

PREDICTORS OF SCHOOL FUNCTIONING AND PROBLEM BEHAVIORS IN SIBLINGS
OF CHILDREN WITH AUTISM

by
SARAH JONES

THESIS

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Supervising Committee:

Genevieve Graaf, Supervising Professor

Philip Baiden

Jandel Crutchfield

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ABSTRACT

When a child has a sibling with a disability, siblings must learn to adapt to additional challenges and demands and may often be overlooked by their parents, teachers, and service providers. While research has demonstrated that the social and emotional development of siblings of children with ASD is impacted in the context of their homes and families, the impact on siblings in the school setting has been minimally examined. Using the Sibling Embedded Systems Framework, this study assesses the relationship between micro and mesosystem factors in relation to school behavioral and academic outcomes for siblings of children with ASD using 1,500 families in the Simmons Simplex Collection. As part of a partnership with the Simmons Simplex Collection (SSC), de-identified data from the Simons Foundation Autism Research Initiative (SFARI) that contains demographic information (i.e., race, ethnicity, gender, health insurance, medical history), developmental and behavior information, and blood samples (DNA) from parents and their children is analyzed. Descriptive analysis and bivariate analysis assess the distribution of variables across the dataset and associations between family and child characteristics with response variables. Multivariable analysis assesses associations between child, family, and home environment characteristics and siblings' total school problems and academic performance. The results showed that siblings of children with ASD had poorer academic performance and total problems in school when also displaying problem behaviors at home such as oppositional defiance and rule breaking. Findings from this study point to several important issues for clinicians and researchers working with families of individuals with ASD to consider

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Introduction

In 2018, the United States estimated that 1 in 59 children had been identified having autism spectrum disorder (ASD), more than doubling the rates recorded from 2010 (Baio et al., 2018). As the number of children diagnosed with ASD continues to grow, so will the necessity to understand their families' experiences and needs. The current body of research addresses the challenges of parents and the child with ASD but has not yet to reach a consensus on whether siblings of children with ASD exhibit similar problems (Shivers, Jackson, & McGregor, 2019). Focusing research on a siblings of children with ASD is critical because 80% of Americans reporting having at least one sibling (Gregory, 2019). When a child has a sibling with a disability, siblings must learn to adapt to additional challenges and demands—helping to provide care and support for their sibling—and their unique needs are overlooked by their parents, teachers, and service providers (Griffiths & Sin, 2013). If these siblings' school and behavioral difficulties go unnoticed, maladaptive outcomes can persist into adolescence and adulthood causing poor peer and family relationships, impaired school and occupational functions, and significant behavioral problems (Chiang & Gau, 2016; Chien, Tu, & Gau, 2017). Understanding the varying needs of siblings of children on the autism spectrum will enable the development of family-centered support programming and interventions that can reduce the likelihood of negative outcomes (i.e., behavioral and emotional problems, poor academic performance, low self-esteem) for siblings of children with ASD (Kovshoff, Cebula, Tsai, & Hastings, 2017).

Siblings of children with ASD and outcomes

A review of the literature on siblings of children with ASD has revealed both positive and negative effects. However, siblings of children with ASD compared to other siblings of children with disabilities have been shown to do more poorly on a number of outcome measures such as

levels of internalizing and externalizing disorders, social and behavioral adjustment problems, hassles with sibling behavior, and distressing emotions (O'Neill & Murray, 2016; Shiver et al., 2018). Walton and Ingersoll (2015) compared sibling adjustment and relationship between siblings of children with ASD and siblings of children with typical development. Although there were no differences in adjustment difficulties compared to typically developed siblings, siblings of children with ASD displayed elevations in behavioral/ emotional difficulties, having issues relating to their sibling, and were more avoidant of their sibling (Walton & Ingersoll, 2015).

Hayden, Hastings, Totsika, and Langley (2019) used longitudinal data to explore the difference in emotional adjustment between siblings of children with and without intellectual disabilities in a population-based sample (Hayden et al., 2019). The researchers examined differences between 19,000 nearest-in-age siblings of children identified with intellectual disabilities or typically developed siblings and followed up with them at age five (Hayden et al., 2019). The researchers found that older siblings of children with an intellectual disability have 1.5-2 times more peer and conduct problems. Researchers conclude that siblings of children with intellectual disabilities are at higher risk of experiencing socio-economic hardships, high levels of psychological distress, and have significant behavioral and emotional problems (Hayden et al., 2019).

When assessing the emotional, social, and physical challenges associated with being a sibling of a child with ASD, Lovell and Wetherell (2016) examined the psychophysiological impact of having a sibling with ASD. Using a sample of 25 siblings of children with ASD and 20 siblings of typically developed children, siblings and their mothers completed questionnaires about depressive symptomology, social support, child behavior problems, and family characteristics (Lovell & Wetherell, 2016). Siblings of children with ASD were found to

experience greater emotional problems and depressive symptoms compared to the typically developed siblings. Social support from family members and close friends was a predictor of total depressive symptoms in the sibling as well as for the behavior problem in the child with ASD.

