		46.4		17.7	8.0
16. Sind songs with your child	11.1		32.5		28.9	27.6	18.1		39.2		25.3	17.5
17. Take your child along while doing errands	6.4		37.5		34.9	21.2	15.2		37.3		28.2	19.4

* Percentages may not add to 100 due to rounding

Logistic regression output for DIF model can be found in Table 2.3. Evaluation of the 17-items on the father involvement scale revealed that nine items showed no evidence of either uniform DIF or non-uniform DIF (p <.05). These invariant items are known as "anchors" because statistically they were found to be DIF-free. These anchor items are used to match nonresidential and residential father groups on the latent score for the father involvement scale, in order to detect DIF in other scale items (Maller & Pei, 2017). The eight anchor items on the scale were (1) assist your child with eating, (2) help your child get dressed, (3) take your child on your shoulders or back, (4) play games indoor with your child, (5) take your child outside for a walk or to play in the yard, a park, or a playground, (6) go to a restaurant or out to eat with your child, (7) tell stories to your child, and (8) take your child along while doing errands. With the exception of one item, the remaining items showed evidence of uniform DIF, meaning residential fathers had a consistently had higher probability of endorsing these items compared to nonresidential fathers: (1) prepare meals for your child (X^2=5.85; p= 0.02), (2) change your child's diapers or help your child to the toilet (X^2=13.44; p= 0.002), (3) help your child to bed (X^2=6.59; p= 0.01), (4) give your child a bath (X^2=3.94; p= 0.05), (5) help your child brush his or her teeth (X^2=11.75; p= 0.0006), (6) take him or her with you to a religious service or religious event (X^2=10.22; p= 0.001), (7) read books to your child (X^2=6.65; p= 0.010). One item (play chasing games with your child) showed sign of non-uniform DIF (X^2=5.07; p= 0.02).

Table 2.3 Results for logistic regression DIF model (N=5100)

	Nonuniform DIF		Uniform DIF	
Item	X^2	p-value	X^2	p-value
1. Play chasing games with your child	5.07	0.02	0.03	0.87
2. Prepare meals for your child	0.17	0.68	5.85	0.02
2. Change your child's diapers or help your child use the toilet?	0.65	0.42	13.44	0.0002
4. Take your child for a ride on your shoulders or back	0.16	0.69	0.21	0.65
5.Play with games or toys indoors with your child	1.71	0.19	3.40	0.07
6. Help your child to bed	1.23	0.27	6.59	0.01
7. Give your child a bath	0.86	0.35	3.94	0.05
8. Take your child outside for a walk or to play in the yard, a park, or a playground	0.22	0.64	0.22	0.64
9. Help your child get dressed	0.08	0.77	0.17	0.68
10. Go to a restaurant or out to eat with your child	1.91	0.17	1.78	0.18
11. Assist your child with eating?	3.13	0.08	2.48	0.12
12. Help your child brush his or her teeth?	1.05	0.30	11.75	0.001
13. Take him or her with you to a religious service or religious event?	1.62	0.20	10.22	0.001
14. Read books to your child	0.02	0.88	6.65	0.01
15. Tell stories to your child	0.09	0.76	0.00	0.98
16. Sing songs with your child	3.80	0.05	2.16	0.14
17. Take your child along while doing errands like going to the post office, the bank, or the store?	0.34	0.56	0.60	0.44

Sensitivity Analysis

The likelihood of false DIF detection (i.e. false positive) increases when there are sparse data in the responses categories (Teresi et al., 2009). In our study data, we found that some items had markedly skewed distributions in the item response categories. As a robustness check, we performed a binary analysis of the item as little-to- no involvement (collapsing not at all and rarely categories) vs involvement (collapsing the remaining categories). Since we found that the majority of the DIF items showed evidence of uniform DIF, we performed the analysis using the Mantel- Haenszel (M-H) procedure. DIF M-H Chi-squared Test output can be found in Table 2.4. Of the seven items that were found to have uniform DIF in the logistic regression analysis, only five showed statistical evidence ($p<0.05$) of uniform DIF in the M-H analysis. Similar to Cole et al (2000), we retained the significant items that had a large effect size (i.e. M-H Odds Ratio > 2.0 or <0.5) (Cole, Bellizzi, Flegal, & Dietz, 2000). Based on these criteria, only one item "changing your child's diapers or help your child use the toilet" had more than twice the odds of being endorsed by residential fathers in contrast to nonresidential fathers (M-H OR: 2.1; 95% CI:1.33, 3.38). The remaining items met the effect size criteria for uniform DIF set by Zwick & Ercikan (1988) who classified moderate DIF as a M-H odds ratio between 1-1.5 and a large DIF as an M-H odds ratio greater than 1.5 and an odds ratio less than 1 suggests that the item favors the reference group (Zwick & Ercikan, 1988).

Table 2.4 DIF M-H Chi-squared Test output (N=5100)

Item	X^2	p-value	Common Odds Ratio	95% CI	
3. Change your child's diapers or help your child use the toilet?	9.91	0.002	2.12	1.33	3.38
6. Help your child to bed	6.76	0.009	0.57	0.38	0.85
12. Help your child brush his or her teeth?	9.67	0.002	1.71	1.23	2.36
13. Take him or her with you to a religious service or religious event?	12.94	0.0003	0.64	0.50	0.81
14. Read books to your child	9.58	0.002	0.63	0.47	0.83
16. Sing songs with your child	4.00	0.05	0.76	0.59	0.98

Discussion

In this study, we aimed to determine and identify the extent of item bias on the father involvement scale featured on the 24-month ECLS-B resident and nonresident self-administered questionnaire. We found that 8 of the 17 scale items did not show signs of item bias statistically, however, the remaining 9 items were biased. Eight were consistently biased against nonresidential fathers (i.e. uniform DIF), but one item showed signs of biased but not consistently between nonresidential and residential fathers. Our findings suggests that the items that showed signs of uniform DIF should not be used to assess nonresidential father involvement.

As hypothesized, the biased items (e.g. preparing meals, changing diapers, giving baths, brushing teeth) mostly reflected caregiving activities fathers would more frequently do at night or in the morning when their child wakes up. Without considering the time nonresidential fathers have to spend with their children, the use of these items to assess nonresidential father involvement could lead to a misrepresentation of their level of father involvement. There were several additional items (e.g., reading books to your child and taking your child to religious services and events) that we did not expect to show signs of biased against nonresidential fathers

that should be further examined in future studies. The one item (i.e. playing chasing games with your child) we found to have non-uniform DIF showed a higher probability that nonresidential fathers would endorse this item at higher levels of involvement compared to residential fathers. This finding is consistent with past research studies that have shown nonresidential fathers tend to spend their allotted time with their children engaging in play-based behaviors (Creighton, Brussoni, Oliffe, & Olsen, 2014; Stewart, 1999). Overall, these results provide new insights on how the ECLS-B father involvement items perform among nonresidential fathers and residential fathers.

