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DOI: 10.1111/cdev.14033

EMPIRICAL ARTICLE

CHILD DEVELOPMENT

Antecedents to and outcomes associated with teacher–child relationship perceptions in early childhood: Further evidence for child-driven effects

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Funding information
National Institute of Food and Agriculture, Grant/Award Number: ALA042-1-14021; National Science Foundation, Grant/Award Number: NSF BCS 16-51189 and NSF BCS 16-51191

Abstract

Preschool teachers' perceptions about relationships with students (teacher–child relationships [TCRs]) predict children's subsequent social competence (SC) and academic progress. Why this is so remains unclear. Do TCRs shape children's development, or do child attributes influence both TCRs and subsequent development? Relations between TCRs and other measures were examined for 185 preschoolers (107 girls, 89 longitudinal, and ~75% European American). Teachers rated TCRs and child social/affective behaviors. Teacher–child interactions (TCIs) and children's affect expressiveness were observed. Child SC and receptive vocabulary were assessed. TCRs were significantly correlated with each type of outcome. TCIs, SC, expressed affect, and teacher-rated behaviors also predicted TCRs longitudinally. Results suggest that TCR ratings predict subsequent adaptation because they summarize children's behavioral profiles rather than on TCR quality per se.

The role of teacher–child relationships (TCRs) in shaping young children's social, emotional, cognitive, and academic trajectories during early and middle childhood has been a topic of considerable research interest for over three decades (e.g., Birch & Ladd, 1997; Botkin & Twardosz, 1988; Howes et al., 2000; Pianta & Steinberg, 1992; Spilt et al., 2015; Suntheimer & Wolf, 2020; White, 2013). This interest is motivated, in part, by attachment and relational health perspectives highlighting the role of infant and toddler attachment relationships within families as foundational for optimal social-emotional growth from infancy to early adulthood (e.g., Sroufe, 2005; Williford et al., 2016). Interest in the possible influences of preschool TCRs on children's development has also been motivated by two related secular trends over the last 50 years; namely the increasing number of women in the paid labor force and the childcare experiences of their children (e.g., Han, 2004). These societal changes raised concerns about potential developmental impacts on children's social, emotional, and cognitive functioning (e.g., NICHD Early Child Care Research Network, 2002; Pianta et al., 2003).

Pianta and colleagues were not the first to argue that TCRs are important aspects of early childhood curricula, but their instrument development (i.e., the Student–Teacher Relationship Scale, STRS; Pianta, 2001) and programmatic research on the role of TCRs for school readiness and subsequent academic success have been most influential over the last 30 years (e.g., Hamre & Pianta, 2001; Nguyen et al., 2020; Pianta &

Abbreviations: CBQ-short, Children's Behavior Questionnaire–short form; CFA, confirmatory factor analysis; CFI, comparative fit index; EFA, exploratory factor analysis; FIML, full-information maximum-likelihood; NAEYC, National Association for the Education of Young Children; ODP, outward-directed problem; PPVT-IV, Peabody Picture Vocabulary Test, version IV; RMSEA, root mean square error of approximation; RQ, research question; SC, social competence; SCBE, Social Competence and Behavior Evaluation; SDP, self-directed problem; SEM, structural equation modeling; STRS, Student–Teacher Relationship Scale; TCI, teacher–child interaction; TCR, teacher–child relationship; TLI, Tucker–Lewis index.

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Stuhlman, 2004). Since the 1990s, virtually all research examining TCRs has been linked to findings from the Pianta group (e.g., Birch & Ladd, 1997; Palermo et al., 2007; Spilt et al., 2015; Suntheimer & Wolf, 2020; Varghese et al., 2019). In most studies, *closeness* and *conflict* ratings from the STRS were significantly associated with children's adaptive functioning in concurrent and/or longitudinal assessments. TCR *closeness* was thought to reflect a teacher's perception of warmth and support, and was often positively associated with children's cooperation in the classroom, social competence (SC), and prosocial behavior, and also negatively associated with aggression (e.g., Glüer & Gregoriadis, 2017; Hughes et al., 2014; Sette et al., 2013). In contrast, TCR *conflict* was thought to reflect teachers' relational hostility and has been positively associated with child aggressive behavior and negatively with child SC (e.g., Birch & Ladd, 1997; Hughes et al., 2014; and see Nurmi, 2012, for a meta-analysis). In some studies, TCR ratings also predict TCR ratings in subsequent years with new teachers and peers (e.g., Howes et al., 2000).

Pianta and Nimetz (1991) explicitly construed TCRs as analogous to parent–child attachments in the initial iteration of the STRS (e.g., Pianta, 1994; Pianta & Steinberg, 1992). However, TCRs cannot be "love" relationships, in Bowlby's sense (i.e., deep and abiding emotional bonds that are the core of attachment relationships, Bowlby, 1969/1982), and "loss" of teachers as children move to new classrooms is rarely accompanied by signs of grief or mourning (e.g., Verschueren & Koomen, 2012). Consequently, the STRS *closeness* and *conflict* scales are typically described as indices of teachers' *perceptions* of their relationships with children in their classrooms. Even so, it remains true that teachers' ratings of *closeness* and/or *conflict* with their students during early childhood tend to be both significant correlates of children's concurrent socioemotional and academic adaptation and significant predictors of later socioemotional and academic adjustment in subsequent classroom settings (e.g., Ansari et al., 2020; Maldonado-Carreño & Votruba-Drzal, 2011).

With the acknowledgment that TCR measures assessed teachers' perceptions, researchers began studying how teachers came to perceive their relationships with children as close or conflicted. Questions regarding whether teacher perceptions were based on unique interaction histories with individual children (i.e., based on the premise that "relationships" summarize stable patterns of dyadic interactions, Hinde, 1976) or whether they reflect generalized expectations about a child's behavior based on observations of the child's classroom behavior were tested (e.g., Birch & Ladd, 1997). Research addressing such questions has increased substantially over the last decade (e.g., Cadima et al., 2019; Guan et al., 2020; Hartz et al., 2017; Wu et al., 2018), and it is now common to consider whether TCR ratings reflect "relationship-driven" or "child-driven" effects (e.g., McKinnon et al., 2018; Mejia & Hoglund, 2016; Zatto & Hoglund, 2019). The results are mixed when "child-driven" versus "relationship-driven" models are contrasted and findings may depend on the specific outcome variable being assessed (e.g., social/emotional vs. cognitive/academic) as well as on the sources of information for TCRs and/or child behaviors (e.g., teacher report, parent report, direct observation, and performance based). However, reports from numerous studies have suggested that teachers' TCR perceptions were at least partially influenced by child behaviors assessed before teachers rated their TCRs (i.e., child-driven effects; e.g., Birch & Ladd, 1997; Guan et al., 2020; Wu et al., 2018; Zatto & Hoglund, 2019). However, in other studies, investigators have reported that TCRs predict children's subsequent social and academic outcomes even when controlling prior child behaviors, temperamental characteristics, and/or cognitive abilities (i.e., relationship-driven effects; e.g., Cadima et al., 2016; Cadima et al., 2019; Varghese et al., 2019).

The available data do not support definitive statements about *why* TCR variables forecast later school success or about whether TCR *closeness* or TCR *conflict* is the critical variable underlying these predictions. What is clear, however, is that there is insufficient data about child factors antecedent to teachers' perceptions of their TCRs. Moreover, few studies have examined simultaneously a wide range of social, affective, and cognitive variables that may underlie teachers' perceptions of their TCRs. Rater idiosyncrasies are another potential issue in the extant literature. In nearly all studies reported, a single teacher provided TCR ratings for a classroom; in many studies, the same teacher-rated child behavior and socioemotional adaptation. Having multiple raters provide assessments would allow for testing whether ratings for TCRs and ratings of child behavior and socioemotional status are invariant in metric, configural, and scalar tests (see Koomen et al., 2012; Milatz et al., 2014, for relevant analyses of the STRS). Finally, direct observations of teacher–child interactions (TCIs) should be helpful for revealing potential social origins of TCR perceptions (e.g., Ansari & Pianta, 2019; Doumen et al., 2012).

Our study aims to address several of these issues in concurrent and longitudinal data using teacher reports for TCRs and child socioemotional functioning, performance measures of child SC and receptive vocabulary, and direct observations of TCIs and children's expressed affect. We examined associations among scores derived from a battery of questionnaires (including the STRS) completed by teachers in each classroom near the end of each academic year. We also examined associations between TCR *closeness* and *conflict* and performance measures of peer SC, receptive vocabulary, rates of TCIs, and children's rates of expressed affect. Because data were obtained over consecutive preschool years, approximately 67% of the children

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recruited to the study as 3-year-olds were seen in two different classrooms, with different teachers, and with a mixture of familiar and new peers. These data allow us to evaluate the degree to which teachers' ratings of TCRs are related to their ratings of child behavior, affect, and cognitive functioning and whether significant longitudinal associations between TCRs and child functioning are detected in new classrooms when prior measures of child functioning are controlled. These data also afford opportunities to test whether TCR *closeness* and *conflict* have distinct concurrent and/or longitudinal correlates. Finally, observations of child–teacher interactions allow us to test whether different interaction patterns are antecedent to teachers' perceptions of TCRs.

Four research questions (RQs) guided our study. First, do teachers in a single classroom and teachers across classrooms use the battery of rating scales in the same ways (i.e., configural, metric, and scalar invariance among raters), and to what degree do teachers converge with regard to their TCR ratings and other social/emotional attributes of the children? Second, are TCR perceptions of *closeness* and *conflict* related to concurrent ratings of children's adaptive and problem behaviors, performance measures of children's receptive vocabulary and SC, observed TCIs, and rates of children's expressed affect? Third, to what extent are the study variables (i.e., teacher ratings, performance scores, observed TCIs, and child-expressed affect) related over time as children enter new classrooms with new teachers? Fourth, do longitudinal analyses support a "relationship driven" interpretation (i.e., T1 TCR scores significantly predict T2 child ratings, performance scores, TCIs, and expressed affect when T1 child scores are controlled)? Or, do longitudinal analyses support a "child-driven" interpretation (i.e., T1 child ratings, performance scores, TCIs, and expressed affect predict T2 TCR scores and T2 child scores when controlling for both T1 TCR scores and T1 child scores)?