Family Factors. When examining the home environment, the relationship and experiences the sibling has at home can have a substantial impact on their outcomes. Siblings can also affect the larger family dynamic, whether it be taking on family roles, serving as a focus for social comparisons and receiving differential treatment from the parents, or as a source of family stress (McHale, Updegraff, & Feinberg, 2016). A study conducted in 2018 considered different familial factors that may relate to a sibling's functioning and found that only 6-23% of siblings were identified within the clinical range of psychological, behavioral, and social functioning (Tudor, Rankin & Lerner, 2018). Based on the results, maternal depression and sibling relationships were identified as strong predictors of a sibling's functioning, and interventions that addressed these factors could be most beneficial to the sibling.

School Outcome. While research has demonstrated that the social and emotional development of siblings of children with ASD is impactful in the context of their homes and families, the impact on siblings in the school setting has been limitedly reviewed. The dynamic between siblings and family factors within the home can trickle into other factors of life impacting a sibling's academic, emotional, social, and physical development (Chien, Tu, & Gau, 2017; Gregory, 2018). Having issues with a sibling with ASD at home may impact school performance and functioning for a number of reasons.

In 2018, Gregory explored school-related outcomes between typically developed siblings and siblings of children with ASD in secondary schools in the UK. Based on self-report, parent

report, and teacher report through online questionnaires, siblings of children with ASD had significantly lower reports of school belonging and academic self-concept, in addition to significantly higher internalizing and externalizing behaviors displayed within the home and school setting compared to typically developed siblings (Gregory, 2018).

Barnes (2019) surveyed teachers to understand their awareness of siblings' challenges and their perceptions of sibling's outcomes and experiences. Using 75 teachers, administrators, and school-related service providers, researchers employed a survey consisting of six sections including Stress and Coping, Behavior, Knowledge and Response, Support, Open-Ended Questions, and Demographics. Barnes found that educators had limited awareness of siblings' needs and indicated that these siblings are more "surviving": trying to cope with negative factors of living with a child with a disability, and handling things on their own (2019, p. 61).

By observing the relationship between family factors and academic functioning, Hassenfeldt (2016) hypothesized lower school functioning and lower grades in siblings of children with ASD when parental stress was high, and family functioning was low. The researchers measured family functioning using Parenting Daily Hassles Questionnaire (PDHQ), Family Adaptability and Cohesion Evaluation Scales [FACES-IV], Parenting Sense of Competence Scale [PSOC] and maternal stress from 20 parents, conducted interviews with an additional 19 families and had 25 teacher report on class functioning using the Academic Performance Rating Scale. Results suggest that families with children with more severe ASD reported higher frequencies of emotional outbursts in the child with ASD and missed social opportunities as a family. However, siblings were reported to be performing well in school (Hassenfeldt, 2016).

Chien, Tu, and Gau (2017) assessed the relationship between school functioning and school maladjustment in siblings of children with ASD by comparing siblings of children with ASD and typically developed siblings. One hundred ninety-eight participants were recruited, and their parents completed the Social Adjustment Inventory for Children and Adolescents, the Social Communication Questionnaire, and the Social Responsiveness Scale (Chien et al., 2017). Chien and colleagues found that siblings of children with ASD had lower school functioning, but unaffected siblings had worse attitudes toward schoolwork and more severe behavioral problems at school (2017).

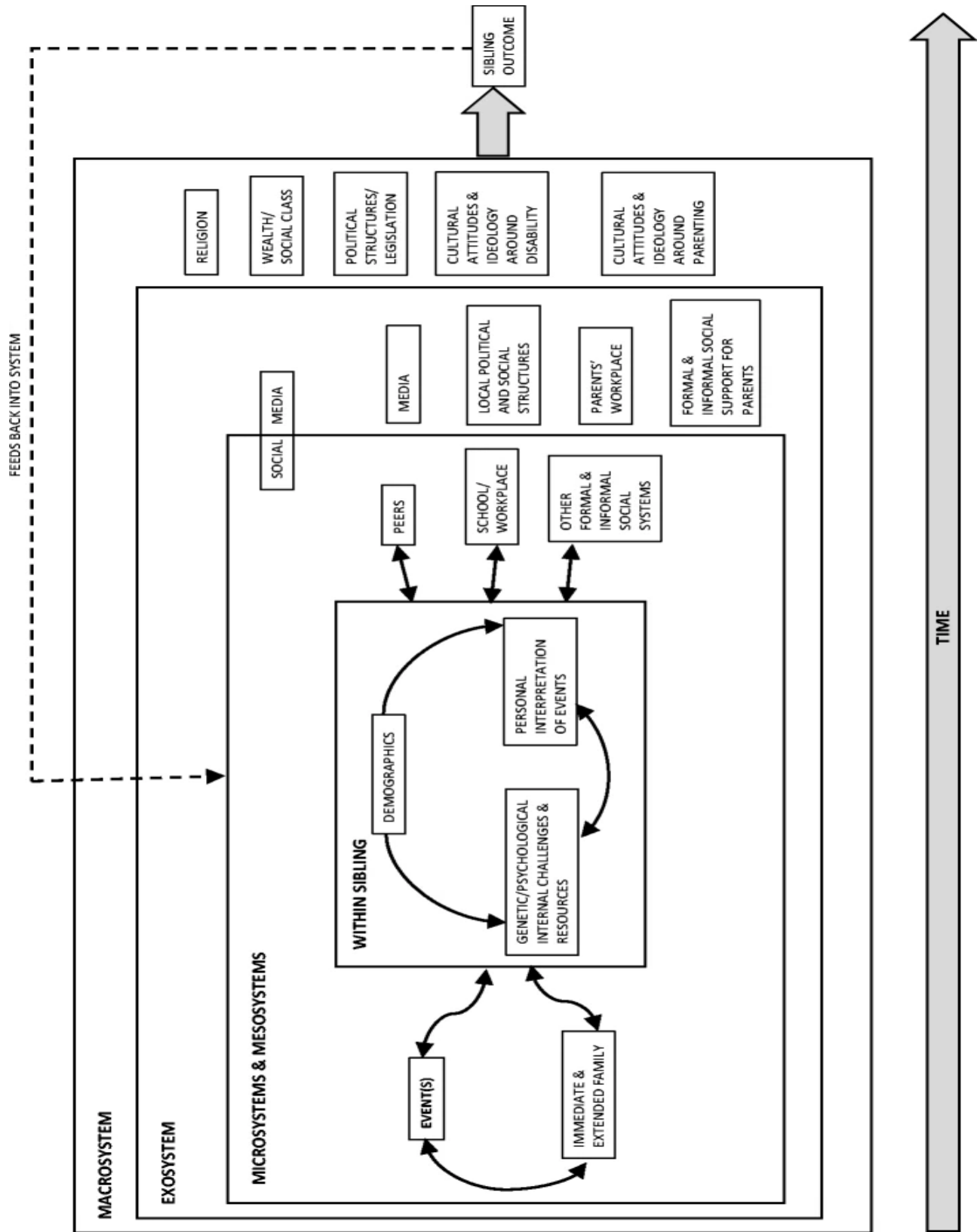
Some limitations found in these studies included smaller sample sizes, using self-reporting measures, and only assessing the sibling at one point in time. Future research could benefit from information about early family interactions and the potential impacts it has on sibling outcomes and sibling relationships across different developmental periods and later in life (Tomeny et al., 2017). Overall, existing research has found that some siblings of children with ASD do experience more problems compared to other comparison groups. Behavior problem and school maladjustment were both key variables that could be risk factors for siblings of children with ASD (Chien et al., 2017; Kovshoff, Cebula, Tsai, & Hastings, 2017). However, they have not been assessed to understand how they collectively impact the sibling in different settings.

