



Outcomes of School–Home Intervention for Attention and Behavior Problems: Teacher Adherence Matters

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Abstract

This study evaluated the effects of teacher adherence to behavioral treatment on student outcomes. Eighty-four children (ages 7–11) completed a 12-week, collaborative school–home behavioral intervention designed for youth with significant attention-deficit/hyperactivity disorder symptoms and impairment. Teacher adherence was assessed via school mental health provider (SMHP) ratings and daily report card (DRC) implementation. Pre- and posttreatment outcomes included parent and teacher ratings of organizational skills and problem behaviors, observational measures of classroom task engagement and off-task behaviors, and report card standard grades. Using multi-level models to account for clustering by school, teacher adherence rated by SMHPs predicted improvement across teacher- and parent-rated organizational skills, parent-rated problem behaviors, and classroom observations of task engagement and off-task behavior. Higher rates of DRC implementation only predicted improvements in parent-rated organizational skills; percentage of days parents signed the DRC only predicted teacher-rated improvement in organizational skills. Post hoc analyses indicated that teacher adherence and child success with academic targets on the DRC during the first month predicted parent-rated improvement in organizational skills. These results suggest that teacher adherence, particularly when rated by SMHPs, is an important predictor of positive treatment outcomes across both school and home settings. Future research is needed to better understand methods for measuring and optimizing teacher adherence to classroom behavioral interventions.

Keywords ADHD · Psychosocial treatments · Teacher adherence · Daily report card · School-based intervention

Attention-deficit/hyperactivity disorder (ADHD) is an early onset, chronic neurodevelopmental disorder characterized by clinically impairing symptoms of inattention, hyperactivity, and impulsivity (American Psychiatric Association, 2013). Children with ADHD are at increased risk of significant school-related impairments, including social-emotional challenges (Wählstedt, Thorell, & Bohlin, 2008), lower report card grades (Loe & Feldman, 2007), academic achievement deficits (Frazier, Youngstrom, Glutting, & Watkins, 2007; Lundervold, Meza, Hysing, & Hinshaw, 2017), specific learning disabilities (DuPaul, Gormley, & Laracy, 2013),

and lower high school and college graduation rates (Barkley, Fischer, Smallish, & Fletcher, 2006; Hechtman et al., 2016; Kuriyan et al., 2013). Adverse academic-related outcomes are particularly concerning given their association with increased rates of delinquent behavior in later adolescence (Bennett, Brown, Boyle, Racine, & Offord, 2003; McGee, Prior, Williams, Smart, & Sanson, 2002) and poor adjustment and socioeconomic outcomes in adulthood (see O'Brien, 2001 for review).

The academic challenges experienced by children with ADHD are partly due to increased rates of disruptive and off-task behaviors that interfere with learning-related tasks in the classroom, such as listening to classroom instruction, completing independent seat work, contributing to class discussions, and completing/turning in assigned work (DuPaul et al., 2004; Pfiffner, Villodas, Kaiser, Rooney, & McBurnett, 2013). Meta-analytic evidence indicates that children with ADHD are off-task approximately 25% of the school day, compared to only 12% for

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same-aged peers ($d=1.40$; Kofler, Rapport, & Alderson, 2008). Over the course of the school year, this equates to an estimated 45 days of lost classroom-related activities due to symptoms of ADHD—a non-trivial amount of lost learning opportunities that likely contributes to the academic underachievement characteristic of the disorder (Frazier et al., 2007; Rivkin & Schiman, 2015). Indeed, prior studies report that children with ADHD receive a high proportion of special education services at school, likely a result of the salient and serious impairments experienced in the classroom (Loe & Feldman, 2007).

School Interventions for ADHD

A large body of research demonstrates that school-based behavioral interventions can reduce the adverse impact of ADHD symptoms and impairment in the classroom (Evans, Owens, Wymbs, & Ray, 2018; Fabiano et al., 2009; Pelham & Fabiano, 2008). School intervention strategies include teacher-implemented, classroom management practices, such as structuring antecedents (e.g., preferential seating, reducing memory demands by posting written classroom routines and rules) and consequences (e.g., frequent, labeled praise, reward and/or response cost-based contingency management programs) (Piffner, 2011). Contingency management programs have the strongest research support with documented decreases in ADHD symptoms, frequency of rule violations, and off-task behaviors, as well as improvements in academic productivity, blinded observations of classroom comportment, accuracy of completed work, and academic grades (DuPaul, Eckert, & Vilaro, 2012; Fabiano et al., 2010; Owens et al., 2012).