METHOD

Participants

A total of 185 children (107 girls) enrolled in a National Association for the Education of Young Children (NAEYC)-accredited early childhood program between September 2017 and June 2020 were recruited into the study and had scoreable data for the TCR ratings (Pianta, 2001). The ratio of girls to boys was similar in the younger and older classrooms. Of these children, 89 recruited when they were <48 months of age were assessed subsequently when they were >48 months of age (total assessments = 274, ~75% of all eligible children participated in the study). Between 75% and 90% of eligible children in each classroom participated in each of the 3 project years, and year-over-year attrition for participating children was ~5%. Attrition was due primarily to families leaving the center; no child was withdrawn from the study within a project year or across project years when the child remained enrolled at the center. The sample was predominantly European American (~75%), with the remaining children being African American (~15%) and Asian or Hispanic (~10%). The sample was broadly middle class in terms of education and occupational title categories, however, the classrooms with older children served as State model Pre-K classrooms and approximately a third of the children in these classrooms (90% African American) received tuition subsidies. Because tuition-subsidized children were enrolled in their last pre-K year, they had no longitudinal data, but they are included in our analyses using full-information maximum-likelihood (FIML) estimation. Similarly, older children assessed in Project Year 1 and younger children in Project Year 3 ($N = 92$) had no longitudinal data. Missing values were estimated using FIML procedures in the substantive and invariance analyses reported here. Finally, no longitudinal cases recruited in Project Year 2 had performance data for peer acceptance or receptive vocabulary in Project Year 3 because the center closed for COVID-19 pandemic reasons (March 2020) before those assessments were initiated; these values were also estimated using FIML procedures.

All teachers were female and at least one teacher in every classroom held a BS or MS in human development or early childhood education. Teachers without a 4-year degree all had a minimum of an Associate degree in early childhood education. All teachers had between 4 and 25 years of experience in early education programs and about 50% were European American, with the remaining being African American. All classrooms met the standards set by the NAEYC).

Procedure

The project was reviewed and approved by the University IRB committee prior to sample recruitment. At the beginning of each Project Year, parents heard a presentation of the project goals and methods from the PI and/or the center Director and this was followed up within a week by a formal consent letter requesting the child's participation, which was signed by a parent or guardian. Observations began by the third week of September and were completed by mid-to-late January (after children returned from the holiday break). In the post-holiday term (between February and June), picture sociometric data were collected and children were also tested individually on a receptive vocabulary measure (*Peabody Picture Vocabulary Test*, version IV, PPVT-IV; Dunn & Dunn, 2007). Between April and July of each year, teachers completed a large battery (235 total items) of scales for each participating child. Teachers received a modest compensation for their time completing the

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questionnaires. Because post-holiday assessment times overlapped, we were not able to consistently order the teacher ratings and either the PPVT or the picture sociometric data collections within a project year. Thus, the ordering of variables within project years (except for *social engagement*) is arbitrary and is not intended to describe causal pathways.

Measures

Children's adaptive traits, problem behaviors, and temperament were assessed from teacher-rated scales that are widely used in studies of early childhood development (e.g., LaFreniere & Dumas, 1996; Putnam & Rothbart, 2006). Teachers also rated the quality of their relationships with each child using the STRS–short form (Pianta, 2001). Ratings were completed for every participating child in a classroom by both co-teachers. In prior analyses for many of the rating measures used here, it was not possible to precisely reproduce the factor structures reported by the original authors (e.g., Snider, 1999). Furthermore, factor structures for individual instruments were not invariant for younger and older preschool children (Akers, 2006). Consequently, we subjected our data to a series of model invariance tests for each instrument across both age levels (study Aim 1). Although we describe the scales reported by the test authors, our analyses do not necessarily represent the precise dimension structures they reported. Performance scores based on standardized tests (i.e., PPVT), sociometric interviews, and direct observations (such as initiated TCIs) provided additional perspectives on the quality of child behavior, cognitive, and affective adaptation.

Teacher-report measures

Student–Teacher Relationship Scale

Teachers completed the STRS–short form (Pianta, 2001). This 15-item measure evaluates teachers' perceptions of their relationships with children in their classrooms. Items are scored on a 5-point Likert scale, with higher scores implying greater closeness (or conflict). Item scores are used to create TC *closeness* and *conflict* scores (α's > .90 for both scales at both age levels) for each participating child.

Penn Interactive Peer Play Scale (Fantuzzo et al., 1995)

This is a teacher-report measure of preschool-age children's behaviors observed during interactive play. Items are rated on a 4-point scale (1 = never, 4 = always) for 32 behaviors observed over the previous 2 months. Fantuzzo et al. (1995) reported that the measure has adequate reliability, as well as construct, convergent, and divergent validity for scales labeled *play disruption*, *play disconnection*, and *play interaction* (α's > .90 for each scale at both age levels).

Children's Behavior Questionnaire–short form (Putnam & Rothbart, 2006; Teglasi et al., 2015)

This 94-item scale yields scores for 15 temperament dimensions and 3 summary factors (*surgency*, *negative affectivity*, and *effortful control*). Items are rated on 7-point Likert scales. Putnam and Rothbart (2006) reported that both scales and summary factor scores derived from the Children's Behavior Questionnaire–short form (CBQ-short) had adequate internal consistency (i.e., alphas for scales all >.65), inter-rater agreement, and criterion validity (i.e., associations with other measures of the same dimension or summary construct). In this sample, α's for the individual temperament scales exceeded .89 at both age levels for all scales except *shyness* (α's > .75 for both age levels) and *perceptual sensitivity* (α's > .77 for both age levels). For the summary factors, alpha levels were greater than .80 for both *effortful control* and *surgency* and above .72 for *negative affectivity* for both age levels.

Social Competence and Behavior Evaluation-30 (LaFreniere & Dumas, 1996)

This 30-item measure uses a 6-point Likert-type scale for each item, ranging from never (1) to always (6). LaFreniere and Dumas (1996) reported acceptable levels of internal consistency and temporal stability for three subscales: *social competence*, *anger-aggression*, and *anxiety-withdrawal*. In this sample, α's > .90 for each scale from the Social Competence and Behavior Evaluation (SCBE).

Teacher Rating Scales of Social Skills (Dodge & Somberg, 1987)

This 17-item measure was intended to assess three behavior domains: *peer relations* (6 items), *aggression* (4 items), and *social skills* (7 items). Items are rated on a 5-point Likert scale, with lower scores indicating low levels of behavior relevant to the item and higher scores indicating higher levels of item-relevant behavior (e.g., better peer relations, higher levels of aggression, and more advanced social skills). All variables had α's > .90 for both age levels.

Antisocial Behavior Scale (Cairns et al., 1995)

This is a list of seven items describing different forms of antisocial behavior with each rated on a 5-point Likert scale with low scores indicating that the behavior is not characteristic of the child and higher scores indicating that the item is more characteristic of the child. All items form a single scale (*antisocial*, α > .90) for both age levels.

Child Self-Regulation and Behavior Questionnaire (Howard & Melhuish, 2017)

This 33-item companion to the executive function tasks from the Early Years Toolbox yields subscale scores for

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cognitive self-regulation, *behavioral self-regulation*, *emotional self-regulation*, *sociability*, *prosocial behavior*, *externalizing problems*, and *internalizing problems*. Items are rated on a scale from 1 (not true) to 5 (certainly true) for the child. In the development study, some of the items had significant cross-loadings on more than one subscale, and all scales yielded Cronbach's αs > .73. In the present sample, the α values were >.85 for all variables at both age levels.

Performance measures of child competencies

PPVT-IV (Dunn & Dunn, 2007)

This widely used, norm-referenced measure of receptive vocabulary is generally accepted to be reliable and valid. A trained research associate administered the PPVT individually to all participating children. Age-adjusted standard scores were used in our analyses.

Peer acceptance: Nominations

Both negative and positive nomination scores were obtained using the standard McCandless and Marshall (1957) picture sociometric task. A research associate was trained to administer the task. Children were presented with an array of photos for participating children in their classroom and asked to identify children they "especially liked" or whom they "did not especially like". Three peers were chosen for each question. Liked peers were always chosen first. After a peer had been chosen, their photo was turned face down. The responding child then continued to choose "liked playmates" until all photos were turned over. Nomination scores were based on the first three positive and negative choices for each child. These were totaled across all participating children in the classroom and then averaged across all children making choices.

Peer acceptance: Paired comparisons

We also scored peer acceptance using a paired comparisons sociometric task. Photos of all possible pairs of participating children in a classroom were prepared, with each child appearing an equal number of times on the left and right side of the slide. The final array of pairs was arranged such that no child appeared twice before all classmates had appeared once. A participating child was presented with the pairs one at a time and asked which of the two children "do you especially like?" This protocol involved judgments of multiple pairs (e.g., 153 in a classroom with 18 participating children) and occasionally a child would become bored or inattentive. For such cases, the task was stopped and restarted at another time. Children rarely took over 15 min to complete the task. Acceptance scores were calculated as the total number of times the child was chosen as a preferred playmate. These were averaged across the children making choices to get a final score.

Peer acceptance: Ratings

A third sociometric task (ratings on a 3-point scale) was also used to obtain positive and negative sociometric choices. After being trained on the intended meanings of the categories, children placed photos of participating classmates into one of three containers (i.e., do not like to play with, like to play with sometimes, and like to play with very much). Positive sociometric scores were the average number of times the child's photo was sorted into the like very much container and negative sociometric scores were the average number of times the child's photo was sorted into the do not like container.

