

Reciprocal Relations Between Children's Social and Academic Skills Throughout Elementary School

Journal of Psychoeducational Assessment
2022, Vol. 0(0) 1–16

© The Author(s) 2022

Article reuse guidelines:

sagepub.com/journals-permissions

DOI: 10.1177/07342829221097186

journals.sagepub.com/home/jpa



Jacqueline M. Caemmerer¹  and Daniel B. Hajovsky

Abstract

The purpose of this study was to estimate the longitudinal and reciprocal predictive relations between children's social skills, measured by an adaptation of the frequently used Social Skills Rating Scale, and their standardized academic achievement. A large nationally representative sample of elementary school students were assessed at least annually from kindergarten through fifth grade in the Early Childhood Longitudinal Study, Kindergarten Class of 2010–2011 ($n = 7963$). Structural equation modeling was used to test a panel model of teacher-rated interpersonal and self-control skills and children's scores on standardized reading, math, and science achievement tests. Reciprocal relations between children's social skills and achievement were supported throughout elementary school, with achievement showing a stronger and consistent pattern of influence on children's subsequent social skills.

Keywords

reciprocal, social skills, academic achievement, elementary school children

Introduction

Children's development of social skills during early childhood helps promote their success in school and influences interactions with both peers and adults (Caemmerer & Keith, 2015; DiPrete & Jennings, 2012; Hajovsky et al., 2021b). Early social skills development has been linked to a number of long-term outcomes including high school completion, employment status, and mental health (Jones et al., 2015; Woodward & Fergusson, 2000). Within elementary school, social skills ratings are related to future performance on both classroom assessments and standardized measures of achievement (Anthony et al., 2021; Caemmerer & Keith, 2015; Durlak et al., 2011;

¹University of Connecticut, Connecticut, CT, USA

²Texas A&M University, College Station, TX, USA

Corresponding Author:

Jacqueline M. Caemmerer, Department of Educational Psychology, University of Connecticut, 249 Glenbrook Rd #3064, Storrs, CT 06269, USA.

Email: jacqueline.caemmerer@uconn.edu

Malecki & Elliot, 2002). School-based social skills can be more narrowly conceptualized to include both interpersonal skills (e.g., verbal and nonverbal interactive positive behaviors) and learning-related social skills (e.g., listening and following directions, engaging with task demands) (Cooper & Farran, 1988; McClelland & Morrison, 2003; Missal & Hojnoski, 2008). There is increasing evidence to suggest that children who are academically engaged, interact well with peers and authority figures, and effectively plan and complete academic tasks are more likely to be academically successful (Farrington et al., 2012; Hajovsky et al., 2021b; Hughes & Kwok, 2007). Although social skills ratings are related to achievement levels within the classroom (e.g., Anthony et al., 2021; DiPerna et al., 2005; DiPrete & Jennings, 2012), there is less empirical research that examines the dynamic, longitudinal reciprocal development of children's social skills and achievement at school entry and throughout elementary school (Caemmerer & Keith, 2015). Research that examines the reciprocal relations between children's social skills and academic achievement could inform prevention and intervention efforts to support children's functioning in both domains.

Associations between Children's Social and Academic Skills

The relations between children's social skills and achievement have been predominantly examined unidirectionally and cross-sectionally (Caemmerer & Keith, 2015). Unidirectional studies either examine the influence of children's social skills on their achievement or the influence of children's achievement on their social skills. Children's social skills are more commonly used to predict their academic achievement than vice versa. Findings suggest children's social skills influence their achievement within cross-sectional and longitudinal samples (Anthony et al., 2021; Fu et al., 2016; Gustavsen & Ozsoy, 2017; Malecki & Elliot, 2002). Children's early social skills, measured in kindergarten, predict the growth of their reading and math achievement from kindergarten to fifth grade for those whose households are below the poverty threshold (Sung, 2014). Kindergarten children with low to average reading skills and higher teacher-rated social skills performed better on fifth grade reading and math assessments than children with similar reading skills but lower kindergarten social skills (Cooper et al., 2014). Intervention evidence also supports a link between children's social skills and achievement, as social-emotional interventions have been shown to improve children's achievement (Durlak et al., 2011).

The majority of the studies cited above measured children's social skills via the Social Skills Rating Scale (SSRS) or an adaptation of the SSRS. The SSRS is one of the most widely used measures of social skills in the United States and abroad (Gresham et al., 2011), and the SSRS is broadly used in externally funded studies such as the U.S. federally sponsored Early Childhood Longitudinal Study (ECLS). In 2008 the SSRS was revised and renamed the Social Skills Improvement System (SSIS-RS; Gresham & Elliott, 2008). The SSIS-RS retains the same SSRS subscales plus four new subscales to better align with assessment needs for autism spectrum disorder and bullying and to strengthen the link from assessment to intervention (Gresham et al., 2011). The two SSRS subscales used in this study evidenced strong correlations with their equivalently named SSIS-RS subscale (Gresham et al., 2011). An adaptation of the SSRS and the most recent ECLS cohort are examined in our study.

Unidirectional studies which examine the other direction of effects, the influence of children's academic skills on their social skills, are less common and tend to focus on children with educational disabilities. For example, children with learning disabilities tend to be rated as having poorer social skills by a variety of raters (Kavale & Forness, 1996). Children with ADHD who received academic interventions showed that improved teacher ratings in reading are associated with increases in teacher-rated SSRS assertion and cooperation social skills, and improved standardized math fluency achievement is associated with increases in SSRS self-control social

skills (Rutherford et al., 2008). Thus, some evidence exists to suggest children's academic achievement may influence their social skills development, especially for children who demonstrate co-occurring academic and social skills difficulties.