One of the most widely used and researched variations of contingency management is the daily report card (DRC). The DRC involves teachers providing ratings on pre-determined student behaviors targeted for improvement (Fabiano et al., 2007; Pelham & Fabiano, 2008; Pyle & Fabiano, 2017). Target behaviors are selected based on students' individual areas of weakness and can address varied areas of impairment such as behavioral, academic, or social concerns. Students are rewarded at home or school contingent upon satisfactory DRC performance at school. A recent meta-analysis shows that DRCs reduce the frequency and severity of teacher-rated ADHD symptoms in the classroom (Iznardo, Rogers, Volpe, Labelle, & Robaey, 2017). DRCs have been shown to produce improvements in parent- and teacher-rated behavior and functional impairment by almost 30% in children with ADHD (Fabiano et al., 2010; Pyle & Fabiano, 2017). Most improvements occur within the first month with continued incremental benefit demonstrated over 4 months (Owens et al., 2012).

Teacher Adherence to Behavioral Treatments

Despite promising results when analyzed at the group level, not all children with ADHD are equally responsive to school-based behavioral interventions (Evans et al., 2018; Fabiano et al., 2009). Several moderators of classroom-related outcomes have been identified such as comorbid internalizing disorders, conduct problems and oppositionality, and socio-economic status (see Ollendick, Jarrett, Grills-Tauechel, Hovey, & Wolff, 2008 for review). While informative, such investigations do not address the likelihood that children often receive varying 'doses' of intervention as a result of varied teacher adherence rates across students. Research indicates that teacher-implemented classroom-based ADHD-related intervention fidelity ranges from 35 to 77% (Murray, Rabiner, Schulte, & Newitt, 2008; Owens, Hinshaw, McBurnett, & Piffner 2018; also see Vujnovic, Fabiano, Pariseau, & Naylor, 2013 for similar findings). Teacher adherence may well play a significant role in the heterogeneity of ADHD-related treatment outcomes observed in the classroom setting given that (a) school-based behavioral interventions for ADHD are predicated upon consistent implementation by classroom teachers (Owens et al., 2012) and (b) teacher adherence predicts improvements in other intervention modalities, including bullying prevention (Biggs, Vernberg, Twemlow, Fonagy, & Dill, 2008).

Only a few studies have directly examined the role of teacher adherence to behavioral intervention for ADHD-related challenges. In a sample of 15 students, Murray et al. (2008) found that greater teacher adherence to the DRC predicted greater improvements on teacher-rated impulse control, but not other student outcomes. This same study also examined the role of parent involvement with the DRC and found that on average, parents reviewed the DRC 59% of the time across the 4 months of the intervention; however, they were unable to examine the association between parent DRC involvement and student outcomes given limited power (Murray et al., 2008). Using a multiple baseline design with three students demonstrating behavior problems, Sanetti, Collier-Meek, Long, Kim, and Kratochwill (2014) found that teacher adherence to behavioral support plans improved student outcomes, including academic engagement and disruptive behavior. However, in a sample of 33 students in special education, DRC completion rates were not associated with posttreatment observations of rule violations in the classroom (Fabiano et al., 2010). Existing findings suggest mixed evidence for the role of teacher adherence for student outcomes, but conclusions are limited by small sample sizes and the scope of student outcomes assessed.

Daily Report Card Target Behaviors

Prior examinations of the DRC have also been primarily limited to behavioral targets (e.g., not following rules, interrupting, noncompliance; Owens et al., 2012). However, the DRC is also commonly used to target academic behaviors such as work completion, accuracy, and study habits (Jurb ergs et al., 2007; Fabiano et al., 2010). Two recent meta-analytic reviews of DRCs using single-subject designs for students with disruptive behavior (Vannest, Davis, Davis, Mason, & Burke, 2010) and for students with ADHD (Pyle & Fabiano, 2017) examined whether academic versus behavioral targets differentially predicted student outcomes. Both reviews found that the DRC was similarly effective for both types of targets (Pyle & Fabiano, 2017; Vannest et al., 2010). However, given these findings are based on meta-analyses, effect sizes are compiled from various studies that differed in context (e.g., special vs. general education) or procedures of the DRC (portion of the day completed, type of contingency, length of time), which were not accounted for in either review (Pyle & Fabiano, 2017; Vannest et al., 2010). Further, neither accounted for social-emotional behavior targets on the DRC (e.g., uses kind words with peers, asks a peer to play with them), which is a common target in some school-home interventions (Fabiano et al., 2010; Pfiffner et al., 2016). It is possible that differences between academic, behavioral, and social-emotional targets have implications for teacher adherence and response to intervention.