Average sociometric scores are affected by group sizes and, by convention, are standardized within the relevant unit (i.e., classroom) to adjust for differences in the classroom means. We followed this convention and standardized each of the scores derived from sociometric testing within each classroom.

Social engagement: Initiated interactions

Two trained observers collected the social interaction data. For each classroom, each observer worked from a randomized class roster and watched each participating child on approximately 100 15-s intervals. Each observed interaction was coded for both the initiator and the recipient. Interaction episodes received a "positive" code if either child expressed positive affect during the interaction. They both received a "negative" code if either child expressed negative affect during the interaction. If neither child expressed affect during the interaction, a code of "neutral" was given. The only exception to these guidelines was if negative affect was expressed within the context of fantasy play (e.g., a hero character attacks a villain character during play). These codes convey two types of information. First, initiating or being the recipient of an initiation distinguishes the roles within the interaction episode and each child is identifiable. Second, the affect valence aspect of the coding does not distinguish between children and both the initiator and recipient are credited with participating in an affectively toned interaction. Although it was possible for an interaction to contain both positive and negative affects, this was not frequently observed.

If a child being observed interacted with a teacher during the 15-sec observation interval, the initiator and recipient for the interaction event were recorded, however, the affective valence of TC interactions was not recorded. Thus, scores for each child only indicate frequencies for initiated and received interactions with teachers.

Each child present in the classroom during an observation round was observed once before any child present was observed twice. Observers worked independently and were never observed in the same classroom at the same time. Observers started observation rounds at different places in the class rosters each day and only began

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after at least 50% of participating children had arrived in class for the day. After at least 30% of the children in a given classroom had been observed 100 times (~25 min of observation per observer) and all children had been observed at least 50 times (usually 6–8 days of observation), the observer moved to a new classroom. A small number of participating children (<2% of total) were absent from the classroom for most days when one or both observers collected data. Children with less than 100 observations (combining observations from both observers) were coded as "missing" for these variables. The observations were scored for the total number of times a given child initiated or received an interactive bid for each category of expressed affect.

Observers were experienced in using this observation system prior to the onset of data collection and had achieved satisfactory observer agreement levels (>90% exact agreement for initiator and recipient of interaction and >85% exact agreement for affect valence) using video-recorded interactions. Because observers never worked in a classroom simultaneously and it was not always possible for observers to collect data in consecutive weeks, we did not assume that interaction rates for individual children would be strongly associated across observers. We did, however, assume that each observer's scores for individual children were accurate. Consequently, the raw scores for initiated and received interactions and their affective valences were summed across observers and divided by the total number of observations to yield final rate scores.

Social engagement: Visual attention

Visual attention data were collected by the same observers who obtained interaction data. Visual attention rounds were interspersed with interaction rounds (e.g., 5 of one type followed by 5 of the other). For visual attention, observers watched each child for a 6-sec interval and recorded the identifiers of any person receiving a unit of visual attention during the interval (a "look" was defined as orientation of the observed child's head and eyes toward another person for 2-s or more, and a "glance" was defined as the orientation of head and eyes toward one another but for less than 2 s). Visual attention recipients were credited with only 1 unit for a given observation interval but up to three different children could receive attention from the observed target during a single interval. As with interaction observations, all children present for a visual attention round were observed once before any were observed twice. A total of 100 observation rounds were completed by each observer (~10 min per child per observer) and were terminated when at least 30% of children in the classroom had been observed 100 times and all children had been observed at least 50 times. The sum over all participating children for visual attention received was calculated and divided by the number of observation rounds the child was present (to adjust for missing rounds due to absence or being out of the classroom during a given round of observation, yielding the child's rate of receiving visual attention from peers). Children present for less than 50% of rounds (i.e., <100 total rounds after combining totals for both observers) were treated as "missing" for analysis purposes.

Observers had been trained to use the coding system and had reached acceptable levels of agreement (>75% exact agreement) on *visual regard* given to peers based on video-recorded peer interactions in previous studies from this laboratory. No formal rater agreement assessments were initiated for this study. Moreover, because observations may have been separated by up to 10 classroom days, we did not expect that rates of receiving visual attention would necessarily be strongly related across observers. As with the *interaction* measure, we anticipated that each observer's scores would accurately reflect what they observed in the class and that a composite score would be a better predictor of other variables than would either rater's individual observation data. To coordinate with the sociometric data, the *interaction* and *visual regard* data were standardized within each classroom. Note that this has the effect of equating means and standard deviations for these scores across classrooms but maintains the rank ordering of children in each classroom.

Expressed affect

After each interval of visual attention observation had been recorded, the observer returned to the observed child and watched for an additional 6-s interval, recording any expression of positive and/or negative affect during the interval. The score for each affect valence was the number of intervals in which positive or negative affect was observed. Total scores for each affect valence were divided by the total number of observations completed (summing the data from both observers) and divided by the number of rounds the child was present for observation. Children observed for less than 50% of total rounds were considered "missing" for these variables. Finally, the affect observation rates were standardized within classrooms prior to further analysis.

Analysis plan

Both confirmatory and exploratory approaches were used in this study. Although there is a body of literature suggesting that TCRs are critical influences on preschoolers' subsequent growth and change in academic settings, this assumption has been challenged by studies suggesting that academic and social growth is driven by child attributes that also underlie TCRs. Analyses relevant to the first RQ are confirmatory in nature. Subsequent analyses attempt to test whether TCRs are causally antecedent to future growth/change in children's adaptive behavior or whether individual differences in adaptive

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behavior pre-date the construction of TCRs. These can be considered exploratory.

The analyses were conducted in three steps. First, after the data were screened for outliers and normality, we used multilevel structural equation modeling to assess first-order factor structures of teacher-rated child constructs across classrooms and teachers using a two-step approach within the R program (R Core Team, 2020) using the "lavaan" (Rosseel, 2012) package. For each construct, we tested measurement invariance using a dyadic approach across classrooms. Although the common assumption is that teachers' evaluations of students are highly consistent within classrooms, we employed multidimensional models that included teacher-specific latent constructs within classrooms. This multi-informant approach allowed us to: (a) test for the equivalence of teacher ratings of child characteristics across classrooms while considering the non-independence of observations within pairs, and (b) ensure that any differences in results between classrooms are not due to differences in measurement models (Sakaluk et al., 2021). Weak measurement invariance indicates that quantitative ratings of child assessments are dependent on teachers or potential discrepancies in their understanding or interpretation of items in child assessments, whereas strong invariance demonstrates the validity of measurements determined by convergence of teachers' interpretation of child assessments (Putnick & Bornstein, 2016). These analyses are relevant to answering RQ 1.

Each set of measurement invariance models contained two within- and two between-level latent variables consisting of teacher 1 and teacher 2 ratings within and between classrooms. The classroom variable ($n = 19$) was used as a cluster variable in the models. Measurement models assessed (a) whether teacher 1 and teacher 2 ratings demonstrate the same factor structures within classrooms and (b) whether latent constructs were approximately equivalent between classrooms. Thus, we tested the configural invariance model for each construct where the number of items in latent constructs was equivalent across teachers and classrooms, but within-level and between-level factor loadings were estimated freely. Next, we assessed a metric invariance model where within- and between-level factor loadings were equal across teachers but estimated differently across classrooms. The last model considered whether within- and between-level factor loadings were equivalent across teachers and classrooms. Factor scores were saved from the final models. Missing data were addressed using FIML estimation. We evaluated the overall goodness of fit for each model using the χ^2 statistic, comparative fit index (CFI), Tucker–Lewis index (TLI), and root mean square error of approximation (RMSEA). A χ^2 with a p-value larger than .05, CFI and TLI values greater than .90, and RMSEA value less than .08 indicate good model fit (Kline, 2016). Configural, metric, and strong invariance models were compared using χ^2 difference tests ($p > .05$), and differences in the CFI ($\Delta CFI \leq .010$) and RMSEA ($\Delta RMSEA \leq .015$) values (Chen, 2007).

We also conducted sensitivity analyses using 30 sets of multiply imputed data. A posterior predictive mean matching algorithm was used to impute missing data within the "Mice" package (van Buuren & Groothuis-Oudshoorn, 2011). In the longitudinal sample, the proportions of missing values were between 1% and 27%, and 30 sets of imputed values were generated to address the variability across imputations. Measurement invariance models were conducted using the "semTools" package (Jorgensen et al., 2018), and 30 sets of plausible values were saved from final models to examine the cross-sectional and longitudinal associations between teacher–child *closeness* and *conflict* and child outcomes. Parameter estimates and confidence intervals on each imputed dataset with plausible values were combined using Rubin's rule (Enders, 2010). Models using FIML and multiply imputed data produced similar results, and FIML estimates were reported.

In the second step, exploratory factor analysis (EFA) was conducted using the "psych" package to identify underlying dimensions and classify latent constructs into groups using estimated latent factor scores for each child. After determining the number of factors, a set of multigroup confirmatory factor analyses was conducted to assess the similarity of factor loadings across age groups. Composite scores of child outcomes were calculated and aggregated across teachers.

In the final set of analyses, latent variable structural equation modeling (SEM) models tested the cross-sectional and longitudinal associations between TCR *closeness* and *conflict* and child outcomes, teacher–child interactions, child expressed affect, and child performance variables. Maximum-likelihood estimation was used, and the χ^2 difference test was performed for model comparison. A probability level of .05 was used to determine statistical significance and goodness of fit was determined by using the χ^2 statistic, CFI, TLI, and RMSEA values.

Inquiries about study data and materials should be directed to the first or last authors.