One shortcoming of unidirectional research designs is reciprocal relations between children's social and academic functioning, which are supported by dynamic systems theories (Yoshikawa & Hsueh, 2001), are ignored. Reciprocal studies examine the relations simultaneously—the influence of children's social skills on their subsequent achievement and the influence of their achievement on their subsequent social skills. A small number of longitudinal studies suggest children's social skills and achievement are reciprocally related, but there are inconsistencies in the strength and pattern of relations. Two studies suggest elementary school aged children's standardized and teacher-rated math and reading achievement have stronger and more consistent influences on their later teacher and peer-rated social skills than vice versa (Caemmerer & Keith, 2015; Welsh et al., 2001). In contrast, among children who were followed at first, third, fifth, sixth, and ninth grades, their teacher-rated reading and math achievement did not influence their subsequent mother-rated SSRS social skills, but their social skills had a small influence on subsequent teacher-rated achievement (Okano et al., 2019). Reciprocal relations were similarly sized between Chinese children's peer and teacher-rated social skills and their language and math grades measured in fourth and sixth grade (Chen et al., 1997), whereas Miles and Stipek (2006) found the pattern of relations depended on whether teacher-rated aggressive or prosocial behaviors were examined with standardized reading performance for low-income children throughout elementary school. In a recent study, children's teacher-rated SSRS social skills and measures of standardized vocabulary and reading comprehension were reciprocally related, but these findings were limited to first grade children (Sparapani et al., 2018). Inconsistent findings may be due to differences in the social skill and achievement measures and raters used, the grade levels and intervals between time points examined, and the size and representativeness of samples across studies. Furthermore, the existing studies are limited to measures of children's reading and math performance. Relations between children's social skills and other academic domains, such as measures of science achievement, have been ignored in social skills-achievement relations research. The consistency of reciprocal relations between children's social skills and broader measures of academic achievement, which include science, is unclear.

Purpose of the Study

The purpose of this study is to better understand the predictive longitudinal and reciprocal relations of children's social skills, measured by an adaptation of the popular Social Skills Rating Scale, and standardized achievement throughout elementary school. This study contributes to the limited longitudinal evidence by examining the pattern of relations at each grade between kindergarten and fifth grade. Empirical findings from longitudinal research can address both the timing and magnitude of effects, which have the potential to direct intervention efforts. For example, if predicted changes in achievement are driven primarily by children's social skills, then school efforts may be aimed at assessment and intervention of social skills functioning to improve academic achievement (ostensibly through increased academic motivation; Anthony et al., 2021). Conversely, if prior levels of academic achievement serve as a primary predictor of social skills, then professionals may direct intervention efforts towards teacher beliefs and attitudes about low achieving children demonstrating social deficits and direct efforts towards academic interventions. If reciprocal relations between social skills and academic achievement are supported, then intervention efforts would likely require a mix of both practices depending on student needs and school resources.

A large nationally representative sample from the Early Childhood Longitudinal Study, Kindergarten Class of 2010–2011 (ECLS-K:2011) was examined in this study. To address the current emphasis on science, technology, engineering, and math (STEM) education and the absence of these domains in prior social skills-achievement relations research, a measure of science achievement is also examined in this study. Achievement was conceptualized as reading and math or reading only in previous studies, therefore we tested if the inclusion of science achievement in the reciprocal model altered any of the relations.

We aimed to address the following research questions: (a) the reciprocal relations between children's social skills and academic achievement from kindergarten through fifth grade and (b) whether findings are similar when achievement is measured by math and reading only versus a broader achievement variable measured by math, reading, and science.

Method

Participants were 7963 children from six waves of the publicly available ECLS-K:2011 dataset. The ECLS-K:2011 is sponsored by several federal agencies including the National Center for Education Statistics (for more information see <https://nces.ed.gov/ecls/kindergarten2011.asp>). Children were followed from kindergarten (2011) to fifth grade (2016). We analyzed child assessment and teacher rating scale data collected in the spring in kindergarten, first, second, third, fourth, and fifth grades. Children in our sample were identified as 49% female, 54% White, 25% Hispanic, 9% Black, 7% Asian, 4% two or more races non-Hispanic, 1% American Indian or Alaska Native, and 0.5% Native Hawaiian or Pacific Islander. The highest level of their parent(s)' education was 25% some college, 22% Bachelor's degree, 21% high school diploma, 12% Master's degree or higher, 8% 9th–12th grade, 6% vocational/tech program, 5% eighth grade or below, and 2% graduate school but no degree.

Measures

Teachers rated children on the Social Rating Scale (SRS), an adaptation of the widely used and supported Social Skills Rating Scale (Gresham & Elliott, 1990; Gresham et al., 2011). The Interpersonal Skills subscale (5 items) measured children's skills in friendship development, sensitivity to others' feelings, helping children, getting along with people who are different, and positive self-expression. The Self-Control subscale (4 items) measured children's ability to control their temper and behavior by respecting others' property, to respond to peer pressure, and to accept peers' ideas for group activities. Teachers rated children on a 4-point Likert-scale, 1 = "never" to 4 = "very often," and could indicate they had no opportunity to observe the behavior. The four-point scale was used in the newer SSIS-RS, but not the original SSRS (Gresham et al., 2011). Cronbach's alpha estimates for the six waves ranged from 0.80 to 0.82 for Self-Control composite scores and 0.86 to 0.87 for Interpersonal composite scores (Tourangeau et al., 2019).

Children completed individually administered adaptive reading, math, and science tests. Each test began with a routing test (14–40 items) to match the student with a low, middle, and high difficulty test (13–28 items), except for the kindergarten spring science test, which was one-stage only. Reading tests had the most items and science tests had the fewest. Test content was guided by national and state performance standards, state and commercial assessments, and curriculum experts. The reading content categories were basic skills, vocabulary, and reading comprehension; math categories were number properties and operations, measurement, geometry, data analysis and probability, and algebra; science categories were scientific inquiry, life science, physical science, and Earth and space science. A vertical scale was created across waves with a possible range of –6 to 6 for the item-response theory-based theta scores. Internal consistency estimates for

the six waves ranged from 0.86 to 0.95 for reading, 0.91 to 0.94 for math, and 0.73 to 0.86 for science composites (Tourangeau et al., 2019).

Child sex and family's socioeconomic status (SES) were included to control for initial school entry differences in children's social skills and academic achievement; both were significant covariates in previous research (Caemmerer & Keith, 2015). Child sex was coded 0 for males and 1 for females. Family household-level SES was a continuous composite variable based on parents' educational level, occupational prestige, and household income (values ranged from -3 to 3). Both were reported by parents during the kindergarten wave.