Theoretical Framework

The factors examined in the literature can contribute to the outcomes and experiences of siblings of children with ASD and can be understood through the use of the Sibling Embedded Systems Framework. The Sibling Embedded Systems Framework (SESF; Kovshoff, Cebula, Tsai, & Hastings, 2017) identifies multiple and interactive factors present in a sibling's life. In addition to 'within sibling' factors (i.e. demographics; internal challenges; a sibling's

interpretation of events), siblings also face factors related to the micro and mesosystems (i.e., peers, school, workplace), exosystems (i.e., parent's workplace, political and social structures, media), and macrosystems (i.e., culture, religion, wealth/social class) (Gregory, 2018; Kovshoff et al., 2017). A sibling's outcome is influenced by several factors such as psychosocial adjustment, the quality of the sibling relationship, academic achievement, parental stress, or life satisfaction/quality of life (Kovshoff et al., 2017). Within the SESF, siblings' outcomes are predicted to feedback into the system and are not viewed as passive, but as actively shaping their environment. These interacting systems stress the importance of understanding outcomes outside the home and how they relate and interact with home life factors. At the microsystem level, the extent to which demographics, internal challenges, and personal interpretation of events has an influence on the outcomes of the sibling across their lifetime is limited in knowledge (Kovshoff et al., 2017). The interaction between the sibling's home and school environment is also neglected to be examined in research. Figure 1 shows a diagram of this framework.

Figure 1. Siblings Embedded Systems Framework



Current Study

The studies presented here have demonstrated that assessing school functioning in siblings of children with ASD is becoming more prevalent in the field, however, only a few of these samples have also reviewed the type of behavior the sibling exhibits at home in relation to school outcomes. Applying the SESF framework to understand the relationship between micro and mesosystem factors in relation to school behavioral and academic outcomes for siblings of children with ASD, this study assesses this relationship using 1,500 families in the Simmons Simplex Collection. The research question is as follows: Among children who have a sibling with ASD, what is the relationship between child and family socio-demographic factors, the unaffected sibling's problem behavior at home, families use of formal supports, and the unaffected sibling's school behavior and academic performance?

Methods

Data Source

As part of a partnership with the Simmons Simplex Collection (SSC), de-identified data from their Simons Foundation Autism Research Initiative (SFARI) Base, an information system for autism and autism-related research data and biospecimens, was analyzed. By the end of 2011, SSC collaborated with 12 university-affiliated research clinics to identify and assess potential families under the guidance from the University of Michigan Autism and Communication Disorders Center. Participants were admitted into the study as biological family groups including one child with autism called the "proband" by the SSC, the biological mother and father, and an unaffected designated sibling. Parents of children with ASD and designated siblings who were minor children or dependent adults were invited to complete surveys about their child(ren). The SFARI data contains demographic information (i.e., race, ethnicity, gender, health insurance,

medical history), developmental and behavior information, and blood samples (DNA) from parents and their children. Data is deidentified and not linked to individuals' private information. The current study has been identified as non-human subjects research by the University of Texas at Arlington's Institutional Review Board.