RESULTS

Measurement models (RQ1)

The dyadic multilevel confirmatory factor analysis (CFA) models were used to test the level of agreement between teachers' evaluations of children and the degree to which teachers' ratings were similar across classrooms by constraining the number of items, factor loadings between teachers, and factor loadings across classrooms iteratively. Table 1 presents the model-fit indices and likelihood ratio tests from CFAs (parameter estimates

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TABLE 1 Fit indices for multilevel confirmatory factor analyses.

	CFI	TLI	χ^2	df	RMSEA	Within-level correlations	Between-level correlations
Sociability	.92	.91	241.65***	115	.06	.766	.84
Externalizing	.92	.91	204.68***	78	.08	.838	.957
Internalizing	.94	.92	51.50***	23	.07	.622	.686
Prosocial	.94	.93	178.43***	78	.07	.711	.737
Behavioral self-regulation	.91	.90	271.76***	117	.07	.813	.961
Cognitive self-regulation	.98	.97	127.48***	82	.04	.754	.957
Emotional self-regulation	.91	.90	258.32***	117	.07	.876	.97
TCR closeness	.91	.89	256.78***	115	.07	.424	.625
TCR conflict	.90	.90	464.63***	167	.08	.837	.98
Anxiety withdrawal	.91	.90	192.16***	119	.05	.498	.823
Social competence	.90	.88	436.46***	217	.06	.587	.484
Anger-aggression	.90	.89	578.68***	222	.08	.745	.976
Antisocial behavior	.90	.89	530.16***	169	.09	.735	.827
Peer relations	.89	.88	672.76***	279	.07	.755	.803
Social skills	.94	.94	423.10***	170	.07	.642	.797
Play disruption	.91	.90	669.94***	363	.06	.733	1
Play disconnection	.88	.87	323.02***	164	.06	.626	.933
Play interaction	.94	.94	269.89***	168	.05	.654	.908

Abbreviations: CFI, comparative fit index; RMSEA, root mean square error of approximation; TCR, teacher–child relationship; TLI, Tucker–Lewis index.
***$p < .001$.

are available upon request) assessing factor structures of the following constructs: TCR *closeness* and TCR *conflict* (Pianta, 2001); *play disruption*, *play disconnection*, and *play interaction* (Fantuzzo et al., 1995); *surgency*, *negative affectivity*, *effortful control* (CBQ-short teacher form, Teglasi et al., 2015); *social competence*, *anger-aggression*, and *anxiety-withdrawal* (SCBE-30; LaFreniere & Dumas, 1996); *peer relations* and *social skills* (Dodge & Somberg, 1987); *antisocial behavior* (Cairns et al., 1995); and *Cognitive self-regulation*, *behavioral self-regulation*, *emotional self-regulation*, *sociability*, *prosocial behavior*, *externalizing problems*, and *internalizing problems* (Child Self-Regulation and Behavior Questionnaire; Howard & Melhuish, 2017). Overall, configural models showed acceptable model fit to data, indicating that teacher-specific latent constructs contained the same items within and between classrooms. In addition, imposing equality in the within-level item factor loadings did not significantly decrease CFI and RMSEA values, demonstrating the interdependence of teacher evaluations within classrooms. Furthermore, differences in CFI and RMSEA values were not greater than .01 when between-level factor loadings were constrained to be equal across classrooms suggesting teachers' interpretation of child assessments were sufficiently similar between teachers across 3- and 4-year-old classrooms.

After establishing similar factor structures across teachers and classrooms, latent factor scores from each teacher were aggregated, and EFA was conducted using average latent factor scores of *play disruption*, *play disconnection*, *play interaction*, *surgency*, *negative affectivity*, *effortful control*, *social competence*, *anger-aggression*, and *anxiety-withdrawal*, *peer relations*, and *social skills*, *antisocial behavior*, *cognitive self-regulation*, *behavioral self-regulation*, *emotional self-regulation*, *sociability*, *prosocial behavior*, *externalizing problems*, and *internalizing problems*. The results indicated three latent factors explaining 77.48% of the total variance: *adaptive* child behavior (*play interaction*, *effortful control*, *SC*, *peer relations* and *social skills*, *cognitive self-regulation*, *behavioral self-regulation*, *emotional self-regulation*, *sociability*, and *prosocial behavior*), *self-directed problem* behaviors (*SDP*; *anxiety-withdrawal*, *disconnection*, *internalizing problems*, and *negative affectivity*), and *outward-directed problem* behaviors (*ODP*; *play disruption*, *antisocial behavior*, *anger-aggression*, and *externalizing problems*). The factor loadings ranged from 0.89 to 0.64, and the correlation between *adaptive* and *SDP* factors was −0.24, *adaptive* and *ODP* factors was −0.05, and *SDP* and *ODP* factors was −0.08. Next, a set of multigroup CFA were conducted to assess whether factor loadings of each construct were similar across older and younger children. Due to the relatively modest sample size, each latent construct was tested separately. We note that a subset of children (i.e., 89 longitudinal cases) are represented in both the younger and the older subsets. However, given that invariance across classrooms at T1 was found and that children were rated by different teachers, and also that peer groups were substantially

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different over time, we do not believe that this degree of non-independence poses problems for interpretation of cross-age CFA results.

The model estimating the factor loadings of *adaptive behavior* freely across age groups fits the data acceptably ($\chi^2(31)=55.697$, $p<.05$; CFI = .987; TLI = .948, RMSEA = .098, 95% CI [.06, .13]). In addition, the model constraining factor loadings across age groups fit the data well ($\chi^2(31)=55.697$, $p<.05$; CFI = .989; TLI = .969, RMSEA = .076, 95% CI [.04, .11]) and the χ^2 difference test comparing the magnitude of factor loadings across age groups was not significant ($\Delta\chi^2(9)=4.623$, $p>.05$), suggesting factor loadings for *adaptive behavior* were similar across groups. The second set of CFA models estimated free and constrained factor loadings of *ODP* across groups. The free model showed an acceptable fit ($\chi^2(2)=0.675$, $p>.05$; CFI = 1.00; TLI = 1.00, RMSEA = .00, 95% CI [.00, .12]) and the χ^2 difference test was not significant ($\Delta\chi^2(3)=5.815$, $p>.05$), suggesting factor loadings of *ODP* were also similar across groups. Finally, the model freely estimating factor loadings of *SDP* across age groups showed a good model fit ($\chi^2(2)=1.777$, $p>.05$; CFI = 1.00; TLI = 1.00, RMSEA = .00, 95% CI [.00, .16]) and the χ^2 difference test comparing models free and constrained factor loadings of the *SDP* construct across older and younger children was not significant ($\Delta\chi^2(3)=3.787$, $p>.05$) indicating that factor loadings of *SDP* did not vary across age groups. Table 2 shows factor loadings of teachers' characterization of children's *adaptive behavior*, *SDP*, and *ODP* behaviors.

Cross-sectional correlations (RQ2)

Table 3 consists of three panels; correlations were calculated independently for each panel. Cross-sectional results are presented in Panels 3a and 3b. Panel 3c presents the longitudinal correlations. Table 3a shows that, for preschoolers <48 months old at the beginning of the academic year (i.e., T1), teachers' perceptions of TCR *closeness* were negatively associated with their perceptions of TCR *conflict* as well as with their characterizations of children's *SDP* behavior. TCR *closeness* was also positively associated with teachers' characterizations of children's *adaptive behavior*, as well as with the SC performance variables (i.e., *peer acceptance* and *social engagement*). Teachers' perceptions of TCR *conflict* were positively associated with their ratings of *SDP* and *ODP* behaviors and expressed negative affect and *teacher-initiated* TCIs. TCR *conflict* was negatively associated with *adaptive behaviors* and *peer acceptance*. Child sex (girls coded as "1" and boys coded as "0") was positively associated with perceptions of TCR *closeness* and *adaptive behaviors*, suggesting that teachers reported feeling

TABLE 2 Factor structure from multigroup confirmatory factor analysis.

					3-year-old	4-year-old
	Estimate	**SE**	***z*-Value**	***p*-Value**	**Std. estimate**	**Std. estimate**
Adaptive behavior						
Play interaction	.785	.065	11.994	<.001	.761	.789
Effortful control	.816	.068	12.063	<.001	.748	.832
Social competence	.879	.067	13.117	<.001	.905	.861
Social skills	.717	.063	11.449	<.001	.746	.722
Prosocial behavior	.849	.061	13.834	<.001	.859	.864
Sociability	.789	.061	12.927	<.001	.771	.824
Behavioral self-regulation	.805	.063	12.715	<.001	.834	.780
Peer relations	.812	.064	12.732	<.001	.777	.834
Cognitive self-regulation	.653	.061	10.703	<.001	.684	.651
Emotional self-regulation	.605	.065	9.273	<.001	.606	.628
Outward-directed behavior						
Play disruption	.916	.063	14.446	<.001	.876	.931
Antisocial behavior	.917	.064	14.386	<.001	.880	.925
Anger-aggression	.918	.066	13.969	<.001	.865	.907
Externalizing problems	.919	.065	14.112	<.001	.929	.883
Self-directed behavior						
Anxiety	.823	.073	11.261	<.001	.804	.807
Disconnection	.983	.078	12.615	<.001	.915	.992
Internalizing	.497	.068	7.358	<.001	.465	.506
Negative affect	.451	.090	4.994	<.001	.399	.441

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closer with girls and rated them more positively in general than they rated boys, at T1. Child sex also was negatively associated with *negative affect*.

For children >48 months of age at the beginning of the academic year (Table 3b, T2), TCR *closeness* scores were negatively associated with TCR *conflict* scores and with both *SDP* and *ODP* behaviors. TCR *closeness* was also positively related to *adaptive behaviors* and *peer acceptance*. TCR *conflict* was positively associated with both *SDP and ODP* behaviors and *child-initiated* TCIs. TCR *conflict* was negatively associated with *peer acceptance* and *adaptive behaviors*. At T2, child sex was positively associated with *adaptive behaviors* and negatively associated with *ODP* behavior, suggesting that teachers rated girls' behavior more positively than they rated boys' behavior.