Models and Analysis Plan

An important consideration prior to examining longitudinal reciprocal relations is testing measurement invariance across time; evidence of construct equivalence ensures comparisons in the predictive relations are not affected by changes in the measurement of constructs over time (Little, 2013; Widaman et al., 2010). Although empirical evidence supports children's social skills and academic achievement are measured consistently over time (e.g., Caemmerer & Keith, 2015; Hajovsky et al., 2021a), metric invariance was tested to ensure equivalent scaling of the latent social skills and achievement variables over time, and to allow for the comparison of paths across time. In all models the factor loadings of each measured variable were constrained equal across all time points (e.g., math factor loadings were the same in kindergarten, first, second, third, fourth, and fifth grade; Little, 2013).

Longitudinal panel models test the predictive relations between latent constructs across time and model individual differences between children as they change over time (Little, 2013). In our study two latent variable panel models tested the reciprocal effects of children's social skills and academic achievement from kindergarten through fifth grade. The first model included two measures of academic achievement, reading and math, and the second model included three measures of academic achievement, reading, math, and science. Autoregressive paths linked the social skills and achievement latent variables with each other, across time, and accounted for the children's prior standings on each construct. Cross-lagged paths linked children's social skills to their achievement one year later and their achievement to their social skills one year later, which tested the reciprocal relations between the two domains of functioning (Little, 2013). Within each grade level, directionality was not assumed between latent social skills and achievement relations, thus their disturbances were correlated. Residual variances of the same measured variables were correlated with all subsequent measurement occasions to account for SRS Interpersonal and Self-Control subscale-specific and math, reading, or science test-specific variance shared in common beyond the latent social skills and achievement variables, respectively (Little, 2013). Paths from child sex and families' household SES to latent fall kindergarten social skills and achievement were included to control for initial school entry differences. While there are several approaches to including covariates in longitudinal models, estimating covariates' direct effects at the first time point controls for their influence indirectly at later time points, which assumes the influence of child sex and family household SES is strongest at school entry and diminishes over time (Little, 2013).

Alternative models were compared and contrasted to test competing hypotheses and select a better model (Little, 2013; Keith, 2019). First unconditional models with and without science achievement were compared to determine whether the inclusion of science influenced the relations between the constructs across time. After a final model was selected, models were conditioned on the two covariates and the statistical significance and consistency of the autoregressive and cross-lagged paths over time were examined. Indirect paths were also examined, which tested longitudinal relations between children's social skills and achievement through intervening or

Table 1. Correlations, Means, Standard Deviations, and Sample Sizes of Weighted ECLS-K:2011 Variables.

	1	2	3	4	5	6	7	8
1 X2RTHETK								
2 X4RTHETK	0.79							
3 X6RTHETK	0.72	0.86						
4 X7RTHETK	0.66	0.77	0.84					
5 X8RTHETK	0.66	0.76	0.83	0.84				
6 X9RTHETK	0.62	0.72	0.79	0.82	0.86			
7 X2MTHETK	0.74	0.72	0.70	0.69	0.66	0.65		
8 X4MTHETK	0.68	0.75	0.72	0.71	0.69	0.67	0.83	
9 X6MTHETK	0.63	0.69	0.72	0.72	0.71	0.69	0.79	0.86
10 X7MTHETK	0.60	0.66	0.69	0.72	0.71	0.71	0.76	0.82
11 X8MTHETK	0.58	0.64	0.67	0.70	0.72	0.70	0.75	0.81
12 X9MTHETK	0.59	0.65	0.69	0.71	0.72	0.73	0.75	0.80
13 X2STHETK	0.54	0.52	0.54	0.59	0.57	0.58	0.62	0.58
14 X4STHETK	0.59	0.61	0.62	0.66	0.64	0.65	0.64	0.66
15 X6STHETK	0.60	0.64	0.68	0.71	0.69	0.70	0.67	0.69
16 X7STHETK	0.60	0.64	0.68	0.75	0.72	0.73	0.67	0.68
17 X8STHETK	0.55	0.61	0.66	0.71	0.71	0.72	0.64	0.67
18 X9STHETK	0.55	0.60	0.65	0.70	0.71	0.75	0.64	0.66
19 X2TCHCON	0.22	0.25	0.23	0.23	0.20	0.19	0.23	0.22
20 X4TCHCON	0.21	0.25	0.24	0.24	0.22	0.23	0.22	0.23
21 X6TCHCON	0.16	0.20	0.20	0.22	0.20	0.19	0.18	0.19
22 X7TCHCON	0.17	0.20	0.21	0.22	0.21	0.21	0.19	0.19
23 X8TCHCON	0.16	0.20	0.21	0.23	0.22	0.22	0.19	0.20
24 X9TCHCON	0.15	0.18	0.18	0.20	0.20	0.21	0.17	0.17
25 X2TCHPER	0.24	0.27	0.25	0.25	0.22	0.21	0.26	0.24
26 X4TCHPER	0.22	0.26	0.26	0.27	0.24	0.24	0.24	0.25
27 X6TCHPER	0.20	0.24	0.25	0.26	0.24	0.23	0.22	0.23
28 X7TCHPER	0.18	0.21	0.22	0.24	0.23	0.23	0.22	0.21
29 X8TCHPER	0.17	0.21	0.22	0.25	0.23	0.23	0.21	0.21
30 X9TCHPER	0.15	0.19	0.19	0.21	0.20	0.21	0.18	0.17
31 FEMALE	0.06	0.07	0.09	0.09	0.05	0.02	-0.02	-0.05
32 X12SESL	0.36	0.35	0.39	0.41	0.41	0.40	0.39	0.38
Sample Size	7939	7933	7932	7919	7917	7919	7928	7931
Mean	-0.25	0.57	0.96	1.13	1.30	1.46	-0.35	0.54
SD	0.63	0.48	0.35	0.29	0.29	0.35	0.61	0.55

mediating variables. Indirect paths are calculated by multiplying and summing two or more direct effects. This longitudinal panel model had many possible indirect pathways, and because hypotheses about specific indirect pathways are uncommon, the total indirect pathways were interpreted (Little, 2013).