This study has several strengths. First, our study benefits from using a large cohort of nonresidential and residential fathers. Despite only having 500 nonresidential fathers in the sample, findings from stimulation studies recommend a minimum of 200 participants per group to achieve adequate power (Scott et al., 2009). Secondly, we used fathers' self-report of their own involvement. Although some researchers have questioned the validity of fathers' self-report of their own parenting behavior (Bronte-Tinkew et al., 2004; Cabrera, Tamis-Lemonda, Lamb, & Boller, 1999; Hernandez & Coley, 2007; McBride & Mills, 1993; Mikelson, 2008), we consider father self-report to be a strength, especially since the overreliance on maternal proxies has led to gaps in knowledge about fathers' direct and indirect contributions to parenting (Bronte-Tinkew et al., 2004). A third strength is that we performed both logistic regression and M-H procedures to assess the extent of the item bias in the father involvement scale, which allowed us to leverage the strengths and limitations of each method to produce more robust findings than we would have if we used only one of the analytic methods (e.g. French & Miller, 1996; Maller & Pei, 2017; Rogers & Swaminathan, 1993).

Limitations of this study is mainly due to the potential for selection bias. Since nonresidential fathers were only eligible to participate if they maintained contact with the child's mother or their child and if the child's mother consented to their participation. These two criteria may have introduced bias in the sample of nonresidential fathers by disqualifying otherwise eligible fathers if the mother did not provide consent or by only enrolling nonresidential fathers who are more involved with their children than the average nonresidential father. The latter would negatively bias our results if the nonresidential fathers in our sample performed more similarly to residential fathers in our study (Bronte-Tinkew, Scott, Horowitz, & Lilja, 2009). We attempted to address this form of bias by dichotomizing the response categories in the sensitivity analysis. However, if nonresidential fathers systematically had a higher level of father involvement in each activity, then the probability of item bias among nonresidential and residential fathers may be larger than we estimated. Lastly, we acknowledge that the application of DIF models assumes unidimensionality in the scale, while findings from previous studies have determined the 9-month ECLS-B father involvement scale to be multidimensional (Bronte-Tinkew et al., 2006, 2007). We attempted to minimize the potential for false DIF detection because of the dimensionality assumptions of DIF analyses by performing a bifactor CFA for the 24-month father involvement scale to ensure that there was only one latent construct. The results demonstrated good model fit (RMSEA= -.054, CFI= 0.96, TLI=0.96), so we felt more confident in our results using both logistic regression and the Mantel-Haenszel methods.

Conclusion

Despite these limitations, this study makes an important contribution to the literature by providing empirical evidence for the psychometric properties of one of the most commonly used father involvement scales. We tested for measurement equivalence in the 24-month ECLS-B

nonresident and resident father involvement scales and found that there were a substantial number of items that showed signs of bias that favored residential fathers over nonresidential fathers. Identifying these bias items is the first step in developing robust father involvement scales that can be used among diverse subgroups of fathers. Measuring nonresidential father involvement is important to assessing the influence of fathers on child outcomes and the role fathers' residency status plays in determining children's health and developmental trajectories. Moreover, nonresidential father involvement has major implications for societal perceptions of fathers (e.g. deadbeat dad stereotypes), child support regulation and child custody arrangements. The continued use of biased father involvement items can further compound parenting disadvantages nonresidential fathers often face, while limiting our understanding of the range parenting behaviors among nonresidential fathers.

More research is needed to develop additional father involvement theories that are inclusive of residential and nonresidential fathers, as well as, other subgroups of fathers. Future modifications to the father involvement scale should factor in the amount of time nonresidential father have physical access to their children when asking nonresidential fathers about time spent in parenting activities. Also, father involvement items, in general, need to be updated to reflect the diverse ways in which fathers engage with their children whether or not they live in the same household, such as using technology (e.g. phones and computers) to connect and engage with children.

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Chapter 3: Intergenerational effects of father involvement on children's social development

Abstract

Introduction: Promoting healthy social and emotional development in children is critical to reducing the risks of behavioral problems and poor mental health outcomes in children. Children who exhibit positive social development have better self-regulation, are better able to develop and foster healthy relationships with others and are less likely to suffer from depression and anxiety. Although both mothers and fathers are critical to promoting children's healthy development, most of the literature focuses on mothers. The few studies conducted with fathers have shown that they have a distinct, positive influence on children's social development, however, little is known about the extent of the effects of fathers' parenting involvement on their son's parenting behaviors and whether there are implications for social development in children.

Objective: The purpose of this study was to develop and test a theoretically-based conceptual model of the intergenerational effects of father involvement on children's social development.

Methods: Social learning theory was used to develop a conceptual model of intergenerational father involvement and we analyzed these mediation models using structural equation modeling. The data for this study were derived from the parent interview, resident father self-administered questionnaire, and the early care and education provider questionnaire at the preschool wave of the Early Childhood Longitudinal Study-Birth Cohort Study.

Results: We found that residential fathers who perceived their own father as treating them positively during childhood had higher involvement in cognitively-stimulating activities with their children, which was also positively associated with higher teacher reports of externalizing

behaviors in 3rd generation children. We stratified our models by child sex and found no associations between father-son interactions and problem behaviors (i.e. externalizing and internalizing) among girls. Among boys, however, we found perceived positive father- son interactions to be associated with residential fathers having higher involvement in cognitively stimulating activities with their children, which was positively associated with higher teacher reports of internalizing problem behaviors. Only one model (i.e. 1st generation fathers influence on residential father involvement) of the five models tested adequately fit the data.

Conclusions: This study introduced a novel and nuanced model of the intergenerational effects of father involvement on child development that can be adapted and built upon in future studies. Findings from this study highlight the need for more robust theories and models of father involvement that are applicable to diverse subgroups of fathers (e.g. nonresidential and residential fathers) and can be used to explain paternal influences on children's development. Future studies should continue to explore the psychosocial pathways that influence father involvement with their children and the mechanisms by which positive father involvement can be "transmitted" to future generations.