Longitudinal correlations (RQ3)

Table 3c shows the correlations among teacher ratings, performance scores, observed TCIs, and child expressed affect over time. Only two autocorrelations (i.e., expressed positive affect and teacher-initiated TCIs) failed to reach significance. For the most part, significant cross-time correlations were plausible and coherent (e.g., T1 TCR *closeness* was positively and significantly associated with T2 *adaptive behaviors* and *peer acceptance* and T1 TCR *conflict* was negatively and significantly associated with both *adaptive behaviors* and *peer acceptance*, but positively and significantly associated with T2 *ODP behaviors*). Additionally, T1 TCR *conflict*, T1 *SDP behaviors*, and T1 teacher-initiated *TCIs* were negatively associated with T2 TCR *closeness*, T2 *adaptive behaviors*, and T2 *peer acceptance*. In addition, T1 *ODP behaviors* were negatively correlated with T2 *adaptive behaviors* and T2 *peer acceptance*. T1 *PPVT* was also positively correlated with T2 *adaptive behaviors*.

Social engagement and *peer acceptance* at T1 had similar patterns of associations with T2 variables, although these reached statistical significance more frequently for *peer acceptance*. The T1 expressed affect scores tended to have reversed signs with regard to the teachers' ratings scores with 6 of 10 correlation values reaching the level of statistical significance. Neither of the T1-expressed affect scores showed a strong pattern of associations with the performance variables, although *positive affect* did have a significant negative association with T2 *child-initiated* TCIs and a significant positive association with T2 *teacher-initiated* TCIs. T1 *child-initiated* TCIs were not significantly associated with any of the T2 teacher ratings but had positive and significant associations with T2 *social engagement* and *teacher-initiated* TCIs. However, the *teacher-initiated* TCIs variable was negatively and significantly associated with T2 TCR *closeness*, *adaptive behaviors*, and *peer acceptance* and was positively and significantly associated with T2 *ODP and SDP*. Finally, the T1 PPVT score had a single off-diagonal significant association with T2 teacher-rated *Adaptive Behaviors*.

We note that this summary does not exhaust the number of significant associations from Table 3c, but conveys the sense that the different variable categories (i.e., ratings, peer evaluations, and direct observations) are associated in conceptually meaningful ways.

Longitudinal associations between TCRs and TCIs and expressed affect (RQ4)

We used SEM models with both latent and observed variables to examine the links among TCIs, *positive affect*, and the TCR latent variables. Because *teacher-initiated* and *child-initiated* TCIs were not significantly associated at either Time 1 (T1) or Time 2 (T2), they were treated as unique variables in this analysis. The *TCI* and *positive affect* variables were treated as exogenous variables, and TCR *closeness* and *conflict* were considered endogenous variables in the model due to the ordering of assessments. Although we had observed and coded *negative affect*, our initial model indicated that *negative affect* had no significant links with any T1 or T2 variable, so it was excluded from our analysis (see Figure 1). All paths were freely estimated, and all indirect effects were tested for significance. Only significant indirect pathways are included in Figure 1.

The figure indicates that T1 *teacher-initiated* TCIs were positively associated with T1 TCR *conflict* ($\beta = .33$, $p < .01$) and negatively predicted T2 TCR *closeness* ($\beta = -.25$, $p < .05$). T1 *teacher-initiated* TCIs were also indirectly associated with T2 TCR *conflict* via T1 TCR *conflict* ($\beta_{ind} = .18$, $p < .05$). Furthermore, T1 *positive affect* was positively associated with Year 1 TCR *closeness* ($\beta = .17$, $p < .05$), which in turn positively predicted T2 TCR *closeness* ($\beta = .38$, $p < .05$). T1 *positive affect* also positively predicted T2 *positive affect* ($\beta = .22$, $p < .01$) and T2 *teacher-initiated* TCIs ($\beta = .21$, $p < .05$), and negatively predicted both T2 *child-initiated* TCIs ($\beta = -.26$, $p < .01$) and T2 TCR *conflict* ($\beta = -.25$, $p < .001$). T1 *child-initiated* TCIs were positively predictive of T2 *child-initiated* TCIs ($\beta = .22$, $p < .05$), which in turn was positively associated with T2 TCR *closeness* ($\beta = .22$, $p < .001$).

Longitudinal associations between TCRs and child ratings and performance scores (RQ4)

Next, structural equation models tested relations among the TCR variables and both teacher-rated and performance-based measures relevant to competence. SEMs using latent and observed variables (when appropriate) were calculated for each relevant predictor model (i.e., TCRs predict later outcomes vs. teacher-rated behavior factors and performance-based measures predicting later TCRs). As shown in Figures 2 and 3, each model

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TABLE 3 Correlations among variables at (a) T1, (b) T2, and (c) T1 x T2.

(a)	T1 TCR closeness	T1 TCR conflict	T1 adaptive	T1 ODP	T1 SDP	T1 social engagement	T1 peer acceptance	T1 positive affect	T1 negative affect	T1 child-init int	T1 teacher-init int	T1 PPVT
T1 TCR conflict	−.306**											
T1 adaptive	.573**	−.664**										
T1 ODP	−.161	.809**	−.618**									
T1 SDP	−.485**	.434**	−.570**	.248**								
T1 social eng.	.348**	.037	.244**	.146	−.262**							
T1 peer acceptance	.359**	−.413**	.565**	−.357**	−.362**	.436**						
T1 positive affect	.146	.006	.176	.090	−.142	.704**	.443**					
T1 negative affect	−.041	.360**	−.285**	.489**	.004	.162	−.160	.156				
T1 child-init int	.115	.140	.002	.218*	−.099	.171	−.012	.029	.227*			
T1 teacher-init int	−.059	.353**	−.382**	.341**	.181*	−.042	−.284**	−.127	.294**	.085		
T1 PPVT	.193	.038	.195	.008	−.112	.077	.118	.020	.110	.021	−.008	
child sex	.226*	−.140	.233**	−.156	.023	−.065	.120	.007	−.206*	−.049	−.132	.027
M	−.026	.018	−.026	.040	.037	.208	.000	.021	−.003	.057	−.023	112.82
SD	.366	.779	.377	.678	.408	.575	.815	.989	.961	1.001	.976	10.39

(b)	T2 TCR closeness	T2 TCR conflict	T2 adaptive	T2 ODP	T2 SDP	T2 social engagement	T2 peer acceptance	T2 positive affect	T2 negative affect	T2 child-init int	T2 teacher-init int	T2 PPVT
T2 TCR conflict	−.546**											
T2 adaptive	.597**	−.758**										
T2 ODP	−.439**	.840**	−.767**									
T2 SDP	−.604**	.553**	−.696**	.464**								
T2 social eng.	.079	.013	−.025	.110	−.072							
T2 peer acceptance	.244*	−.327**	.586**	−.451**	−.450**	−.023						
T2 positive affect	−.013	−.031	−.023	.020	.011	.669**	.085					
T2 negative affect	−.074	.065	−.075	.110	.007	.089	−.154	.124				
T2 child-init int	.108	.228*	−.098	.161	−.012	−.026	−.174	−.135	.081			
T2 teacher-init int	.018	−.041	−.080	.021	.113	.142	−.084	.036	.103	.052		
T2 PPVT	.063	.017	.191	.012	−.201	−.193	.076	−.036	.061	.108	.230	
Child sex	.059	−.119	.284**	−.204*	−.110	−.143	.159	−.125	−.074	−.061	−.085	−.006
M	.018	−.021	.024	−.023	−.017	.238	.031	.000	.031	−.003	−.081	116.50
SD	.352	.932	.449	.747	.347	.558	.817	.966	.996	.963	.950	8.83

(Continues)

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TABLE 3 (Continued)

(c)	T2 TCR closeness	T2 TCR conflict	T2 adaptive	T2 ODP	T2 SDP	T2 social engagement	T2 peer acceptance	T2 positive affect	T2 negative affect	T2 child-init int	T2 teacher-init int	T2 PPVT
T1 TCR closeness	.395**	−.139	.373**	−.033	−.307**	.126	.356*	−.055	−.064	−.087	.112	.123
T1 TCR conflict	−.280*	.553**	−.579**	.545**	.189	.076	−.506**	.020	.204	.126	−.035	−.255
T1 adaptive	.243*	−.467**	.666**	−.499**	−.335**	.059	.518**	.054	−.065	−.217*	.086	.283
T1 ODP	−.117	.481**	−.411**	.632**	.023	.209*	−.330*	.064	.250*	.129	−.052	−.288
T1 SDP	−.250*	.199	−.447**	.150	.444**	−.316**	−.575**	−.259*	−.047	.012	−.070	−.058
T1 social eng.	.184	−.196	0.202	−.027	−.198	.354**	.089	.315**	.051	−.111	.208	.157
T1 peer acceptance	.257*	−.412**	.456**	−.313**	−.172	.189	.392*	.248*	−.016	−.239*	.062	.251
T1 positive affect	.131	−.264*	.231*	−.104	−.269*	.135	.190	.163	.005	−.260*	.215*	.203
T1 negative affect	−.179	.329**	−.317**	.467**	.032	.141	−.262	−.038	.218*	.152	−.032	−.067
T1 child-init int	−.001	.097	0.032	.059	−.153	.283**	.051	.193	.193	.209*	.073	−.131
T1 teacher-init int	−.310**	.205	−.353**	.326**	.217*	.144	−.414**	.098	.139	.147	−.034	−.179
T1 PPVT	.187	−.172	.257*	−.090	−.203	−.018	.208	−.124	.089	.154	.093	.625**

Abbreviations: ODP, outward-directed problem; PPVT, Peabody Picture Vocabulary Test; SDP, self-directed problem; TCR, teacher–child relationship.
*$p < .05$; **$p < .01$;

tested the direct links between T1 TCRs and a T1 and T2 child rating or performance score, as well as the autocorrelation between T1 and T2 TCRs. Each model includes the direct links between a T1 child rating or performance score and T2 TCRs as well as the autocorrelations for the child rating or performance score and the direct links between T2 TCRs and a T2 child rating or performance score. Child sex was included in all models as a control variable. The models also tested indirect links between T1 TCRs and T2 TCRs via T1 child ratings and performance scores, as well as indirect associations between T1 and T2 child ratings and performance scores. Again, only significant indirect paths are included in the Figures. Model fit was adequate for all outcomes with non-significant χ^2 values (ranging from 7.46 to 9.43, df = 4).