Mplus version 8.5 (Muthén & Muthén, 1998-2017) was used to estimate all models and missing data were handled by the full information maximum likelihood procedure (Enders, 2010). The ECLS-K:2011 used a complex multistage probability sampling design to produce nationally representative child-level data. A longitudinal child-level weighting variable (W9C29P_2T290) was used to produce national level estimates and to adjust for differential non-response patterns

9	10	11	12	13	14	15	16
0.88							
0.86	0.89						
0.85	0.88	0.90					
0.58	0.57	0.56	0.56				
0.64	0.64	0.62	0.63	0.78			
0.71	0.70	0.68	0.69	0.74	0.84		
0.71	0.73	0.71	0.71	0.71	0.79	0.84	
0.70	0.71	0.72	0.72	0.68	0.76	0.81	0.84
0.71	0.73	0.73	0.75	0.65	0.74	0.79	0.82
0.22	0.20	0.20	0.22	0.16	0.18	0.19	0.18
0.23	0.22	0.22	0.23	0.16	0.19	0.19	0.20
0.20	0.20	0.20	0.21	0.10	0.13	0.15	0.16
0.20	0.20	0.20	0.22	0.11	0.13	0.15	0.17
0.21	0.20	0.21	0.23	0.13	0.15	0.16	0.18
0.19	0.19	0.21	0.23	0.11	0.13	0.15	0.16
0.24	0.22	0.23	0.24	0.21	0.21	0.22	0.21
0.25	0.24	0.24	0.25	0.19	0.21	0.22	0.23
0.23	0.23	0.22	0.24	0.15	0.18	0.19	0.20
0.22	0.22	0.22	0.24	0.15	0.16	0.17	0.19
0.21	0.21	0.21	0.23	0.14	0.16	0.17	0.19
0.19	0.18	0.20	0.21	0.11	0.12	0.14	0.15
-0.08	-0.11	-0.11	-0.07	-0.02	-0.04	-0.05	-0.05
0.39	0.39	0.38	0.40	0.43	0.42	0.41	0.42
7929	7921	7921	7917	7823	7914	7924	7916
1.06	1.43	1.65	1.84	-0.55	0.15	0.77	1.20
0.52	0.45	0.46	0.46	0.73	0.78	0.72	0.65

that could bias estimates (Tourangeau et al., 2019). A maximum likelihood with robust standard errors (MLR) estimator handled the weight and was used with the corresponding cluster (W9C29P_2T29PSU) and stratification (W9C29P_2T29STR) variables and the Mplus complex sampling procedure to adjust the standard errors for non-independent data (Muthén & Muthén, 1998-2017). Statistical significance of indirect effects was tested with bootstrapped standard errors (1000 draws; Preacher et al., 2007).

Multiple measures were used to assess the fit of models to the data. Root mean square error of approximation (RMSEA) values below 0.05, standardized root mean square residual (SRMR) values below 0.08, comparative fit index (CFI) and Tucker-Lewis index (TLI) values above 0.95

17	18	19	20	21	22	23	24
0.85							
0.18	0.18						
0.21	0.21	0.47					
0.16	0.17	0.43	0.50				
0.17	0.18	0.40	0.47	0.50			
0.19	0.21	0.39	0.44	0.46	0.50		
0.17	0.20	0.37	0.38	0.44	0.45	0.50	
0.21	0.22	0.81	0.41	0.37	0.34	0.36	0.33
0.23	0.23	0.44	0.80	0.46	0.42	0.41	0.36
0.20	0.21	0.40	0.47	0.80	0.45	0.43	0.41
0.20	0.21	0.37	0.42	0.45	0.80	0.46	0.42
0.19	0.21	0.38	0.41	0.44	0.46	0.81	0.47
0.16	0.19	0.34	0.36	0.40	0.42	0.47	0.81
−0.05	−0.05	0.17	0.18	0.18	0.20	0.21	0.22
0.39	0.38	0.10	0.13	0.12	0.14	0.16	0.15
7917	7915	7785	7574	7800	7814	7783	7793
1.54	1.88	3.20	3.24	3.23	3.26	3.28	3.30
0.62	0.66	0.62	0.61	0.62	0.62	0.60	0.61

suggested good fit (Hu & Bentler, 1999). Alternative models were compared with the Satorra-Bentler change in chi-square test to account for the MLR estimator (“Mplus website, n.d,” Chi-square difference testing using the Satorra-Bentler scaled chi-square). Statistically significant changes in chi-square indicate the less constrained model fits the data better (Keith, 2019).

Results

Descriptive statistics, correlations, and sample sizes for all weighted variables are presented in Table 1. Variables were normally distributed (range of skewness = −1.7 to −28 and

25	26	27	28	29	30	31	32
----	----	----	----	----	----	----	----

0.43							
0.39	0.48						
0.36	0.43	0.46					
0.37	0.41	0.45	0.48				
0.33	0.37	0.42	0.44	0.48			
0.20	0.21	0.21	0.23	0.23	0.24		
0.12	0.13	0.14	0.14	0.16	0.15	0.01	
7789	7619	7825	7842	7794	7783	7963	7935
3.16	3.17	3.13	3.13	3.12	3.13	N/A	−0.09
0.64	0.64	0.66	0.66	0.65	0.65	N/A	0.78

Note. Abbreviations: X2 = kindergarten spring, X4 = first grade spring, X6 = second grade spring, X7 = third grade, X8 = fourth grade, and X9 = fifth grade measurements; RTHET = reading theta score, MTHET = math theta score, and, STHET = science theta score; CON = SSRS Self–Control, PER = SRS Interpersonal.

kurtosis = −0.07–5.24 except the first grade reading variable was 6.50 (Curran et al., 1996). Missingness across waves of the weighted data ranged from 0.30% to 2% for the achievement and 2% to 7% for the social skills measures.