Introduction

Promoting healthy social and emotional development in children is critical to reducing the risks of behavioral problems and poor mental health outcomes in children. Children who exhibit positive social development have better self-regulation, are able to develop and foster healthy relationships with others, and are less likely to suffer from depression and anxiety (Katz & Mcclellan, 1991). Moreover, positive social development is associated with school readiness, higher educational attainment, and lower rates of conduct problems during childhood and adolescence (Bierman et al., 2008; Thompson, 1990; Webster-Stratton, Reid, & Hammond, 2001). The importance of children's social development has been widely researched, so much so, that it is the second most commonly studied child outcome in the literature (McLanahan et al., 2013). However, the research on paternal influences on children's social development is limited.

Past studies have shown that parents play an important role in children's developmental outcomes and although both mothers and fathers have a critical role in promoting children's healthy development, fathers have a distinct influence on children's social development (Deur & Hetherington, 1971; Easterbrooks & Goldberg, 1984; Lamb, 1975, 2003; West, 2007). Positive father-child interactions has been linked to better intellectual and social skills in children and reduced risks of antisocial and risky behaviors (e.g. substance abuse and delinquency) (Allen & Daly, 2007; McLanahan et al., 2013; Stahlschmidt, Threlfall, Seay, Lewis, & Kohl, 2013). Previous studies have also noted fathers' engagement in play, caregiving, and cognitvely-stimulating activities has positive effects on children's language development,helps children foster skills in self-regulation and social competence, and promotes prosocial behaviors in adulthood (Allen & Daly, 2007; Cabrera, Hofferth, & Chae, 2011; McLanahan et al., 2013; Pattnaik, 2013). However, father involvement can also have a negative influence on children's

social development. For example, fathers are more likely to engage in play activities with their children, but fathers' typical form of "rough-and-tumble" play has been shown to promote aggressive behaviors in children, especially in boys (Coltrane et al., 2016; Panter-Brick et al., 2014; Paquette, Carbonneau, Dubeau, Bigras, & Tremblay, 2003). Fathers are also more likely to encourage children to engage in risk-taking behaviors which can set children on a pattern of engaging in risky behaviors during adolescents and adulthood (Allen & Daly, 2007; Bureau et al., 2016; Carolina, Cox, Owen, Henderson, & Margand, 1992; Grienenberger, Kelly, & Slade, 2005; Newland et al., 2013). Several studies have pointed out that children, especially boys, are more likely to model their fathers' poor behaviors and experience similar consequences (e.g. teenage pregnancy, incarceration, father absenteeism) (Belsky, Conger, & Capaldi, 2009; McLanahan et al., 2013; Sipsma, Biello, Cole-Lewis, & Kershaw, 2010). This modelling hypothesis has been documented in the literature and posits that children, especially boys, mimic the behaviors of their father or father-figure which can create an intergenerational cycle of maladaptive behaviors (Furstenberg & Weiss, 2000; Wilkinson, Khurana, & Magora, 2013).

Efforts to "break the cycle" of intergenerational problem behaviors, in part, centers on the early identification and prevention of problem behaviors during childhood. These problem behaviors (e.g. externalizing and internalizing behaviors) tend to be early markers of risky behaviors such as early sexual initiation, criminal behaviors and psychological distress (e.g. depression and anxiety in adolescence and adulthood (Merrell, 2013; Nokali, Bachman, & Votruba-drzal, 2011). Focusing on paternal influences on children's problem behaviors may be an important step in preventing maladaptive and behaviors and their downstream consequences, particualrly as it relates to parenting. Children who have nonresidential fathers, especially those

with absent fathers, are more likely to initiate in early sexual activity and are more likely to become a teenage parent (Allen & Daly, 2007). Boys who grow up with an absent father are more likely to become absent father to their children (McLanahan et al., 2013). Understanding the pattern of father-child behaviors across generations may be a key step in breaking the cycle of intergenerational problem behaviors. Previous studies have proposed models of integenerational effects of fathering to better understand how fathers' parenting behaviors influence future generations. These studies have adapted theories such as the ecological systems theory (Cabrera, Fitzgerald, Bradley, & Roggman, 2014; Doherty et al., 1998; Sipsma et al., 2010) developed by Brofenbrenner (1977) (Bronfenbrenner, 1977) and social learning theory (Furstenberg & Weiss, 2000; Guzzo, 2011; Jessee & Adamsons, 2018; Masciadrelli, Pleck, & Stueve, 2006) developed by Bandura (1971) to explain the pathways by which children are influenced by their father. These multilevel theories provide insight on the individual behaviors and societal-level factors that influence the ways in which fathers interact with their child(ren), and in turn, influences child(ren)'s development and behavior.

Guided by the social learning theory and models proposed in previous studies (Furstenberg & Weiss, 2000; Guzzo, 2011; Jessee & Adamsons, 2018; Masciadrelli et al., 2006), we developed and tested a theoretically-based conceptual model of the intergenerational effects of father involvement on children's social development. We expanded on the previous conceptual models by including multiple domains of father-child interactions (e.g. residential fathers' perceptions of his own father) and multiple domains of residential father involvement (e.g. cognitively-stimulating activities, caregiving). We also expound on previous findings by examining the differential effects of our proposed models on male and female children. There is

a growing body of research that suggests that fathers' influence on girls may be different from their influence on boys (Merrell, 2013); and so, we also tested for effect modifcation by child sex.

Conceptual Model

In Figure 3.1, we present the conceptual model for the intergenerational effects of father involvement on children's social development. We operationalized social development based on the presence (or absence of) problem behaviors, specifically externalizing and internalizing problem behaviors in children (Merrell, 2013). Externalizing behaviors in children is characterized by outward expressions of aggression, hyperactivity and disruptive behaviors and has been linked to attention deficit/hyperactive disorder and other disorded conduct problems (Merrell, 2013). In contrast, internalizing problem behaviors are behaviors that are directed inward such as depression, anxiety and social withdrawal (Merrell, 2013). Internalizing behaviors is associated with the increased risks of mood disorders and anxiety disorders in adulthood (Merrell, 2013).

Based on findings from previous studies, we expect that positive 1st generation father interactions with 2nd generation residential father to be associated with higher levels of residential father involvement. Subsequently, we expect that higher levels of residential father involvement to be associated with better social development in 3rd generation children, evidenced by less internalizing and externalizing behaviors. Because fathers tend to interact with their sons differently than their daughters (Schoppe-Sullivan, Kotila, Jia, Lang, & Bower, 2013), we expect that the effects will be stronger for boys than girls. We also expect that 2nd generation fathers will more closely mimic parenting ibehavior pattern of their father if they perceive their

fathers to be a role model for their parenting (Brown, Kogan, & Kim, 2017; Furstenberg & Weiss, 2000; Mammen, 2011). While we do anticipate that girls will also benefit from father involvement, it will likely be to a lesser extent than boys.