Figure 2a presents the associations between TCR *closeness and conflict*, and teacher-rated child *adaptive behaviors*. Results of SEMs indicated that TCR *closeness* was positively and *conflict* was negatively associated with *adaptive behaviors* at both T1 ($\beta = .36$, $p < .001$ and $\beta = -.55$, $p < .001$, respectively) and T2 ($\beta = .30$, $p < .001$ and $\beta = -.40$, $p < .001$, respectively). T1 TCR *conflict* predicted T2 TCR *conflict* and *closeness* ($\beta = .41$, $p < .05$ and $\beta = -.25$, $p < .05$, respectively), and T1 TCR *closeness* predicted T2 TCR *closeness* ($\beta = .37$, $p < .001$). T1 teacher-rated *adaptive behaviors* predicted T2 teacher-rated *adaptive behaviors* ($\beta = .41$, $p < .001$) and T2 TCR *conflict* ($\beta = -.23$, $p < .10$). Child sex was also positively associated with T2 *adaptive behaviors* ($\beta = .15$, $p < .05$), suggesting that girls had higher scores. Finally, T1 TCR *closeness* was indirectly predictive of T2 *adaptive behaviors* via T1 *adaptive behaviors* and T2 TCR *closeness* ($\beta = .26$ $p < .001$), and T1 TCR *conflict* was indirectly associated with T2 *adaptive behaviors* via T1 *adaptive behaviors* and T2 TCR *conflict* ($\beta = -.39$, $p < .001$).

Figure 2b shows that, after controlling for child sex, T1 TCR *closeness* was associated with T1 *ODP* behaviors ($\beta = .15$, $p < .05$), and predicted T2 TCR *closeness* ($\beta = .31$, $p < .01$), which in turn was associated with T2 *ODP* behaviors ($\beta = -.34$, $p < .001$). Additionally, T1 TCR *conflict* was associated with T1 *ODP* behaviors ($\beta = .85$, $p < .001$), and predicted T2 *conflict* ($\beta = .39$, $p < .001$) and T2 TCR *closeness* ($\beta = -.28$, $p < .10$). T2 TCR *conflict* was also directly associated with T2 *ODP* behaviors ($\beta = .67$, $p < .001$). T1 TCR *closeness* indirectly predicted T2 *ODP* behaviors via T1 *ODP* ($\beta = .06$, $p < .05$). T1 *conflict* also indirectly predicted T2 *ODP* via T1 *ODP* ($\beta_{ind} = .33$, $p < .001$) and T2 *Conflict* ($\beta_{ind} = .26$, $p < .001$).

Figure 2c shows that for *SDP* behaviors, T1 TCR *closeness* and *conflict* were both associated with T1 *SDP* ($\beta = -.38$, $p < .001$, and $\beta = .35$, $p < .001$, respectively) and T2 TCR *closeness* and *conflict* were associated with T2 *SDP* ($\beta = -.34$, $p < .001$, and $\beta = .47$, $p < .001$, respectively). Child sex was associated with *SDP* behavior at both T1 ($\beta = .14$, $p < .05$) and T2 ($\beta = .14$, $p < .05$), suggesting that girls had higher *SDP*

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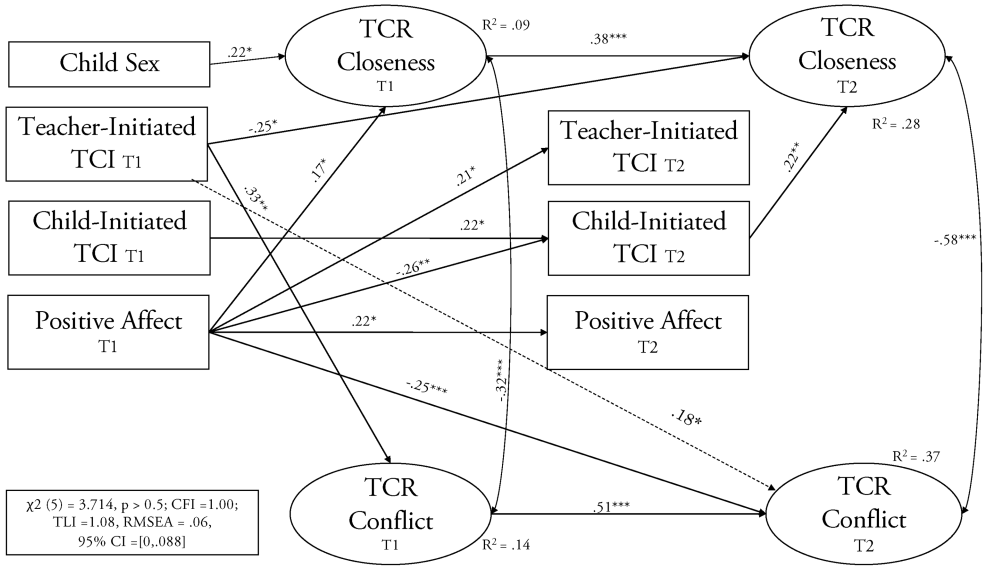

FIGURE 1 Associations between TCR closeness and conflict and teacher- and child-initiated TCIs, and children's affect over time. Coefficients are standardized. ***$p<.001$, **$p<.01$, *$p<.05$. TCI, teacher–child interaction; TCR, teacher–child relationship; dotted arrow = indirect pathway.

scores. In addition, T1 TCR *conflict* predicted both T2 TCR *conflict* and TCR *closeness* ($\beta=.57$, $p<.001$ and $\beta=-.21$, $p<.05$, respectively). T1 TCR *closeness* was indirectly associated with T2 *SDP* via T2 TCR *closeness* ($\beta_{ind}=-.10$, $p<.05$) and T1 *SDP* ($\beta_{ind}=-.18$, $p<.001$). T1 TCR *conflict* also had an indirect association with T2 *SDP* behavior via T1 *SDP* ($\beta_{ind}=.16$, $p<.01$), T2 TCR *CONFLICT* ($\beta_{ind}=.27$, $p<.001$), and T2 TCR *closeness* ($\beta_{ind}=.07$, $p=.056$).

Models examining associations between performance-based social competence scores (i.e., *social engagement*, *peer acceptance*, and the TCR variables, Figure 3a,b) across T1 and T2 showed that for *social engagement* (Figure 3a), T1 TCR *conflict* predicted both T2 TCR c*onflict* and *closeness* ($\beta=.56$, $p<.001$, and $\beta=-.20$, $p<.05$, respectively). T1 *social engagement* positively predicted T2 *social engagement* ($\beta=.32$, $p<.01$), and negatively predicted T2 TCR *conflict* ($\beta=-.23$, $p<.05$). T1 *social engagement* positively predicted T1 TCR *closeness* ($\beta=.37$, $p<.001$), which in turn positively predicted T2 TCR *closeness* ($\beta=.32$, $p<.01$). T1 *social engagement* also indirectly predicted T2 TCR c*loseness* via T1 *TCR closeness* ($\beta_{ind}=.12$, $p<.05$). Child sex was positively associated with T1 TCR *closeness* ($\beta=.24$, $p<.001$), and negatively associated with T1 TCR *conflict* ($\beta=-.17$, $p<.05$), indicating that teachers reported higher T1 TCR *closeness* and lower T1 TCR *conflict* for girls compared to boys. Analyses of the *peer acceptance* variable (Figure 3b) showed that T1 TCR *conflict* was negatively and T1 TCR *closeness* was positively associated with T1 *peer acceptance* ($\beta=-.34$, $p<.001$, and $\beta=.29$, $p<.01$, respectively) and that T1 *peer acceptance* negatively predicted T2 TCR *conflict* ($\beta=-.22$, $p<.05$). T1 TCR *conflict* positively predicted T2 TCR *conflict* ($\beta=.45$, $p<.001$), and negatively predicted both T2 TCR *closeness* ($\beta=-.17$, $p<.10$) and T2 *peer acceptance* ($\beta=-.27$, $p<.10$). T1 TCR *closeness* also positively predicted T2 TCR *closeness* ($\beta=.33$, $p<.01$).

The model examining links between TCR variables and PPVT (Figure 3c) revealed that each variable was predictive of itself from T1 the T2 but only TCR *conflict* had a significant cross-time, cross-variable relation (T1 TCR *conflict* predicted T2 TCR *closeness*, $\beta=-.20$, $p<.05$). These results suggest that teachers did not base their perceptions of closeness versus conflict with children on between child differences with respect to receptive vocabulary.