The unconditional reciprocal models, both without and with science, fit the data well, and fit indices were similar across the two models (see Table 2 models 1 and 2). The statistical significance and magnitude of the achievement and social skills autoregressive paths and achievement-social skills cross-lagged paths were similar across the two models. The magnitude of the social skills-achievement cross-lagged paths were also similar across the two models, but

Table 2. Fit Indices of All Tested Models.

Model	χ^2	df	SB $\Delta\chi^2$	Δdf	Δp	RMSEA	CFI	SRMR
1. Unconditional No science (Math & reading only)	2254.963	176	—	—	—	.039	.980	.070
2. Unconditional with science (3 achievement measures)	4020.695	319	—	—	—	.038	.974	.064
3. Final conditional science	5138.783	387	—	—	—	.039	.968	.066
4. Equal Ach paths ^a	5738.853	391	487.618	4	<.001	.041	.964	.072
5. Equal SRS paths ^a	5169.476	391	41.669	4	<.001	.039	.968	.067
6. Equal Ach to SRS paths ^a	5134.583	391	15.223	4	.004	.039	.968	.066
7. Equal SRS to Ach paths ^a	5137.035	391	20.711	4	<.001	.039	.968	.066
8. No Ach to SRS paths ^a	5468.739	392	231.656	5	<.001	.040	.966	.098
9. No SRS to Ach paths ^a	5145.427	392	30.544	5	<.001	.039	.968	.066

Note: An adjustment was made to the chi-square difference tests using the Satorra-Bentler scaled chi-square test. This adjustment was required because the MLR estimator was used to account for the longitudinal sampling weight included in all analyses.

^aCompared to final conditional science model (model 3).

the statistical significance for three social skills-achievement cross-lagged paths varied. Kindergarten to first, first to second, and second to third grade social skills-achievement cross-lagged paths were statistically significant in the model without science, but the magnitude of the standardized paths ranged from 0.01 to 0.02, which is too small to be considered practically meaningful (according to rules of thumb from Keith, 2019, which specifies 0.05 as a cut-off for practically meaningful). These three social skills-achievement cross-lagged paths were not statistically significant in the model with science. The cross-lagged path from fourth grade social skills to fifth grade achievement was statistically significant in both models, but the effect size was not practically meaningful in either model ($\beta = 0.02$ and $SE = 0.01$, $p < .02$ in both models).

The reciprocal model with science was selected as the basis of comparison for further models because science achievement was of interest due to its absence in prior studies and the model with science fit the data well. The final science model included child sex and family household SES as covariates. 11 SRS Interpersonal correlated residuals, out of 15, were removed from the model due to a lack of statistical significance in model 2 ($p > .05$) and an absence of theoretical expectations (Little, 2013). The final science reciprocal model fit the data well (model 3, see Table 2), suggesting children's academic achievement and social skills are reciprocally related. All cross-lagged paths from children's achievement scores to their social skills ratings in the next grade were statistically significant, effect sizes were small to medium (see Figure 1 and Keith, 2019 for effect size guidelines). For example, a standard deviation increase in children's second grade and third grade achievement resulted in a 0.12 standard deviation increase in their third grade and fourth grade social skills, respectively, controlling for other variables in the model ($SE = 0.01$ – 0.02 , β 95% CI = 0.08–0.15, $p < .001$). One cross-lagged path from children's social skills to their achievement in the next grade was statistically significant, from fourth grade social skills to fifth grade achievement, but the effect size was not practically significant (see Figure 1).

Children's second and third grade social skills had significant indirect but not practically sized effects on their fifth grade achievement ($\beta = .01$ – $.02$, $SE = 0.01$, β 95% CI = 0.00–0.03, $p < .05$); indirect effects of social skills at other grades were not statistically significant. Children's achievement had significant and moderate to large sized indirect effects on their later social skills at all time points ($\beta = 0.16$ – 0.23 , $SE = 0.01$ – 0.02 , β 95% CI = 0.13–0.26, $p < .001$).

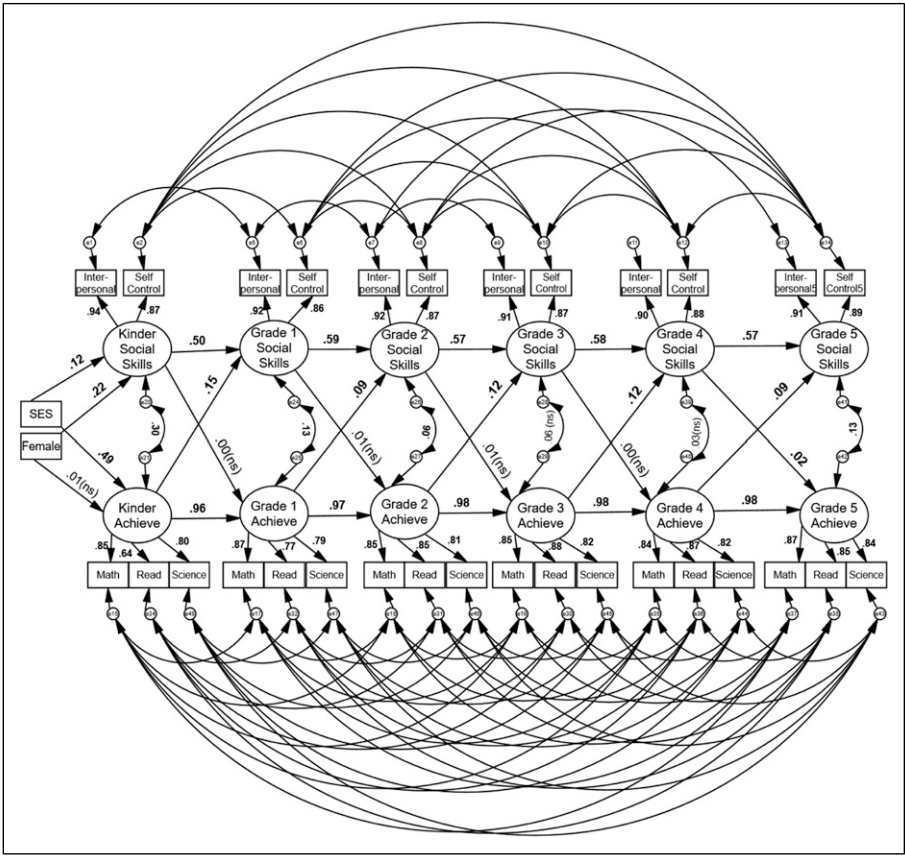


Figure 1. Final reciprocal model with standardized estimates (model 3 in Table 2). Statistically significant coefficients appear in bold and (ns) was used to label coefficients that were not statistically significant. The unstandardized factor loadings for each measured variable on latent social skills and achievement were constrained equal across all grades (metric invariance). The marker variable method set the scales of the latent achievement and social skills variables based on the reading and self-control measured variables, respectively.