Teacher Background and Experience

Finally, teacher experience with behavioral interventions can impact both their adherence and student outcomes (Sherman, Rasmussen, & Baydala, 2008), since prior experience may increase acceptability and skill with behavioral interventions. Unfortunately, many teachers do not receive adequate training in evidence-based classroom behavioral interventions (Flower, McKenna, & Haring, 2017; Freeman, Simonsen, Briere, & MacSuga-Gage, 2014; Pelham, Wheeler, & Chronis, 1998) or ADHD (Martinussen, Tannock, & Chaban, 2011). This lack of training is likely to adversely impact teacher's ability to implement DRC programs or other classroom behavior modification techniques with students that have ADHD. Prior studies of teacher adherence to DRCs have not considered the potential confounding effect of teacher background (i.e., experience with classroom interventions and overall ADHD knowledge); thus, it is unclear to what extent observed associations between adherence and student outcomes remain significant after taking into account prior experience or to what extent experience is associated with intervention adherence.

Current Study

The present study evaluates the role of teacher adherence to a school component of a school-home intervention (Collaborative Life Skills, CLS) for children with ADHD-related behaviors and impairment. CLS (which combines classroom management/daily report cards, parent training, and child skills training) demonstrates positive treatment effects, relative to services as usual, on symptom reduction and improvement across functional impairment domains for both English and Spanish language versions (Pfiffner et al., 2016, 2018; Haack et al., 2019). In the current study, we hypothesized that greater teacher adherence to the CLS intervention, measured via clinician ratings and coded frequency of DRC implementation, would predict greater improvement across multiple student outcomes, as rated by both teacher and parents, as well as classroom observation measures and report card grades. We also predicted that greater parent involvement with DRC implementation (i.e., parent signatures after reviewing the DRC at home) would predict improvement across student outcomes. We also hypothesized that teacher's prior experience with behavioral interventions and overall ADHD knowledge would be positively correlated with teacher adherence to the intervention. To further understand the impact of teacher adherence, in particular teacher implementation of the DRC, on student outcomes, we explored the association between target behavior domains on the DRC (i.e., academic, behavioral, and social-emotional targets) and student outcomes. In line with prior studies (Pyle & Fabiano, 2017), we hypothesized that academic, behavioral, and social-emotional target behaviors will demonstrate similar improvement, on average, for student outcomes.

Methods

Participants

Data for the current study are drawn from a larger, cluster-randomized controlled trial of a school-home collaborative behavioral intervention for children with ADHD-related problems. Briefly, children aged 7–11 attending 27 schools ($N=6$ students per school) from an urban public school district were randomly assigned to a school-home intervention (Collaborative Life Skills, CLS; $N=14$ schools) or services as usual ($N=13$ schools). Of the 14 schools that were assigned to CLS, two received the parent component in Spanish (referred to as CLS-S, which stands for CLS-Spanish). Only children assigned to the CLS or CLS-S conditions were included in the present study ($n=84$ students, $N=14$ schools; grades 2–5, 75% boys). All enrolled participants completed post-intervention measures. A more

detailed description of the study procedures can be found in (Piffner et al., 2016). Participants were ethnically diverse (32% were Caucasian, 32% were Latino, 19% were Asian-American, 7% were African-American, and 15% were mixed race), with 86% of participants identifying as native English speakers, while 14% of students identified as bilingual English–Spanish speakers. Thirty-one percent of all participants were living in single-parent homes.