Study Sample

A subset of approximately 1,500 families participated in the SSC and were enrolled in an online, contactable platform called the SSC registry. Families were included in the study if they had one child with ASD to take part in the study and at least one biological sibling willing to participate. The biological sibling and proband were between 4 years and 17 years, 11 months of age when the data was collected. The biological sibling was excluded if the sibling was suspected or diagnosed with having autism, an intellectual disability, or a developmental or psychiatric disorder. Parents were excluded if they were diagnosed or suspected of having autism, an intellectual disability, or schizophrenia. Families were excluded if their child with ASD was younger than 36 months, had a known genetic disorder, and did not meet the requirements for minimum nonverbal IQ or nonverbal mental age.

Measures

Outcome Variables.

School Outcome. School factors are within the micro- and meso-systems and can influence the sibling's outcomes and experiences. Sibling school functioning will be an outcome variable and is measured using the Teach Report Form (TRF) to assess academic performance, academic competence, and education history (Achenback & Rescorla, 2001). During the first data collection in 2011, teachers completed the Teach Report Form regarding academic performance and adaptive functioning for the sibling of the child with ASD. The survey consisted of 113

items completed by a teacher who has known the child in the school setting for more than two months. Scales measure competencies such as academic competence, adaptive functioning, hyperactivity-impulsivity, social problems, thought problems, and anxiety or depression. The TRF assesses problem behavior and can identify eight syndromes. The survey consists of fill-in-the-blank questions and a 3-point Likert scale with 0= Not True, 1=Somewhat or Sometimes True, and 2=Very True or Often True. To measure the school outcomes of the siblings, we used the teacher's scores on the siblings' Academic Performance and their Total School Problems. The TRF has been found to have good test-retest reliability, with a t-score of .85, and good content validity ($p < .01$).

Covariates.

Problem Behavior at Home. In the SESF, internal challenges such as problem behaviors or avoidant coping strategies are difficult within-sibling factors that impact how a sibling responds to events (Kovshoff et al., 2017). Problem behavior displayed from the sibling at home is an outcome variable measured by the Child Behavior Checklist for ages 6 to 18. The Child Behavior Checklist (CBCL) is a widely used caregiver report form identifying problem behavior in children (Achenbach, c1999). The CBCL/6-18 provides ratings for 20 competence and 120 problem items covering open-ended items covering physical problems, concerns, and strengths. The self-administered questionnaire is scored on a 3-point Likert scale with 0=absent, 1=occurs sometimes, and 2=occurs often. Subscales measuring the sibling's oppositional defiance and rule breaking reported by the sibling's parents were used in the current analysis. Research has found strong reliability and validity data across multiple languages and cultural contexts.

Proband Level of Disability. The level of disability and need of the proband is within a sibling's micro- and meso- systems. The level of disability and need will be a covariate variable

measured by using the the Vineland Adaptive Behavior Scales-Second Edition. The Vineland Adaptive Behavior Scales-Second Edition (Vineland-II) assess adaptive behavior of individuals with intellectual and developmental disabilities, autism spectrum disorders, ADHD, post-traumatic brain injury, hearing impairment, and dementia/Alzheimer's disease. Researchers conducted semi-structured interviews with parents regarding the proband's behavior. The main domains included Communication, Daily Living Skills, Socialization, Motor Skills, and Maladaptive Behavior. Test-retest reliability has been found to have average correlations ranging between .76 and .92 across domains.

Proband Diagnosis. Following the SSC evaluation, the proband received a clinical 'best estimate diagnosis' of autistic disorder, Asperger's disorder or pervasive developmental disorder not otherwise specified (PDD-NOS), according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR). The best-estimate diagnosis was made by a psychologist or physician with appropriate credentials and experience requisite for making clinical psychiatric or psychological diagnoses. The diagnostician had direct observation of the proband in making the best estimate diagnosis.

Formal Family Supports. Within the exosystem of the framework, sibling outcomes are affected not only by micro- and meso- systems but also by factors such as formal and informal social supports (Kovshoff et al., 2017). Formal family support will be a covariate variable measured using information from the SSC Background History Form. Medical support services were measured during a telephone interview with the parents. Parents were asked questions on whether families used pediatricians, psychiatrists, psychologist, neurologists, or other doctors and answered with either yes or no (yes=1 and no=0). This measure was labeled as Medical Support Services. To measure therapy support services, researchers asked parents yes or no

questions in regard to whether they use occupational therapists, physical therapists, or speech therapists. This variable was labeled Therapy Support Services.