All stability paths from each latent variable to its later measurements were statistically significant and large sized, which suggests high individual-difference stability in children’s social skills and achievement over time (Little, 2013). A comparison of the magnitude of the standardized coefficients suggests children’s achievement scores were comparatively more stable from kindergarten to fifth grade than teachers’ ratings of their social skills over time (see Figure 1). Family SES and child sex were significantly related to children’s fall kindergarten teacher-rated social skills (medium and small effect sizes, respectively); girls’ social skills were rated significantly higher. Family SES, but not child sex, significantly predicted children’s fall achievement (large effect size; see Figure 1).

Six competing, or alternative, models were tested to determine a better theoretical model (Little, 2013). Equality constraints were imposed on paths or paths were removed to test the consistency of the effects across time. Each alternative model was compared to the final reciprocal model (model 3, see Table 2). Autoregressive paths between children’s latent social skills and autoregressive paths between their achievement were constrained to be equal across time,

respectively. Results did not support these constraints and indicated children's latent social skills and achievement changed from one grade to the next (unequal stability paths, models 4 and 5). Both directions of cross-lagged paths were constrained to be equal across time, respectively, but results did not support this constraint either. This indicates relations between children's latent social skills to their subsequent latent achievement and relations between their latent achievement to subsequent latent social skills changed over time (unequal cross-lagged paths, models 6 and 7). Finally, both directions of cross-lagged paths were constrained to zero across time, respectively, but results did not support these constraints. This indicates the cross-lagged paths were statistically different from zero (retain cross-lagged paths, models 8 and 9), and the inclusion of the cross-lagged paths in the model better represented the data.

Discussion

There is relatively little research examining the dynamic, developmental relations between children's social skills and their academic achievement at school entry and at several time points throughout elementary school. The purpose of this study was to understand the developmental relations between children's social skills, measured by an adaptation of the frequently used Social Skills Rating Scale, and their standardized achievement. In prior social skills and achievement reciprocal studies, achievement was limited to measures of children's performance on reading tests, math tests, or a combination of the two. Our study broadened achievement to include a standardized science measure in each elementary grade. We used a longitudinal panel model of teacher-rated social skills and children's standardized reading, math, and science scores with six waves of data from kindergarten to fifth grade to examine the relations between these existing instruments. Findings from the recent large and nationally representative ECLS-K:2011 cohort supports reciprocal, or bidirectional, relations between children's social skills and academic achievement throughout their development in elementary school. The inclusion of a science test within our longitudinal models did not alter the results. This suggests children's social skills and science achievement demonstrate dynamic relations, similar to prior research with reading and math achievement (Caemmerer & Keith, 2015; Welsh et al., 2001).

Children's social and academic skills appear to be interrelated domains, as posited by the dynamic systems theory (Yoshikawa & Hsueh, 2001). The findings from this recent cohort replicate findings from the ECLS-K:1999 cohort, assessed 12 years prior without a measure of science achievement (Caemmerer & Keith, 2015). Similarly, children's standardized academic achievement had a consistently significant and mostly moderate sized influence on their teacher-rated social skills at the following grade, effect sizes were similar to the 1999 cohort. Across both cohorts, children's kindergarten social skills significantly influenced their later academic skills, directly and indirectly. In the recent 2011 cohort the magnitude of social skills' direct and indirect effects was too small to be practically meaningful, but the magnitude was small and meaningful in the 1999 cohort ($\beta = .05-.06$). Despite the small magnitude in the 2011 cohort, the reciprocal model with paths from children's social skills to their achievement in later grades fit the data significantly better than a model without these paths. The relatively small influence of children's social skills on their later achievement in both ECLS-K cohorts differs from unidirectional studies of children's social skills to achievement, which were mostly cross-sectional and did not account for the influence from achievement to social skills (e.g., Malecki & Elliot, 2002).

Unidirectional examinations may obscure the relations between these two domains. This study's evidence of reciprocal relations suggests both sets of skills are interrelated during children's development in elementary school. Children's social functioning appears important for their subsequent achievement, but achievement appears to have a more consistent and robust pattern of influence on subsequent social skills. Achievement may serve as a stronger influence on social skills, rather than

vice versa, because achievement may influence how children navigate the school social environment. Our findings are consistent with two prior reciprocal studies which used measures of children's teacher and peer-rated social skills and standardized and teacher-rated measures of academic achievement (Caemmerer & Keith, 2015; Welsh et al., 2001). Our findings are inconsistent with two other reciprocal studies. One used mother-rated social skills and teacher-rated achievement and found children's social skills had a small influence on later achievement but children's achievement did not influence their social skills (Okano et al., 2019), and another used teacher and peer-rated social skills and classroom grades in fourth and sixth grade and found similarly sized reciprocal relations across domains (Chen et al., 1997). Inconsistent findings may be due to the measures and raters used, the grade levels studied, and the intervals between measurements.