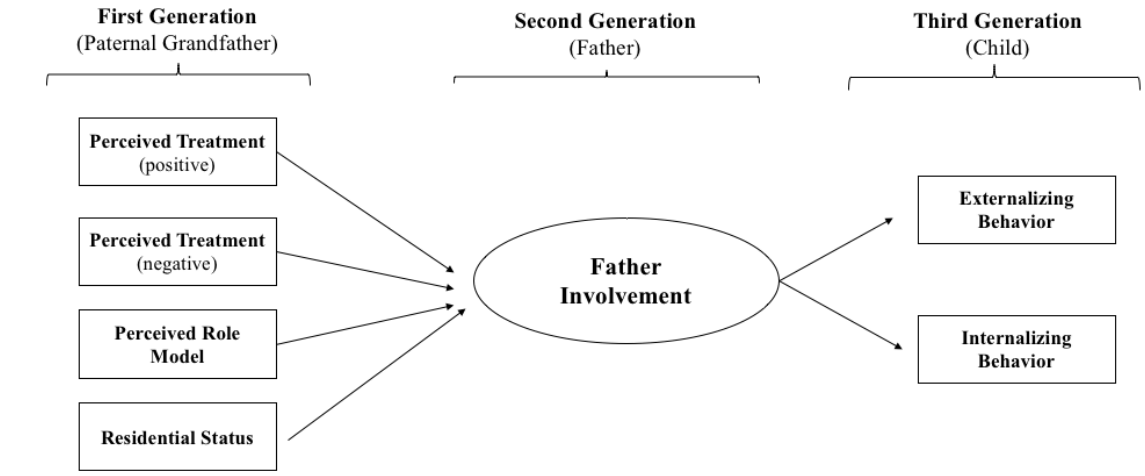

Figure 3.1 Conceptual model of the intergenerational effects of father involvement on children's social development

Methods

Data

The Early Childhood Longitudinal Study- Birth Cohort (ECLS-B) is a nationally representative probability sample of 10,700 children born in 2001 (National Center for Education Statistics, 2005). The ECLS-B followed a cohort of children from when they were approximately 9-months old until they entered kindergarten. The purpose of the ECLS-B was to prospectively study children's development and school readiness. The data are oversampled for American Indian and Alaska Native children, Asian and Pacific Islander children, twins, and low- and very low-birth weight children. Primary caregivers (mainly mothers), fathers, child care and education providers and teachers completed a series of questionnaires, interviews and observation on

behalf of study children. Data from primary caregivers were obtained at the 9-month, 24-month, preschool (48-months), and kindergarten study waves. Resident fathers completed a self-administered questionnaire (SAQ) at the preschool wave. Nonresident fathers were only asked to complete questionnaires at the baseline and at 24-months. Teachers and child care and education providers completed questionnaires for each child in the study at the preschool and kindergarten waves. This study sample is restricted to biological residential fathers and their children. Only children with complete teacher/child care questionnaires at the preschool wave were included in the study. The study sample consists of roughly 1,250 father-child dyads. All sample sizes are rounded to the nearest 50 or 100 to comply with NCES confidentiality guidelines (National Center for Education Statistics, 2005).

Measures

Dependent variable. The outcomes of interest for this study were children's externalizing and internalizing problem behaviors in preschool. The social development scale was derived from several instruments (e.g. Preschool Behavior Scales- second edition, Social Skills Rating System, Family and Child Experiences Study) (Augustine & Kimbro, 2017; Roisman & Fraley, 2012). The social development scale from the ECLS-B early care and education provider questionnaire consists of a 22-item list of problem behaviors. Teachers and child care providers reported on the frequency in which study children exhibited the specified problem behavior. Similar to a previous study using this scale, we created externalizing and internalizing subscales (Augustine & Kimbro, 2017). The externalizing behavior subscale consisted of 5-items (e.g. child has temper tantrums, is physically aggressive, etc.) and the internalizing behavior subscale consisted of 3-items (i.e., child seems unhappy, acts shy, and worries about things) (Elder, 2010). Higher

scores on each item indicate higher teacher reports in the frequency of the specified problem behavior item.

Mediating Variables. The mediating variable in the analysis was residential father involvement in 2nd generation fathers. We used three subscales of the father involvement based on the 11-item father involvement scale featured on the preschool resident father questionnaire. We performed a factor analysis of the 11-item scale to confirm the three-factor structure (results not shown). The subscales were 1) cognitive stimulating activities (i.e. read books, tell stories and sing songs to your child); 2) direct care (i.e. prepare meals, help child bathe him/herself, dress, and brush his/her teeth); and 3) play activities (i.e. play together with toys for building). The item "take him or her with you to a religious service or religious event" did not load on any of the scales and was consequently dropped from the model. Model fit for the 10-item scale was excellent based on having RMSEA= .03; CFI=.95; TLI=.93 (Hu & Bentler, 1999; Kline, 2011).

***Exogenous Variables*.** The father-son interactions between 1st generation fathers (paternal grandfather) and 2nd generation fathers (child's father) were modeled using five observed variables:

Fathers' Residency Status. Residential fathers were asked two questions: (1) whether they lived with their biological father at any time until age 16 and (2) did you live with your biological father from the time you were born until age 16. Second generation fathers who reported living with their biological father for the first 16 years were coded as having a residential father. The remaining 1st generation fathers were coded as nonresidential. Since very few 2nd generation fathers reported never living with their biological fathers, fathers who said

they did not live with their biological father at any time during their first sixteen years were coded as having a nonresidential father instead of creating a third variable for absent father.

Father-son Interactions. Residential fathers' perception of their father/father-figure was measured using 6-item Likert scale. This scale assessed how 2nd generation fathers felt their father/father figure (1st generation) treated them during childhood. We conducted an a priori factor analysis to determine whether the scale was multidimensional. Our results indicated that the scale could be divided into two subscales: 1) perceived positive father-son interactions and 2) perceived negative father-son interactions. Three items were found to be associated with perceived positive father-son interactions (e.g. father treated me with kindness) and three items were associated with perceived negative father-son interactions (e.g. father punished me severely). Items were reverse coded so that higher values indicated stronger agreement with the statement.