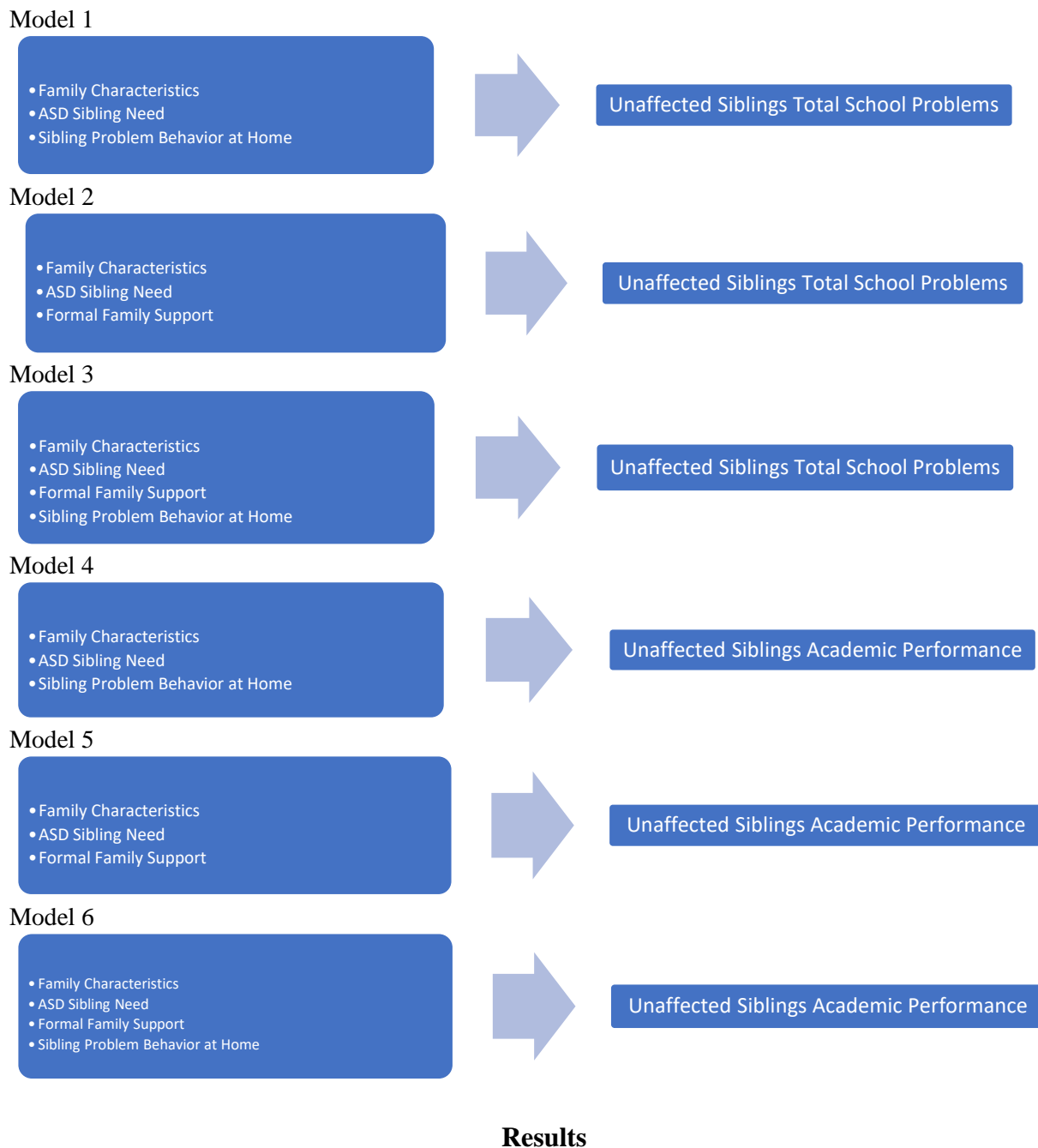
Demographics. Background history was collected from phone interviews with the parents from questions in the Parent Questionnaire Packet concerning contact information, family demographic information, and parent report of proband's developmental milestones. The sibling and probands sociodemographic information included their age in months, gender, who the child lives with, and race/ethnicity. Parent's sociodemographic information included age, gender, race/ethnicity, highest level of education, household annual income, and their marital status.

Data Analysis

Descriptive analysis and bivariate analysis were conducted to assess the distribution of variables across the dataset and associations between family and child characteristics with response variables (unaffected sibling's total school problems and academic performance). For multivariable regression, a model building approach was used, employing six multivariate linear regression models. The total sample size for the final regression models depended on the completeness of data for each observation. Observations were only included in the final models if it had data for all model variables. Three models assessed relationships between siblings' Academic Performance and associated factors such as family characteristics, sibling's problem behavior at home, the proband's level of need, and the type of formal supports utilized by the family. Three additional models assessed relationships between siblings' Total School Problems and associated factors such as family characteristics, sibling's problem behavior at home, the proband's level of need, and the type of formal supports utilized by the family. Models are

illustrated in Figure 2. All analyses will be performed using Stata 16. All statistical significance will be set at $p < 0.05$.

Figure 2. Modeling Building to Assess Child and Family Factors related to Behavioral and Academic Performance for siblings of children with ASD



Demographics of the Study Sample

Table 1 presents the descriptive analysis results for sociodemographic information for the proband and designated sibling. Table 2 presents descriptive analysis results on all the sociodemographic variables for the mother, father, and family. Of the 1500 families that participated in the SSC data collection, most mothers (82.4%), fathers (83.13%), designated unaffected sibling (79.37), and the proband (79.19) were white. Male was the predominant gender in the sibling with ASD (86.43), however siblings were relatively different with 52.21% being female. Siblings with ASD and the designated sibling predominantly lived with both the mother and father in the home (92.3%). The majority of proband's were under the age of 12 (76.41) and diagnosed with Autism Spectrum Disorder (69.2) compared to Asperger's Syndrome or Pervasive Developmental Disorder. Most families used medical support services for the proband (56.47%) and 45.28% of families used therapy support services for the proband.