Limitations and Suggestions for Future Research

Conclusions are limited to the data collection time points and measures used in the ECLS-K:2011 and the models tested in our study. In our sample, children were assessed each year throughout elementary school. Less is known about the reciprocal relations between children's social and academic skills in middle and high school, which is an area for future research. Additionally, findings are also limited to the measures used in this study. Multimodal assessment of children's achievement and social skills may provide more comprehensive results. A limitation of cross-lagged panel models is between-person and within-person variance is aggregated. Alternative models, such as the autoregressive latent trajectory model or random-intercept cross-lagged panel model, disaggregate between-person and within-person effects through the inclusion of a latent random intercept, the overtime average mean, and the difference between individual's time-specific deviation from the overtime mean (Curran et al., 2014). Future research should compare the cross-lagged autoregressive panel model with the random-intercept cross-lagged panel model to explore the influence of within-person effects, and also test other alternative models such as the bivariate latent difference score model (McArdle, 2009). Future research may also test multigroup models to examine whether the reciprocal social skills-achievement relations are similar across various demographic characteristics of children. The ECLS-K:2011 data are non-experimental, and although inferences regarding directionality of effects are supported, causal conclusions are unwarranted.

Implications of the Findings

Our findings suggest assessments of children's academic skills and teacher-rated social skills are likely to show reciprocal relations between the two domains throughout elementary school. Thus, the longitudinal reciprocal model suggests interventions targeting children's academic or social skills may positively influence children's skill development in the other domain. Children identified with difficulties in one domain of functioning could proactively be provided with support to prevent future difficulties in the other domain. Academic interventions may have a stronger influence on children's social skills than vice versa because of the stronger and consistent influence of children's academic skills on their social skills in the next grade. Professionals who intervene to improve children's academic skills may also reduce the probability of later social skills difficulties. Although children's standardized academic performance was highly related from one grade to the next, our findings suggest children's academic and social skills both change over time and are thus modifiable. Intervention and prevention efforts that target academic and social skills are likely to be mutually beneficial.

Acknowledgments

This research was enhanced by training Jacqueline Caemmerer received during the American Educational Research Association Institute on Statistical Analysis: Development of Mathematics Competencies in Early Childhood. AERA receives funds for its "AERA Grants Program" from the National Science Foundation (NSF) under NSF award NSF-DRL #1749275. Opinions reflect those of the authors and do not necessarily reflect those AERA or NSF. We also wish to thank Eunice Blemahdoo for providing literature search support.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Jacqueline M. Caemmerer  <https://orcid.org/0000-0001-9555-3625>

References

- Anthony, C. J., Ogg, J., & Jenkins, L. N. (2021). Academic enablers as dynamic moderators: Exploring academic enablers and achievement across elementary school. *Journal of School Psychology, 86*, 15–31. <https://doi.org/10.1016/j.jsp.2021.02.007>
- Caemmerer, J. M., & Keith, T. Z. (2015). Longitudinal, reciprocal effects of social skills and achievement from kindergarten to eighth grade. *Journal of School Psychology, 53*(4), 265–281. <https://doi.org/10.1016/j.jsp.2015.05.001>
- Chen, X., Rubin, K. H., & Li, D. (1997). Relation between academic achievement and social adjustment: Evidence from Chinese children. *Developmental Psychology, 33*(3), 518–525. <https://doi.org/10.1037/0012-1649.33.3.518>
- Cooper, D. H., & Farran, D. C. (1988). Behavioral risk factors in kindergarten. *Early Childhood Research Quarterly, 3*(1), 1–19. [https://doi.org/10.1016/0885-2006\(88\)90026-9](https://doi.org/10.1016/0885-2006(88)90026-9)
- Cooper, B. R., Moore, J. E., Powers, C. J., Cleveland, M., & Greenberg, M. T. (2014). Patterns of early reading and social skills associated with academic success in elementary school. *Early Education and Development, 25*(8), 1248–1264. <https://doi.org/10.1080/10409289.2014.932236>
- Curran, P. J., Howard, A. L., Bainter, S. A., Lane, S. T., & McGinley, J. S. (2014). The separation of between-person and within-person components of individual change over time: A latent curve model with structured residuals. *Journal of Consulting and Clinical Psychology, 82*(5), 879–894. <https://doi.org/10.1037/a0035297>
- Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods, 1*(1), 16–29. <https://doi.org/10.1037/1082-989X.1.1.16>
- DiPerna, J. C., Volpe, R. J., & Elliott, S. N. (2005). A model of academic enablers and mathematics achievement in the elementary grades. *Journal of School Psychology, 43*(5), 379–392. <https://doi.org/10.1016/j.jsp.2005.09.002>
- DiPrete, T. A., & Jennings, J. L. (2012). Social and behavioral skills and the gender gap in early educational achievement. *Social Science Research, 41*(1), 1–15. <https://doi.org/10.1016/j.ssresearch.2011.09.001>

- Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, 82(1), 405–432. <https://doi.org/10.1111/j.1467-8624.2010.01564.x>
- Enders, C. K. (2010). *Applied missing data analysis*. The Guilford Press
- Farrington, C. A., Roderick, M., Allensworth, E., Nagaoka, J., Keyes, T. S., Johnson, D. W., & Beechum, N. O. (2012). *Teaching adolescents to become learners. The role of non-cognitive skills in shaping school performance: A critical literature review*. University of Chicago Consortium on Chicago School Research. <https://consortium.uchicago.edu/sites/default/files/publications/Non-cognitive%20Report.pdf>
- Fu, R., Chen, X., Wang, L., & Yang, F. (2016). Developmental trajectories of academic achievement in Chinese children: Contributions of early social-behavioral functioning. *Journal of Educational Psychology*, 108(7), 1001–1012. <https://doi.org/10.1037/edu0000100>
- Gresham, F. M., & Elliott, S. N. (1990). *Social skills rating system: Manual*. AGS
- Gresham, F. M., & Elliott, S. N. (2008). *Social skills improvement system: Rating scales*. Pearson Assessments
- Gresham, F. M., Elliott, S. N., Vance, M. J., & Cook, C. R. (2011). Comparability of the social skills rating system to the social skills improvement system: Content and psychometric comparisons across elementary and secondary age levels. *School Psychology Quarterly*, 26(1), 27–44. <https://doi.org/10.1037/a0022662>
- Gustavsen, A. M., & Ozsoy, G. (2017). Longitudinal relationship between social skills and academic achievement in a gender perspective. *Cogent Education*, 4(1), 1411035. <https://doi.org/10.1080/2331186x.2017.1411035>
- Hajovsky, D. B., Caemmerer, J. M., & Mason, B. A. (2021a). Gender differences in children's social skills growth trajectories. *Applied Developmental Science*. Advance Online Publication. <https://doi.org/10.1080/10888691.2021.1890592>
- Hajovsky, D. B., Chesnut, S. R., Helbig, K. A., & Goranowski, S. M. (2021b). On the examination of longitudinal trends between teacher-student relationship quality and social skills during elementary school. *School Psychology Review*. Advance Online Publication. <https://doi.org/10.1080/2372966X.2021.1883995>
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Hughes, J., & Kwok, O.-M. (2007). Influence of student-teacher and parent-teacher relationships on lower achieving readers' engagement and achievement in the primary grades. *Journal of Educational Psychology*, 99(1), 39–51. <https://doi.org/10.1037/0022-0663.99.1.39>
- Jones, D. E., Greenberg, M., & Crowley, M. (2015). Early social-emotional functioning and public health: The relationship between kindergarten social competence and future wellness. *American Journal of Public Health*, 105(11), 2283–2290. <https://doi.org/10.2105/AJPH.2015.302630>
- Kavale, K. A., & Forness, S. R. (1996). Social skill deficits and learning disabilities: A meta-analysis. *Journal of Learning Disabilities*, 29(3), 226–237. <https://doi.org/10.1177/002221949602900301>
- Keith, T. Z. (2019). *Multiple regression and beyond: An introduction to multiple regression and structural equation modeling* (3rd ed). Taylor & Francis.
- Little, T. D. (2013). *Longitudinal structural equation modeling. Methodology in the social sciences*. The Guilford Press
- Malecki, C. K., & Elliot, S. N. (2002). Children's social behaviors as predictors of academic achievement: A longitudinal analysis. *School Psychology Quarterly*, 17(1), 1–23. <https://doi.org/10.1521/scpq.17.1.1.19902>
- McArdle, J. J. (2009). Latent variable modeling of differences and changes with longitudinal data. *Annual Review of Psychology*, 60, 577–605. <https://doi.org/10.1146/annurev.psych.60.110707.163612>

- McClelland, M. M., & Morrison, F. J. (2003). The emergence of learning-related social skills in preschool children. *Early Childhood Research Quarterly*, 18(2), 206–224. [https://doi.org/10.1016/s0885-2006\(03\)00026-7](https://doi.org/10.1016/s0885-2006(03)00026-7)
- Miles, S. B., & Stipek, D. (2006). Contemporaneous and longitudinal associations between social behavior and literacy achievement in a sample of low-income elementary school children. *Child Development*, 77(1), 103–117. <https://doi.org/10.1111/j.1467-8624.2006.00859.x>
- Missal, K. N., & Hojnoski, R. L. (2008). The critical nature of young children's emerging peer-related social competence for transition to school. In W. H. Brown, S. L. Odom, & S. R. McConnell (Eds.), *Social competence of young children: Risk, disability, and intervention* (pp. 117–137). Brookes
- Mplus website (n.d.). *Chi-square difference testing using the Satorra–Bentler scaled chi-square*. <http://www.statmodel.com/chidiff.shtml>
- Muthén, L., & Muthén, B. (1998–2017). *Mplus user's guide* (8th ed.). Muthén & Muthén
- Okano, L., Jeon, L., Crandall, A., Powell, T., & Riley, A. (2019). Developmental cascades of social competence, achievement in school, and achievement on standardized assessments during the transition to adolescence and secondary school. *Journal of Adolescence*, 74, 91–102. <https://doi.org/10.1016/j.adolescence.2019.06.001>
- Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research*, 42(1), 185–227. <https://doi.org/10.1080/00273170701341316>
- Rutherford, L. E., Dupaul, G. J., & Jitendra, A. K. (2008). Examining the relationship between treatment outcomes for academic achievement and social skills in school-age children with attention-deficit hyperactivity disorder. *Psychology in the Schools*, 45(2), 145–157. <https://doi.org/10.1002/pits.20283>
- Sparapani, N., Connor, C. M., McLean, L., Wood, T., Toste, J., & Day, S. (2018). Direct and reciprocal effects among social skills, vocabulary, and reading comprehension in first grade. *Contemporary Educational Psychology*, 53(1), 159–167. <https://doi.org/10.1016/j.cedpsych.2018.03.003>
- Sung, Y. (2014). Differential effect of social-emotional behaviors on academic achievement of language-minority students. *Child & Youth Care Forum*, 43(3), 393–416. <https://doi.org/10.1007/s10566-014-9245-2>
- Tourangeau, K., Nord, C., Lê, T., Wallner-Allen, K., Vaden-Kiernan, N., Blaker, L., & Najarian, M. (2019). *Early Childhood Longitudinal Study, Kindergarten Class of 2010–2011 (ECLS-K:2011): User's manual for the ECLS-K:2011 kindergarten-fifth grade data file and electronic codebook, public version (NCES 2019-051)*. US. Department of Education National Center for Education Statistics.
- Welsh, M., Parke, R. D., Widaman, K., & O'Neil, R. (2001). Linkages between children's social and academic competence: A longitudinal analysis. *Journal of School Psychology*, 39(6), 463–481. [https://doi.org/10.1016/s0022-4405\(01\)00084-x](https://doi.org/10.1016/s0022-4405(01)00084-x)
- Widaman, K. F., Ferrer, E., & Conger, R. D. (2010). Factorial invariance within longitudinal structural equation models: Measuring the same construct across time. *Child Development Perspectives*, 4(1), 10–18. <https://doi.org/10.1111/j.1750-8606.2009.00110.x>
- Woodward, L. J., & Fergusson, D. M. (2000). Childhood peer relationship problems and later risks of educational under-achievement and unemployment. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 41(2), 191–201. <https://doi.org/10.1017/s002196309900520x>
- Yoshikawa, H., & Hsueh, J. (2001). Child development and public policy: Toward a dynamic systems perspective. *Child Development*, 72(6), 1887–1903. <https://doi.org/10.1111/1467-8624.00384>