Role Modeling. Residential fathers rated whether they used the way their father/father figure raised them as a model for raising their own children. The scale used a four-point Likert response scale in which (1) indicated not at all and (4)) indicated very much. Fathers' responses were dichotomized as "not used as a role model", if the response was not at all or not very much. If residential fathers responded that they somewhat or very much used their father/father figure as a role model, the response was recoded as "used as a role model". We included an interaction term for perceived role model and 1st generation fathers' residency status (i.e. nonresidential and residential father) to assess the presence of an interaction effect in role modeling and 2nd generation father involvement based on whether their father (1st generation) was residential or nonresidential.

Statistical Analysis

Descriptive analyses and data preparation were performed in STATA version 15 (StataCorp, 2017a). We used structural equation modeling (SEM) to test the mediated pathways between 1st generation father-son interactions and social development in children. SEM is a robust statistical technique that allows for structural and measurement models to be estimated simultaneously in a single model (Kline, 2011). The model building process was performed in accordance with Kline's (2011) recommendations (Kline, 2011). We conducted exploratory factor analyses for each measurement scale introduced in the model, in spite of, their use as observed variables in the model. We checked the reliability for each scale using Cronbach's alpha. We estimated the three-generation mediation model in stages. In the first stage, we estimated the effect of 1st generation father-son interactions on each subscale of father involvement. In the second stage of the analysis, we estimated effects of 2nd generation father involvement on externalizing and internalizing problem behaviors. In the third stage, we tested the full mediation model. Then, in the last stage, we conducted a multiple-group analysis to test for differences in the mediated pathways based on child sex (3rd generation).

The SEM models were estimated in MPlus version 7.31 (Muthén & Muthén, 2014). There were several advantages to using MPlus for our analyses. First, MPLUS uses Full Information Maximum Likelihood (FIML) to estimate missing data, which means we were able to use all available data regardless if other variables for that observation were missing. Simulation studies found FIML estimations to be "unbiased and more efficient" compared to other missing data methods such as list-wise and pairwise deletion (Allison, 2001, 2008). Using FIML allowed us to retain more observations which helped achieve an appropriate sample size.

Our analyses was adequately powered based on the recommended 5:1 participant to parameter ratios (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Additionally, models were satisfactorily identified with each measurement variable having at least two items. Model fit was assessed based on three of the five commonly used goodness-of-fit indices. Acceptable model fit was based on having a Root Means Squared Error of Approximation (RMSEA) less than 0.05 and Bentler Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) greater than 0.90 (Hu & Bentler, 1999).

Results

Descriptive Analysis

The final analytic sample consisted of approximately 3,400 residential father-child dyads. Most fathers were White (64.4%) and lived with their biological father until the age of 16 (72.1%). Third generation children were between the ages of 3 and 5-years old (M= 52.6 months; SD= 4.1). Slightly more than half (51.9%) of the sample children were boys. Results from the correlation analysis indicated no issues with multicollinearity between items on the father involvement subscales and the social development scales. The correlation matrix of the ECLS-B preschool resident father involvement scale and social development scale is presented in Table 3.1 in the Appendix.

Structural Equation Models

Figure 3.2, in the Appendix, displays the analytic model of the effect of 1st generation father-son interactions on three domains of residential father involvement (i.e. caregiving, play-based and cognitively-stimulating activities). The results indicated that 2nd generation fathers who perceived their father/father figure (child's paternal grandfather) as treating them positively

engaged in more cognitively stimulating activities (e.g. reading books, singing songs, and telling stories) with their child (3rd generation) (β=.05; p<0.05). Second generation fathers who reported using their father/father figure as a role model also engaged in more cognitively stimulating activities with their children (β=.33; p<0.05). The interaction effect between 1st generation fathers' residency status and perceived role modeling was also significant. This result shows that residential fathers who did not live with their biological father and also reported using their father as a parenting role model were significantly less likely to engage in cognitively stimulating activities with their children (3rd generation) (β= -.50; p<0.05). The remaining pathways in the model were not statistically significant, however, the overall model fit was acceptable (RMSEA=0.04; CFI= .95; TLI =. 94).

In the second model, we examined the pathway between specific 2nd generation father involvement activity types and teacher reports of children's externalizing and internalizing behaviors. Figure 3.3, located in the Appendix, presents the analytic model for the effects of three domains of residential father involvement (i.e. cognitively stimulating activities, play-based activities, and caregiving) on externalizing and internalizing problem behaviors in children. The results showed a significant relationship between 2nd generation father involvement in cognitively stimulating activities (β=.70; p<0.05) and direct care activities (e.g., preparing meals and helping dress their child) (β=.81; p<0.05) with higher reports of externalizing behavior in children. The remaining pathways were nonsignificant. The fit for this model was poor (RMSEA=0.08; CFI= .88; TLI =. 84), indicating that there could be a better fitting model that was not tested.

Figure 3.4 presents the intergenerational model of father involvement on social development in children (3rd generation). In this model, we tested the mediated effects of father involvement in specific caregiving behaviors and 2nd generation fathers' perceived relationship with his own father (paternal grandfather) on externalizing and internalizing problem behaviors in 3rd generation children. We found evidence for a statistically significant mediated pathway between 2nd generation fathers' perceptions that their fathers/father figure (paternal grandfather) treated them positively (e.g. treated them kindly) and higher frequencies of residential father involvement in cognitively stimulating activities (β=.03; $p<0.05$), which, was also significantly associated with higher teacher reports of externalizing problem behaviors in 3rd generation children. Our results also showed that 2nd generation residential father involvement in direct care activities was also positively associated with higher teacher reports of externalizing problem behaviors (β=.61; $p<0.05$). The fit for this model was poor (RMSEA=0.08; CFI= .80; TLI =. 73).

Model Fit Indices: (RMSEA= 0.08; CFI= .80; TLI =. 73)