Table 1. Child Characteristics

Demographics	Proband	Designated Sibling	Sibling Dyad
Age	M=108, SD=.81	-	-
Sex			
Female	13.57% (n= 374)	52.21% (n= 1,371)	-
Male	86.43% (n= 2,383)	47.79% (n= 1,255)	-
Race			
White	79.19% (n= 2,165)	79.37% (n= 2,243)	-
African American	4.06% (n= 111)	4.67% (n= 132)	-
Asian	4.06% (n= 111)	5.13% (n= 145)	-
Native American/ Hawaiian	0.29% (n= 8)	1.73% (n= 49)	-
More than One/Other	12.4% (n= 339)	9.09% (n= 257)	-
Who the Children Lives With?			
Both	-	-	92.3% (n= 2,614)
Father	-	-	0.35% (n= 10)
Father-Stepmother	-	-	0.04% (n= 1)
Group	-	-	0.14% (n= 4)
Mother	-	-	5.3% (n= 150)
Mother-Stepfather	-	-	1.45% (n= 41)
Other	-	-	0.39% (n= 11)
Relatives	-	-	0.04% (n= 1)
Diagnosis			
Autism Disorder	69.2% (n= 1,927)	-	-
Asperger's Syndrome	10.2% (n= 283)	-	-
Pervasive Developmental Disorder	20.8% (n= 580)	-	-

Table 2. Family Characteristics

Demographics	Mother	Father	Family
Race			
White	82.4% (n= 2,290)	83.13% (n= 2,316)	-
African American	4.53% (n= 126)	5.42% (n= 152)	-
Asian	5.25% (n= 146)	4.67% (n= 130)	-
Native American/ Native Hawaiian	1.44% (n= 40)	1.22% (n= 34)	-
More than One/ Other	6.37% (n= 177)	5.56% (n= 155)	-
Education History			
Associate	7.97% (n= 226)	6.66% (n= 187)	-
Baccalaureate	35.98% (n= 1,020)	31.34% (n= 880)	-
GED	1.13% (n= 32)	1.6% (n= 45)	-
Graduate	25.04% (n= 710)	28.24% (n= 793)	-
High School	7.27% (n= 206)	10.54% (n= 296)	-
Less Ninth	0.18% (n= 5)	0.32% (n= 9)	-
Some College	21.59% (n= 612)	19.23% (n= 540)	-
Some High School	0.81% (n= 23)	1.92% (n= 54)	-
Up Ninth	0.04% (n= 1)	0.14% (n= 4)	-
Household Annual Income			
Less than \$20,000	-	-	2.98% (n= 80)
\$21,000-35,000	-	-	5.26% (n= 141)
\$36,000-50,000	-	-	8.57% (n= 230)
\$51,000-65,000	-	-	10.81% (n= 290)
\$66,000-80,000	-	-	14.24% (n= 382)
\$81,000-100,000	-	-	17.22% (n= 462)
\$101,000-130,000	-	-	15.28% (n= 410)
\$131,000-160,000	-	-	9.21% (n= 247)
Over \$161,000	-	-	16.44% (n= 441)
Medical Support Services			
Yes	-	-	43.53% (n= 1,245)
No	-	-	56.47% (n= 1,615)
Therapy Support Services			
Yes	-	-	54.72% (n= 1,565)
No	-	-	45.28% (n= 1,295)

Bivariate Analysis of Variables Among the Family

In the bivariate analysis (Table 3), sex of sibling, oppositional defiance of sibling, and rule breaking of sibling were positively associated with more total problems at school for the sibling. In general, therapy support services and medical support were not associated with the designated sibling's total problems at school. Mother and father's characteristics were not significantly associated with the sibling's total problems at school. The gender, diagnosis, and adaptive functioning (Vineland- II) of the sibling of the proband was not associated with the sibling's total problems at school as well. Regarding academic performance, oppositional

defiance and rule breaking from a sibling were associated with worse academic performance.

When reviewing family factors, household annual income and the race of the father was negatively associated, while who the children live with was positively associated. When looking at variables of the proband, the age of the proband was the only variable associated with academic performance of the sibling. Medical support services and therapy support services were associated with better academic outcome.

Table 3. Bivariate Analysis of Study Variables in Model Analysis

Measures	Sibling Total School Problems				Sibling Academic Performance			
	β	P>t	95% CI		β	P>t	95% CI	
Race of Father	0.24	0.73	-1.12	1.59	-0.92	0.03	-1.76	-0.07
Race of Mother	0.58	0.40	-0.79	1.95	-0.49	0.36	-1.35	0.37
Race of Sibling	0.18	0.75	-0.96	1.33	-0.16	0.66	-0.87	0.56
Race of Proband	0.00	0.99	-1.18	1.18	0.01	0.98	-0.73	0.74
Education History of Father	0.21	0.47	-0.36	0.79	-0.07	0.69	-0.43	0.29
Education History of Mother	0.52	0.06	-0.03	1.07	-0.61	0.00	-0.95	-0.27
Household Annual Income	-0.30	0.27	-0.83	0.24	0.50	0.00	0.16	0.84
Who the Child Lives With?	0.82	0.11	-0.19	1.82	-0.34	0.28	-0.97	0.29
Sex of Sibling	5.78	0.00	3.54	8.02	-1.18	0.10	-2.61	0.25
Sex of Proband	1.17	0.49	-2.18	4.53	-0.96	0.37	-3.07	1.15
Age of Proband	-0.02	0.26	-0.05	0.01	0.03	0.00	0.01	0.05
Diagnosis of Proband	0.00	0.95	-0.04	0.04	0.00	0.86	-0.02	0.03
Vineland-II	0.00	0.94	-0.09	0.10	-0.01	0.81	-0.07	0.05
Medical Support Services	-0.60	0.60	-2.87	1.67	1.60	0.02	0.16	3.03
Therapy Support Services	-1.36	0.23	-3.61	0.89	1.90	0.00	0.48	3.32
Oppositional Defiance of Sibling	2.80	0.00	2.26	3.34	-0.58	0.00	-0.94	-0.21
Rule Breaking of Sibling	3.13	0.00	2.49	3.77	-0.85	0.00	-1.28	-0.42