DISCUSSION

Although the influence of TCRs during early childhood has been studied extensively over the last 30 years, the nature and sources of TCRs continue to be debated vigorously. Using a mixed cross-sectional/longitudinal design testing how children's social, emotional, and verbal skills related to teachers' perceptions of TCRs within and across time, this study addresses the issue of whether TCRs reflect the quantity and quality of teachers' interactions with children or whether underlying social, emotional, cognitive, and behavioral attributes of the child transcend relationships with multiple social partners and determine TCR perceptions. This study advances the literature via three primary contributions: (a) a rigorous examination of convergence in teachers' perceptions of TCRs and invariances across ratings of child behavior,

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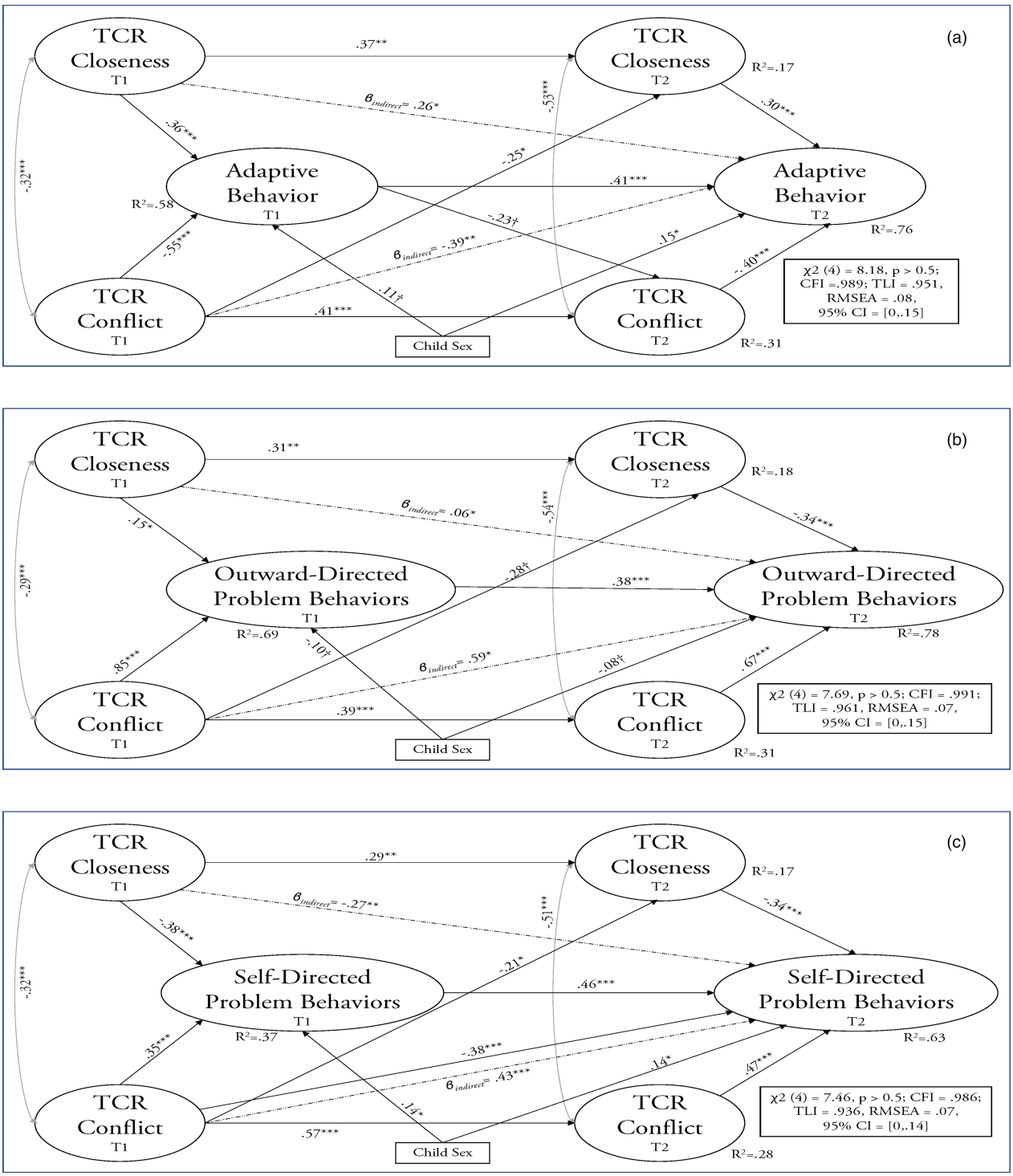

FIGURE 2 (a–c) Associations between TCR Closeness and Conflict and Children's Teacher Rated Adaptive, Self- Directed, Outward-Directed Behaviors over Time. Coefficients are standardized. ***$p<.001$, **$p<.01$, *$p<.05$, †$p<.10$; TCR, teacher–child relationship.

(b) investigation of associations between observed TCIs and TCR *closeness* and *conflict*, and (c) concurrent and longitudinal examination of links between teachers' TCR perceptions and teachers' perceptions of child behavior, emotion attributes, and SC, as well as performance measures of receptive vocabulary, TCIs, expressed affect, social engagement, and peer acceptance.

Convergence in teachers' perceptions (RQ1)

We found significant convergence for teachers' reports within classrooms and across age levels for all report measures. Teachers tended to see the same children similarly and reported similar TCRs. All teacher-report data met rigorous tests of configural, metric, and

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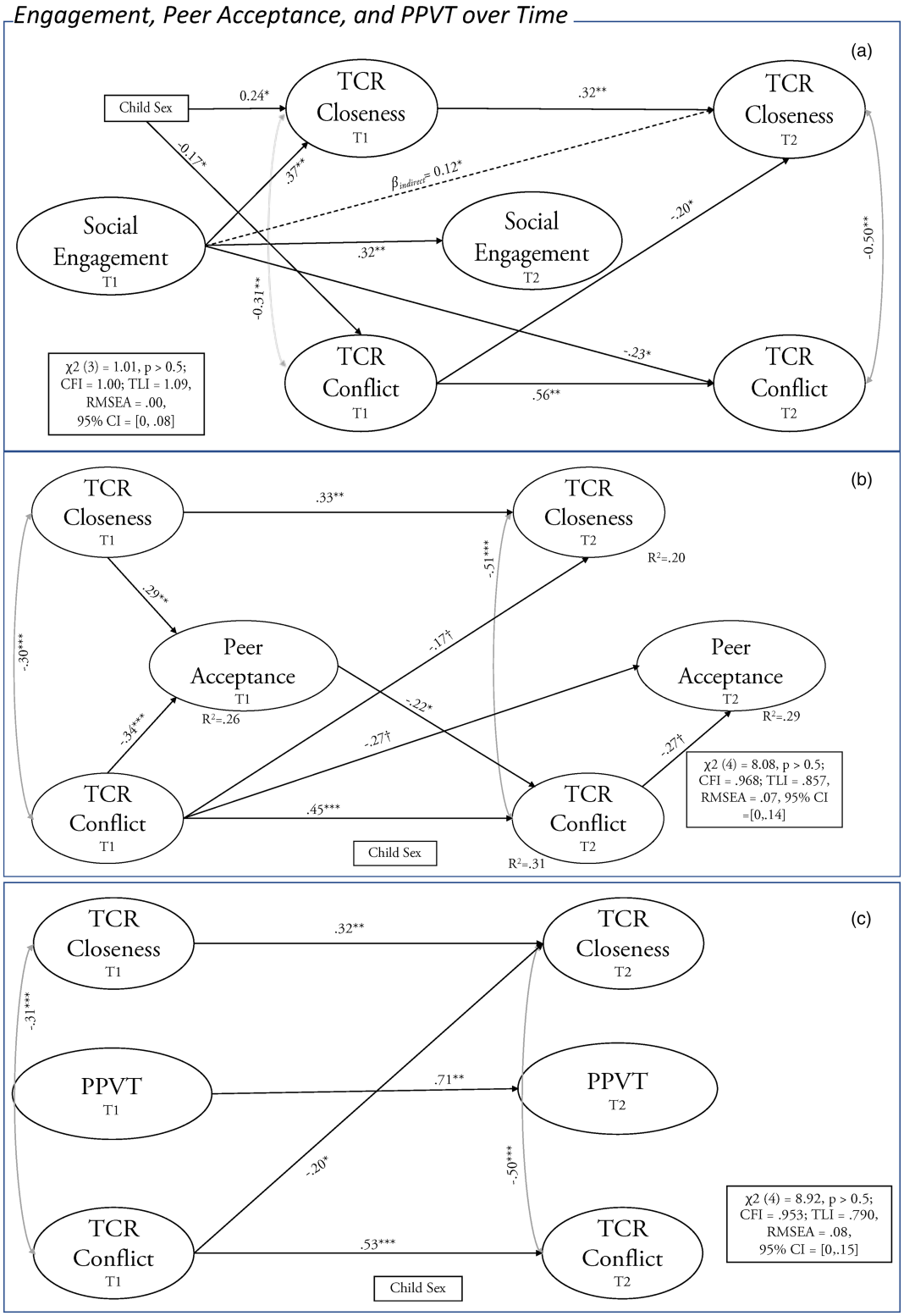

FIGURE 3 (a–c) Associations between TCR closeness and conflict and children's social engagement, peer acceptance, and PPVT over time. Coefficients are standardized. ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .10$; PPVT, Peabody Picture Vocabulary Test; TCR, teacher–child relationship.

scalar invariance, and the scales obtained did not differ significantly within or across time. This degree of detail is not often reported in this area of research (but see Koomen et al., 2012; Milatz et al., 2014, for reports on the STRS with regard to factorial and measurement invariance at different age levels) and constitutes a valuable contribution to the literature on teachers' ratings of children.

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TCRs and TCIs (RQ2)

Interactions between teachers and children had different patterns of effect, depending on who initiated the interaction. Analyses indicating that teachers tend to initiate interactions with children who express more negative affect suggest that TCR *conflict* perceptions may be driven by the need for teacher intervention to control or redirect child behavior. Our observational measures of affect expression (that were independent of observations of TCIs) amplify this interpretation. Positive affect, assessed in the first term of the academic year, positively predicted T1 TCR *closeness* and negatively predicted T2 TCR *conflict* assessed in the spring terms of the academic years. T1 positive affect also predicted T2 rates of TCIs (positively for *teacher-initiated* TCIs and negatively for c*hild-initiated* TCIs). These results suggest that children's observed affect expressiveness predicts perceptions of TCR *closeness* and *conflict* as much or more than do rates of TCIs per se.