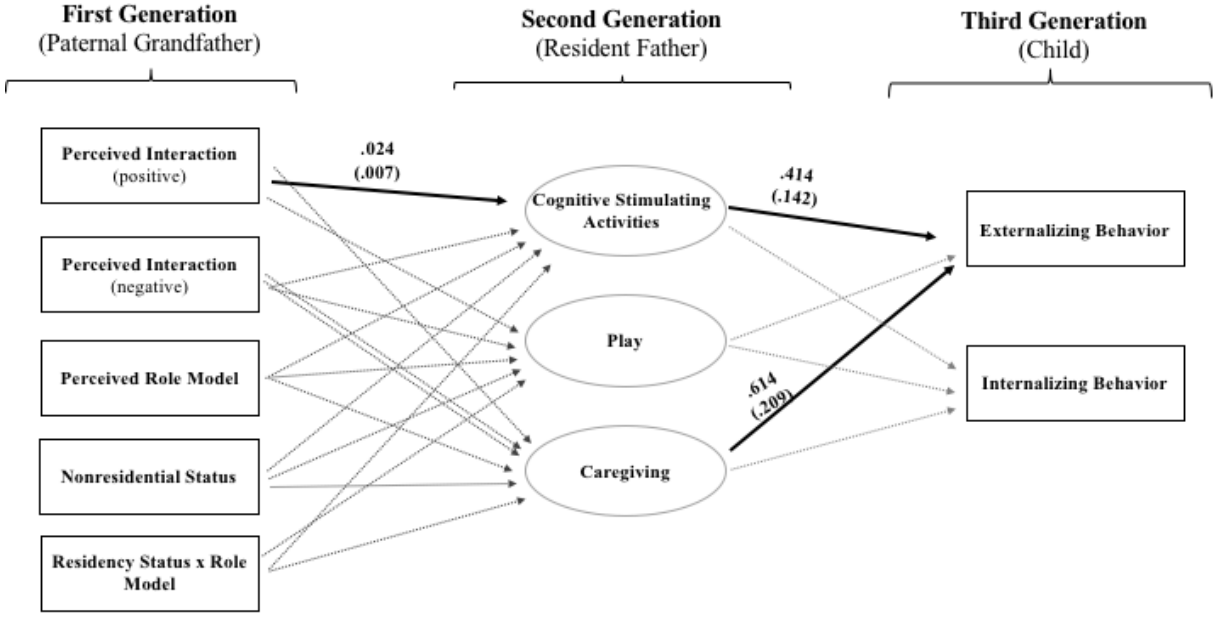

Figure 3.4 Intergenerational model of father involvement on social development in children

Figure 3.5 present the intergenerational model of father involvement and its effect on social development in boys (3rd generation). In our stratified model for boys, we found a significant, positive mediated pathway between 2nd generation fathers' perceptions of positive interactions with his father/father figure during childhood and higher levels of resident father involvement in cognitively stimulation activities (β=.05; p<0.05). We also found this relationship to have a significant, positive association with higher teacher reports of internalizing behaviors (β=.26; p<0.05). Additionally, we observed that residential father involvement in play-based activities (e.g. playing with toys) was associated with higher teacher reports of externalizing behavioral problems in boys (β=.74; p<0.05). The model fit for the stratified model for boys was poor (RMSEA=0.08; CFI=.79; TLI=.72). We did not find a significant mediation effect in the model stratified for girls (3rd generation).

Model Fit Indices: RMSEA= 0.08; CFI= .79; TLI =. 72)

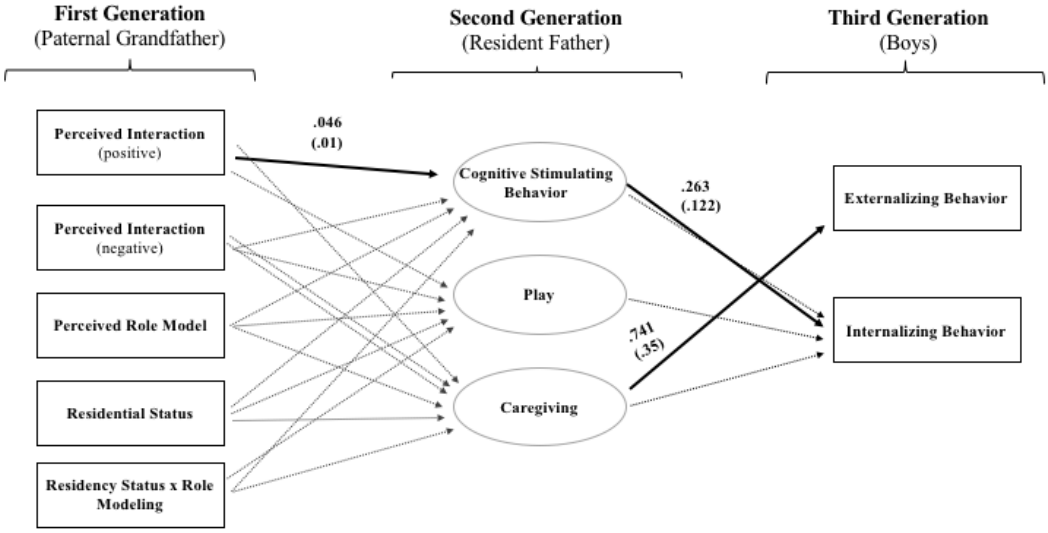

Figure 3.5 Intergenerational model of father involvement and its effect on social development in boys (3rd generation)

Discussion

In this study, we developed and tested an intergenerational model of father involvement across three generations of fathers and their children. We sought to identify whether the effects of father- son interactions and perceived behaviors can be influence parenting and social development in future generations. We performed a strictly confirmatory structural equation modeling (Jöreskog, 1993) and found that four of the five estimated SEM models should be rejected based on having poor model fit. We found evidence for the modeling hypothesis which suggests boys mimic the behaviors of their father or father-figure (Guzzo, 2011; Masciadrelli et al., 2006; Thorn & Gilbert, 1998). Our results partially supported our initial hypothesis that residential father involvement is, in part, determined by fathers' childhood experiences with their own father. The model for the direct effects of 2nd generation fathers' perceived positive interactions with their own father was associated with higher levels of 2nd generation father involvement in cognitively stimulating activities with their children (3rd generation). Our results showed that residential fathers who used their nonresidential father as a parenting role model engaged in more play-based activities and fewer cognitively-stimulating activities with their children.

The findings from our subsequent models were unexpected. We expected our main mediation model to be well-fit for our data and to confirm our study hypothesis, which was that positive father-son interactions would lead to significantly higher levels of residential father involvement across all father involvement domains and 3rd generation children would have better social development, evidenced by fewer problem behaviors. Instead, we found that higher levels of father involvement in cognitively-stimulating activities, such as reading, singing and telling stories to their children was associated with higher reports of externalizing behavior in children.

We also found that more frequent involvement in cognitively-stimulating activities was associated with higher reports of internalizing behaviors in boys. We did not find any significant effects for girls. These results only partially support previous research findings on the effects of father involvement on boys' externalizing behaviors since we did find a positive association between father involvement in play-based activities and externalizing behaviors in boys.