Regression of Total Problems at School and Academic Performance

Table 4 displays three multivariate regressions predicting the sibling’s Total Problems at School based on Models 1-3. Linear regression results indicated that, after adjusting for the child and family’s demographic characteristics factors, siblings’ rule breaking at home and oppositional defiance had a strong association with total problems at school. The race of the father, sex of the sibling, and who the children live with also had a positive association with total

problems at school. The only negative association with total problems was with age of the proband. Regarding formal family support, linear regression results showed that medical support services and therapy support services did not have a strong association with total problems at school in the sibling. The race of the mother, sex of the sibling, and who the children lives with had a positive association with total problem at school. When reviewing all interacting effects on formal family supports, family characteristics, and problem behavior at home from the sibling, oppositional defiance and rule breaking observed in the sibling was associated with more total problems displayed at schools. The sex of the sibling and who the children lives with was associated as having a strong association with total problems at school from the sibling.

Table 4. Linear Regression Between Study Variables and Sibling Total School Problems

Measures	Model 1 n= 631				Model 2 n= 794				Model 3 n= 777			
	β	P>t	95% CI		β	P>t	95% CI		β	P>t	95% CI	
Race of Father	-	-	-	-	-	-	-	-	-	-	-	-
Race of Mother	-	-	-	-	2.07	0.07	-0.13	4.26	-	-	-	-
Race of Sibling	-	-	-	-	-	-	-	-	-	-	-	-
Race of Proband	-	-	-	-	-	-	-	-	-	-	-	-
Education History of Father	-	-	-	-	-	-	-	-	-	-	-	-
Education History of Mother	-	-	-	-	-	-	-	-	-	-	-	-
Household Annual Income	-	-	-	-	-	-	-	-	-	-	-	-
Who the Children Lives With?	-	-	-	-	1.14	0.06	-0.07	2.35	1.13	0.05	-0.02	2.28
Sex of Sibling	3.65	0.01	0.88	6.41	5.05	0	2.60	7.49	3.78	0	1.43	6.13
Sex of Proband	-	-	-	-	-	-	-	-	-	-	-	-
Age of Proband	-	-	-	-	-	-	-	-	-	-	-	-
Diagnosis of Proband	-	-	-	-	-	-	-	-	-	-	-	-
Vineland-II	-	-	-	-	-	-	-	-	-	-	-	-
Medical Support Services	-	-	-	-	-	-	-	-	-	-	-	-
Therapy Support Services	-	-	-	-	-	-	-	-	-	-	-	-
Oppositional Defiance of Sibling	2.85	0	2.14	3.56					1.92	0	1.14	2.70
Rule Breaking of Sibling	-	-	-	-					1.59	0	0.65	2.52
R-Square	0.1261				0.0401				0.1441			
Adj. R-Square	0.1048				0.0216				0.1249			

Table 5 demonstrates the linear regression between each variable and the academic performance displayed from the sibling at school and includes Model 4-6. When reviewing

family characteristics, the proband's disability and need, and the problem behaviors displayed from the sibling at home, oppositional defiance was found to associated with poor academic performance. Both the race of the father and mother was negatively associated with academic performance. The only positive association with academic performance was from the education history of the mother and the age of the proband. In regard to the formal family supports, neither medical support services or therapy support services had an association to academic performance. The age of the proband had a positive association, while the race of the father and the household annual income was associated with worsened academic performance. Evaluating all variables within the model, rule breaking from the sibling was associated with poor academic performance from the sibling at school. The age of the proband was positively associated, while the race of the father was negatively associated with academic performance.

Table 5. Linear Regression Between Study Variables and Sibling Academic Performance

Measures	Model 4 n= 619				Model 5 n= 779				Model 6 n= 763			
	β	P>t	95% CI		β	P>t	95% CI		β	P>t	95% CI	
Race of Father	-2.19	0	-3.60	-0.78	-1.84	0.01	-3.11	-0.57	-1.85	0.01	-3.13	-0.57
Race of Mother	-1.81	0.02	-3.37	-0.25	-	-	-	-	-	-	-	-
Race of Sibling	-	-	-	-	-	-	-	-	-	-	-	-
Race of Proband	-	-	-	-	-	-	-	-	-	-	-	-
Education History of Father	-	-	-	-	-	-	-	-	-	-	-	-
Education History of Mother	-0.46	0.04	-0.90	-0.02	-0.38	0.05	-0.77	0.00	-	-	-	-
Household Annual Income	-	-	-	-	-	-	-	-	-	-	-	-
Who the Children Lives With?	-	-	-	-	-	-	-	-	-	-	-	-
Sex of Sibling	-	-	-	-	-	-	-	-	-	-	-	-
Sex of Proband	-	-	-	-	-	-	-	-	-	-	-	-
Age of Proband	-	-	-	-	0.03	0.01	0.01	0.05	0.03	0.01	0.01	0.05
Diagnosis of Proband	-	-	-	-	-	-	-	-	-	-	-	-
Vineland-II	-	-	-	-	-	-	-	-	-	-	-	-
Medical Support Services	-	-	-	-	-	-	-	-	-	-	-	-
Therapy Support Services	-	-	-	-	-	-	-	-	-	-	-	-
Oppositional Defiance of Sibling	-0.52	0.03	-0.98	-0.07	-	-	-	-	-	-	-	-
Rule Breaking of Sibling	-	-	-	-	-	-	-	-	-0.63	0.05	-1.25	-0.01
R-Square	0.0613				0.053				0.0633			
Adj. R-Square	0.0379				0.0344				0.042			