Concurrent and cross-year associations with child attributes (RQ2, RQ3)

Consistent with studies dating back over 25 years (e.g., Birch & Ladd, 1997), our findings suggest that how closely (or conflicted) teachers perceive themselves to be with particular children parallels their ratings of those children's behaviors, affects, and cognitions for preschool children. TCR *closeness* tends to be associated with characterizations of children as well adapted and as exhibiting lower levels of *SDP* and *ODP* behaviors (only at T2). TCR *closeness* showed similar patterns of association with the SC performance scores, although *social engagement* was not associated with *closeness* at T2. TCR *conflict* was not significantly associated with *social engagement*; otherwise, the pattern correlations for *conflict* mirrored those for *closeness*, but with signs reversed.

Cross-year autocorrelations for both TCR *closeness* and *conflict* were significant. Furthermore, T1 *closeness* predicted the new teachers' scores for *adaptive* (positively) and *SDP* (negatively) behaviors, whereas T1 *conflict* predicted lower *adaptive* scores and higher *ODP* scores at T2 (see also Mejia & Hoglund, 2016). T1 TCRs also predicted *peer acceptance* at T2. In contrast, receptive vocabulary (i.e., PPVT) was not significantly associated with TCR ratings in concurrent or longitudinal data. These results parallel previous reports about longitudinal associations between TCR *closeness* and *conflict* (e.g., Pianta & Stuhlman, 2004).

Multivariate associations between TCRs and child functioning (RQ4)

Our latent variable SEM models tested predictive associations between the TCR variables and the TCI and child affect variables (Figure 1), the summary factors from teacher ratings (Figure 2a–c), and the three performance variables (Figure 3a–c). T1 × T2 autocorrelation paths for teacher-rated variables and for the performance variables (except *peer acceptance*) were all significant and not further discussed.

Both the TCI variables and the affect variable have paths suggesting child-driven effects in our analyses. T1 expressed *positive affect* positively predicted T1 TCR *closeness* and also predicted T2 TCR *conflict* (negatively). *Teacher-initiated TCI*s at T1 predicted T1 TCR *conflict* positively and T2 TCR *closeness* (negatively). *Child-initiated TCIs* at T1 predicted *T2 child-initiated TCIs*. Finally, child sex predicted T1 TCR *Closeness*. Neither T1 TCR variable predicted any T2 TCI or affect variable.

For latent variables derived from teachers' ratings (Figure 2a–c), TCR *closeness* and *conflict* showed anticipated associations within each year for *adaptive*, *ODP*, and *SDP* latent variables (e.g., TCR *closeness* positively with *adaptive* and negatively with the problem behavior factors; TCR *conflict* negatively with *adaptive* and positively with the problem behavior factors). The single exception was a small positive path between TCR *closeness* and *ODP* behaviors at T1. *Adaptive behavior* at T1 predicted T2 TCR *conflict* (negatively), but only at the .10 level of significance. The T1 TCR *conflict* variable negatively predicted T2 *SDP*, suggesting that higher TCR *conflict* at T1 predicted lower levels of T2 *SDP*, which seems counterintuitive. However, both T1 TCR variables were indirectly predictive of T2 outcome variables via their relations with T1 child variables. These analyses provide limited support for both relationship- and child-driven effects when teachers rate both TCRs and child behaviors.

For the performance variable models (Figure 3a–c), T1 *social engagement* and child sex directly predicted T1 TCR *closeness* and indirectly predicted T2 TCR *closeness* (through *T1* TCR *closeness*). T1 *social engagement* also negatively predicted T2 TCR *conflict*. No T1 TCR variable directly or indirectly predicted T2 *social engagement*. T1 *peer acceptance* was associated with both T1 *closeness* (positively) and *conflict* (negatively) and negatively predicted T2 TCR *conflict*. T1 TCR *conflict* also negatively predicted T2 *peer acceptance*. No direct or indirect cross-time paths between TCR variables were significant for receptive vocabulary (i.e., PPVT standard score). These analyses suggest that direct assessments using observation and peer sociometric ratings yield more substantial child- than relationship-driven effects, although this conclusion is tempered by recognition of the numerous indirect effects observed for both TCRs ratings and directly assessed variables.

Overall, our results suggest that TCR *conflict* is more implicative for subsequent functioning than TCR *closeness* for preschool children which is consistent with other studies of TCRs and child competencies.

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For example, Varghese et al. (2019) found that TCR *conflict* negatively predicted both SC and literacy achievement among kindergarteners and first graders, suggesting that the effects of perceived *conflict* on children's development may extend beyond the social and emotional realms.

Although not central to our aims, we note that, in most models tested, there was a significant negative pathway from T1 *conflict* to T2 *closeness*, but the direct path from T1 1 *closeness* to T2 *conflict* was never significant. This suggests that early ratings of *conflict* predict more of the overall variability in later TCR ratings than do earlier ratings of *closeness*. This conclusion aligns with Ferreira et al. (2020) who found that while the cross-year TCR *closeness* autocorrelation was significant, T1 *conflict* predicted both T2 *closeness* and T2 *conflict*. These kinds of findings suggest that monitoring early TCR *conflict* may prove more useful than monitoring TCR *closeness* for predicting future TCRs and child SC.

Strengths and limitations

Unlike most prior TCR studies, we used co-teachers' reports of TCRs and their ratings of children's behavior using multiple measures and we directly observed TCIs. Performance variables relevant to child SC were also obtained. Inclusion of both performance and teacher-rated child outcomes over time is a study strength. Testing for configural, structural, and metric invariance is another strength and suggests that the teachers' ratings yielded similar results across raters. Our findings that the cross-teacher associations were broader and stronger for TCR *Conflict* than *Closeness* suggest that, in this setting, teachers agreed more about how much conflict they perceived with a given child than about how close they felt with that child. Moreover, even though data collection was impacted by the COVID-19 pandemic, our tests of cross-time associations between TCR *closeness* and *conflict* and child outcomes parallel results reported in the current TCR literature (e.g., McKinnon & Blair, 2019; Wu et al., 2018).

Limitations include the amount of missing data for the longitudinal analyses. While observed interaction, visual attention, and expressed affect data and teachers' ratings were complete in each project year, the second cohort of children did not have data for the sociometric measures or for the PPVT at T2 due to the site's closure in early March of 2020 in response to the COVID-19 pandemic. Our conclusions are also limited because data were obtained from a single site and racial and ethnic minority children were not fully represented. The site itself may also be a limitation, as it is a NAEYC-accredited program with well-prepared teachers. Thus, our results require replication to extend generalizability to other early childhood environments, where teachers' roles, responsibilities, resources, and relationships with children may differ. We also note that all teachers (and indeed, nearly all preschool teachers were women and their views on TCRs and child behavior more generally may reflect their social niche(s)). Finally, although we assessed teachers' perceptions of their TCRs, it is not clear how well these reports capture young children's own perceptions of their TCRs. We note that this is an emergent area of research in early childhood development (e.g., Vatou, 2020; White, 2016).

Implications and future directions

We have suggested that preschool TCRs are deemed important because they forecast critical aspects of child functioning that can enhance the probability of success in subsequent academic and social contexts. Our data support that conclusion, particularly when TCR *conflict* is considered. However, we suggest that TCR scales have these implications because they synthesize and distill a great deal of information that preschool teachers acquire about the behavioral profiles of their students, based not only on direct TCIs but also on their observations of the child's behavior in social and non-social contexts involving peers and other adults. In support of this conjecture, we note that child expressions of positive affect based on 20 min of observation (spread across two observers and 10–14 observation days) completed in the first 3 months of the child's initial year in the study significantly forecast both within- and cross-year TCR scores as well as rates of teacher-initiated TCIs in the next year. This is remarkable and highlights the potential impact of affect expression on young children's adaptation to preschool (e.g., Shin et al., 2011).

To conclude, although our data cannot fully characterize the bases for TCR ratings, they do highlight the importance of looking at how activities and/or behaviors motivate teacher–child transactions, rather than considering STRS scores as indicative of a unique relationship between teacher and student. This does not undermine the predictive utility of the STRS scales, but instead, places them in a different conceptual space. That said, our results suggest that the children who might benefit most from positive TCRs may be the least likely to experience them (see also, Espinosa & Laffey, 2003; Vancraeyveldt et al., 2015). Teacher preparation and professional development opportunities emphasizing both the predictive value of TCR perceptions for later child outcomes and the contributions of child behavior and affect to those perceptions may be means for supporting children's positive development over time.

ACKNOWLEDGMENTS

The authors wish to thank the co-directors, teachers, and families of children who have participated in data collection for this project. We also thank Lisa Krzysik for her assistance with data collection and participant recruitment/retention over the duration of the project.

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FUNDING INFORMATION

The research reported here has been supported in part by NSF grants BCS 1651189, BCS 1651191, and NIFA Hatch Project ALA042-1-14021.

DATA AVAILABILITY STATEMENT

This study was not preregistered. Inquiries regarding the availability of study data, materials, and code logs should be directed to Elif Dede Yildirim: elif.dedeyildirim@nih.gov; or to Brian E. Vaughn: vaughbe@auburn.edu.

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How to cite this article: Dede Yildirim, E., Frosch, C. A., Santos, A. J., Veríssimo, M., Bub, K., & Vaughn, B. E. (2024). Antecedents to and outcomes associated with teacher–child relationship perceptions in early childhood: Further evidence for child-driven effects. *Child Development*, *95*, 679–698. https://doi.org/10.1111/cdev.14033

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