We argue that these differences may be attributable to psychosocial factors related the 1st generation father-son interactions. Residential fathers may be more likely to engage in cognitive behaviors such as reading and telling stories if their father engaged in those behaviors with them (i.e. the modeling hypothesis), these cognitive interactions may directly impact children's cognitive and language development while having an indirect impact on their social development. Also, our model does not account for reciprocal interactions (i.e. reverse causation) between children and their fathers. Jia et al (2012) found that father involvement tends to be transactional, so fathers tend to engage with their children based on their child's temperament and preferences rather than fathers solely determining their own involvement behaviors (Jia, Kotila, & Schoppe-Sullivan, 2012). As a result, boys who internalize their behaviors may want their father to engage in more cognitive-based activities such as reading rather than play-based activities. Whereas, boys who externalize their behaviors may prefer to engage in more play-based activities with their fathers. Cabrera et al (2011) and Bronte et al (2011) noted a similar relationship between father involvement in cognitively-stimulating activities and child behavior and proposed the observed association may be due to a ceiling effect in the measure (Bronte-Tinkew et al., 2006; Cabrera, Fagan, Wight, & Schadler, 2011). Future studies may want to explore this association in other samples of fathers and children.

This study has several strengths that make our findings compelling. First, our data was taken from the ECLS-B, which contains a large sample of children and fathers. We used fathers' self-report of their own involvement in parenting activities rather than maternal proxies of fathers' parenting behaviors. The data from residential fathers was rich enough that we were able to develop a model of three generations of father-child relationships, as well as, analyze the effects separately for male and female children. We minimized the potential for bias from parental reports of their children's behavior by using teachers reports of study children's externalizing and internalizing behaviors. Studies have shown that teachers are able to provide a less biased account of child behavior and their contributions tend to be more nuances since they are assessing children's behavior in contrast to their same-aged peers (Johnson & Hannon, 2014; Newfield, 1980; Shernoff, Hill, Danis, Leventhal, & Wakschlag, 2014). The methodological strengths of this study include our use of structural equation modeling to simultaneously estimate the mediated effects of intergenerational effects of father-child interactions. SEM analysis in MPlus employs the Delta method for mediation (Jöreskog, 1993; Kline, 2011; Zhao, Lynch, & Chen, 2010), which approximates Sobel's test and is considered to be an improvement over Baron and Kenny's method (Cook, Campbell, & Shadish, 2002; Kline, 2011; Wretman, 2016; Zhao et al., 2010).

There were a few limitations that we were not able to address in our study. First, our sample was comprised of predominately White residential fathers, the majority of whom lived with their father or father-figure throughout their childhood; and so, our findings may not be applicable to racially diverse fathers or those who grew up with nonresidential fathers. There were not enough non-White father-child dyads in our sample to perform sub-analyses by race or

ethnicity. We were also limited by the data in the types of father-son relationships (e.g. father involvement among 1st generation fathers) we could model. Lastly, nonresidential fathers were not included in the preschool wave of the ECLS-B Study, so our findings are limited to residential fathers only.

Conclusion

Findings from this study make an important contribution to the fatherhood literature by providing empirical evidence for the intergenerational effects of father involvement and social development in children. Although many of the pathways in our proposed models were not significant, we did find statistical evidence for a link between father-son interactions and the social development of boys through father involvement in cognitively-stimulating activities. Findings from this study also highlights the need for more robust theories of father involvement that are applicable to diverse subgroups of fathers. Future studies should explore the psychosocial influences of father-child interactions to better understand the pathways and mechanisms by which fathers' parenting behaviors and their associated effects are passed down to subsequent generations. These findings may be key to "breaking the cycle" of maladaptive behaviors and improve mental health outcomes for future generation of children and adults. This study introduced a novel and nuanced model of the intergenerational effects of father involvement on parenting and child development that can be adapted and built upon in future studies.

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APPENDIX

Table 3.1 Correlation matrix for the ECLS-B 48-month residential father involvement scale and the social development scale

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Father involvement																	
1. Read books	-																
2. Tell stories	0.47*	-															
3. Sing songs	0.29*	0.41*	-														
4. Play with toys	-0.23*	-0.27*	-0.20*	-													
5. Prepare meals	-0.17*	-0.18*	-0.21*	0.32*	-												
6. Put child to sleep	-0.25*	-0.21*	-0.21*	0.28*	0.45*	-											
7. Bathe child	-0.24*	-0.19*	-0.18*	0.28*	0.44*	0.50*	-										
8. Play outside	-0.18*	-0.22*	-0.20*	0.38*	0.35*	0.32*	0.35*	-									
9. Help child dress	-0.21*	-0.18*	-0.21*	0.29*	0.49*	0.48*	0.54*	0.36*	-								
10. Help child brush teeth	-0.30*	-0.21*	-0.21*	0.30*	0.40*	0.48*	0.54*	0.30*	0.61*	-							
Social Development – Externalizing Behaviors																	
11. Child acts impulsively	0.02	-0.03	-0.02	0.02	0.005	0.002	-0.01	0.02	0.001	-0.03	-						
12. Child disrupts others	0.02	-0.02	-0.02	0.02	0.005	0.001	-0.02	0.02	-0.001	-0.03	0.97*	-					
13. Child throws temper tantrums	0.02	0.03	-0.001	0.02	0.01	0.001	-0.01	0.02	-0.003	-0.03	0.96*	0.97*	-				
14. Child acts aggressive to others	0.02	-0.03	-0.01	0.01	0.002	-0.004	-0.02	0.02	-0.004	-0.03*	0.97*	0.97*	0.98*	-			
15. Child annoys others	0.02	-0.03	-0.01	0.01	0.003	-0.001	-0.02	0.02	-0.003	-0.03	0.97*	0.98*	0.98*	0.98*	-		
Social Development- Internalizing Behaviors																	
16. Child seems unhappy	0.01	-0.03*	-0.01	0.02	0.01	0.01	-0.01	0.01	0.005	-0.02	0.95	0.96*	0.97*	0.97*	0.96*	-	
17. Child seems to worry a lot	0.02	-0.02	-0.02	0.01	0.01	0.01	-0.01	0.01	0.01	-0.02	0.94*	0.94*	0.96*	0.95*	0.95*	0.97*	-
18. Child acts shy	0.02	-0.02	-0.01	0.01	0.02	0.004	-0.01	0.01	0.006	-0.02	0.93*	0.93*	0.95*	0.95*	0.94*	0.96*	

* p<0.05, ** p<0.01, *** p<0.001 †

Model Fit: RMSEA= 0.04; CFI= .95; TLI =.94)