Discussion

In literature, little has been explored about the relationship between home factors and school factors for siblings of children with ASD. The goal of this study was to examine the relationship between home behavior, child and family characteristics, and school outcomes for siblings of children with ASD by analyzing data from 1,500 families from the Simmons Simplex Collection. Using a data from the SSC, we discovered that the sample of siblings who participated in the study were characterized mostly as white, middle class, and living in a home with both family members. In the study, the siblings with ASD were mostly male and under the age of 12. Similar to past findings, a younger the sibling with ASD is the more risk factors that are found in the older sibling (Hayden et al., 2019; Walton & Ingersoll, 2015). Several studies have found that birth order may have an impact on a sibling's behavioral and emotional adjustment (Hayden et al., 2019). Our results found that the younger the proband, the more total problems at school the sibling displayed. Therefore, it is especially important to monitor the problems displayed by older siblings in order to identify and support those who are having difficulties.

Overall, the results showed that siblings of children with ASD had poorer academic performance and total problems in school when also displaying problem behaviors at home such as oppositional defiance and rule breaking. Similar to past findings, observations of oppositional problems in siblings have been positively related to school behavioral problems (Chien et al., 2017). Problems displayed at home can trickle into problem behaviors in school and affect their academic performance. Our results differed from others in regard to how siblings perform well in the school when considering factors outside of the classroom (Hassenfeldt, 2016). Research has shown that siblings can be overlooked at school by their teachers and may not have awareness of

their home environment (Barnes, 2019). Children who display disruptive behavior at both home and at school could potentially be reaching out for attention in inappropriate ways. This can result in their grades being affected and inattention in school. In the future, school staff such as school psychologists, social workers, counselors, teachers should consider external factors, such as family history and the home environment when conducting evaluations and creating specialized plans for the sibling (Barnes, 2019).

Many studies have found the severity or level of need of sibling with ASD to have a negative impact on the sibling's behavior and relationship with their sibling (Hassenfeldt, 2016; Walton & Ingersoll, 2015). However, our results showed no significance in problem behaviors at home or school depending on the severity and need of the sibling with ASD. Research has shown that a sibling's adjustment and behavioral problems can be lessened when socio-demographic factors of the family are taken into consideration (Hayden et al., 2019). Due to most parents being highly educated and of middle-class income, families may be able to afford support services and better able to attend to their children's interpersonal and psychological needs.

However, our study results were counter to our beliefs that formal family supports would have an impact on school functioning. Our results showed that neither medical support services or therapy support for the child with ASD had an association to academic performance or total problems in school for a sibling. Research has observed that siblings of children with ASD, on average, need more support than other siblings of children with a disability, particularly in terms of social and behavioral functioning (Shivers et al., 2018). Interventions that enhance siblings' feelings of support and gives them a place to share experience with others might be helpful for alleviating behavior issues or the lack of attention siblings experience (Lovell & Wetherell, 2016). In this study we did not review school support services, but services provided outside of

the school system. In the future, research should observe how school support services impact siblings school behavior and academic performance.

By using the Sibling Embedded Systems Framework, additional child and family factors were included and helped us understand a sibling's experience more than viewing them separately. Assessing school functioning and problem behavior at home collectively can add to research about siblings that has been limitedly reviewed together. Our results can be used to understand the interactive factors that affect sibling outcome and can help develop services that aims to enhance and support sibling adjustment, school functioning, and well-being in families of children with autism (Kovshoff, Cebula, Tsai, & Hastings, 2017).

Study Limitations

We have several limitations to be acknowledged. Firstly, most measures were completed by the parents, except the Teach Report Form. Future studies should collect data from additional informants such as the sibling or proband to increase the validity. Some of the measures had missing data and can reduce the statistical significance of the study. The sample consisted of primarily white, well-educated, and middle-class families. Given this sampling bias, these results may not be generalizable to all families. Future studies should review sampling strategies for their studies and select participants that are more representative of the full spectrum of families and siblings of children with ASD. Although the parents were interviewed about the proband's ASD diagnosis, the severity and functional impairments associated with that diagnosis was not measured.

Conclusion

Findings from this study point to several important issues for clinicians and researchers working with families of individuals with ASD to consider. Siblings of children with ASD are

examined less often than other siblings of children with disabilities but can have more risk factors. In this study, siblings of children with ASD that were found to have problem behavior at home were more likely to display problem behaviors at school and have poorer academic performance. Formal family supports were not found to make a significant impact on siblings' school outcomes. However, siblings' outcomes may vary due to different factors that we have seen in our study such as income, gender, age, or the type of services they receive. Due to this, parents, teachers, and clinicians should look into the specific circumstances of siblings' lives to determine what kinds of supports, if any, are most appropriate across the lifespan.

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