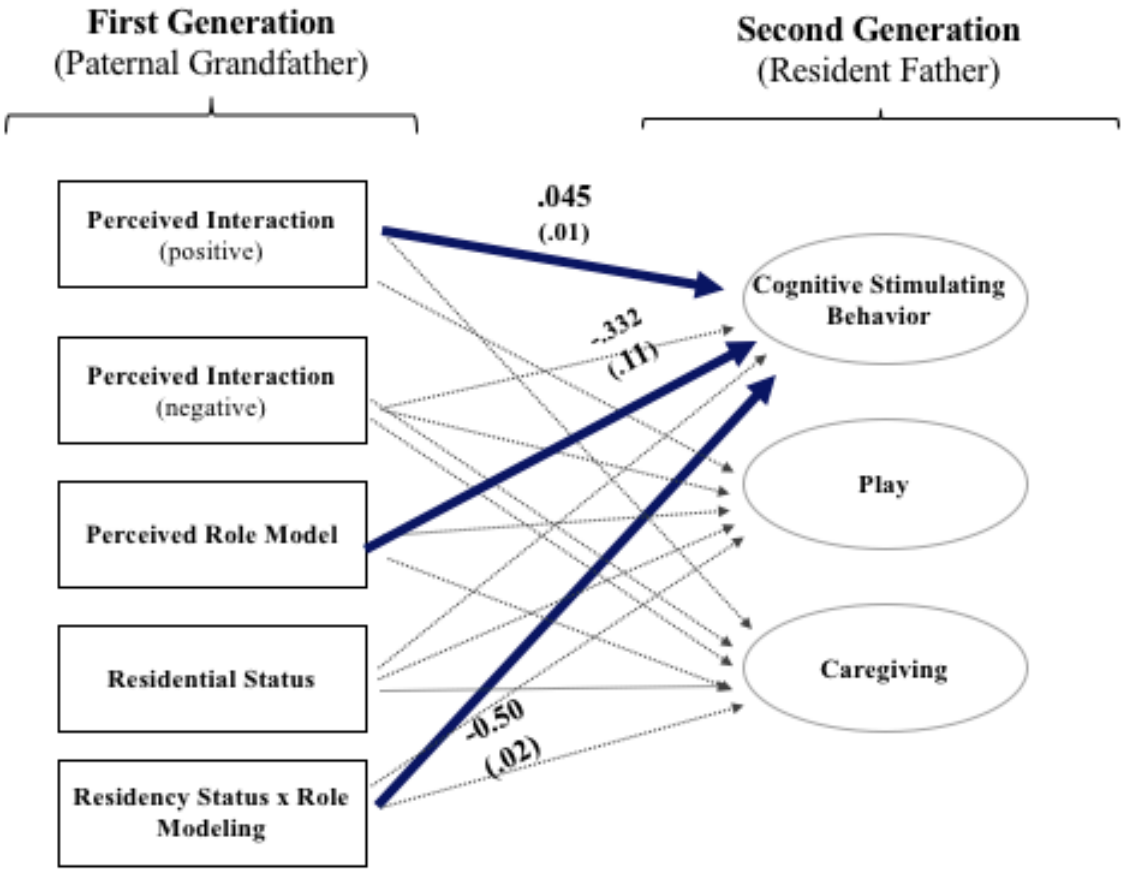

Figure 3.2 Analytic model for the effect of 1st generation father-son interactions on three domains of residential father involvement (i.e. caregiving, play-based and cognitively-stimulating activities)

Model Fit: RMSEA= 0.08; CFI= .88; TLI =.84)

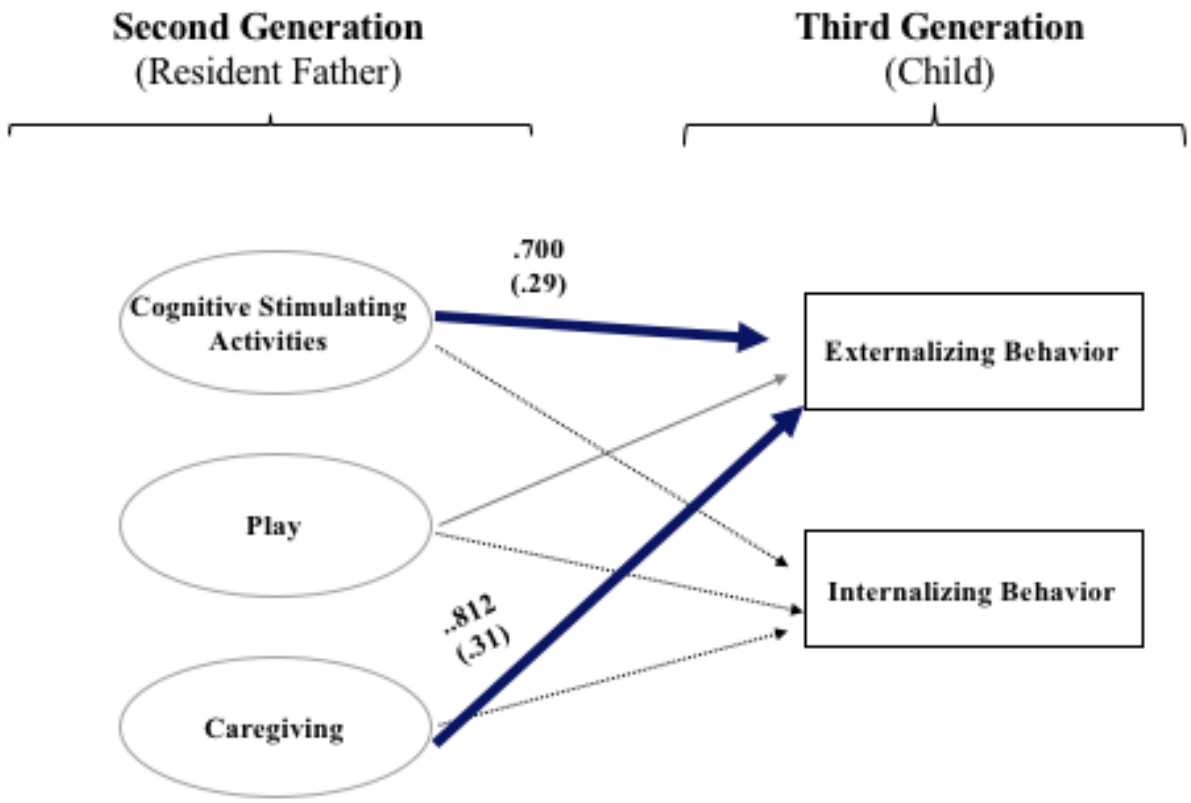

Figure 3.3 Model for the effects of three domains of residential father involvement (i.e. cognitively-stimulating activities, play-based activities, and caregiving) on externalizing and internalizing problem behaviors in children