Students were recruited from participating schools between 2012 and 2015. Children were referred to participate in our study by school personnel due to excessive inattention and/or hyperactivity/impulsivity symptoms and related academic and/or social problems (generally those who would be identified as needing school services). Children taking stimulant medication were eligible to participate as long as their medication regimens were stable. To be considered for inclusion, participants were required to meet the following criteria: (a) clinically significant ratings of ADHD symptoms (i.e., ≥ 6 inattention symptoms and/or ≥ 6 hyperactive/impulsive symptoms) occurring “often” or “very often” as indicated by parents or teachers on the Child Symptom Inventory (CSI; Gadow & Sprafkin, 1997), (b) evidence of impairment across multiple domains (home and school), characterized by score of ≥ 3 in at least one domain of functioning on parent and teacher Impairment Rating Scales (IRS; Fabiano et al., 2006), (c) Full-Scale Intelligence Quotient higher than 79 on the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999), (d) at least one parent or guardian available to attend weekly behavioral parent training groups, and (e) a primary classroom teacher agreeing to participate. Students with visual or hearing impairments, severe language delay, psychosis, pervasive developmental disorder, or enrollment in full-day special day classrooms were excluded. Study procedures were approved by the Committee on Human Research at the University of California, San Francisco. Consent (parent and teacher) and assent forms (child) were obtained, and parents and teachers were each compensated \$50 for completing measures at each assessment time point.

Procedures

The CLS program consists of manualized intervention components for teachers/classroom, students, and parents. The program was delivered by school mental health providers (SMHPs) at their respective school sites. For a detailed description of session content, SMHP training, and SMHP implementation fidelity, see Piffner et al., 2016.

Classroom Component: The classroom component consisted of a school–home DRC and teacher consultation regarding classroom management and homework planning. Classroom teachers met with the SMHP during one 60-min group meeting at the beginning of the program to develop a

DRC and to learn classroom behavioral management strategies and skills taught during the child groups to promote cross-setting reinforcement and generalization. One 30-min group troubleshooting meeting was held midway through the program. Target behaviors on the DRC were selected and modified during individual meetings between SMHPs, teachers, students, and parents. All students participating in CLS and CLS-S had at least one parent/teacher/student meeting to review the DRC (73% had two meetings), homework plans and classroom management strategies. Each DRC included two to three target behaviors from the following behavioral categories: *academic and study habits* (e.g., complete and return homework), *behavioral* (e.g., follow seat rules), and *social-emotional tools* (e.g., treat others with respect). Teachers rated the student on each target behavior three times per day on a 0–2 scale (0 = target goal not met, 1 = target goal partially met, 2 = target goal fully met). Parents reviewed the DRC at home and signed each day after reviewing. Parent signatures on the DRC indicated whether they reviewed the DRC at home. Students earned rewards at home for meeting daily goals on the DRC.

Student Component

The student component consisted of nine weekly, SMHP-led group sessions that took place during school hours. Sessions focused on improving organization skills, social skills, and homework/routine independence. Behaviors related to each of these skills were targeted on student’s DRCs and home-based behavioral programs implemented by parents to encourage generalization across settings. Average child attendance rates (for both CLS and CLS-S) at group sessions were 91%.

Parent Component

The parent component was comprised of ten weekly, 60-min behavioral parent management training groups led by SMHPs. Group sessions were designed to teach parents contingency management skills covered in traditional parent training programs (i.e., giving effective instructions, implementing a reward system, and response cost strategies), strategies covered in the child group, and stress management. Parents were coached how to reinforce the DRC component at home and develop a homework plan. Parent group session attendance, averaged across CLS and CLS-S, was 84%. Parents provided weekly ratings of their implementation of strategies taught during groups (71% of parents reported using the skills at least most days; across CLS and CLS-S) and provided signatures on the DRC (average = 68%); clinicians rated parents’ overall adherence to the treatment program (1 = not at all to 5 = great deal; mean = 4.4; averaged across CLS and CLS-S).

SMHP Training

Fourteen SMHPs (nine full-time and five half-time master-level social workers or school counselors), one at each school, were trained by doctoral level clinicians to implement study procedures as part of their regular work responsibilities. SMHPs were compensated at a rate similar to their district salary for attending study-related training that occurred outside their normal work hours. Details regarding SMHPs adherence to content, implementation quality fidelity, and overall competence for facilitating parent and child groups are described in previous studies (see Piffner et al., 2016).

Measures

Teacher Adherence

Teacher adherence to the CLS program was assessed via SMHP ratings and DRC completion rates:

SMHP Ratings of Teacher Adherence SMHPs provided ratings of teacher adherence on two items, the first to assess adherence frequency: “how often does the teacher implement the DRC?” rated on a 5-point Likert scale ranging from 1 (never), 2 (once a week), 3 (2–3 times per week), 4 (3–4 times per week), and 5 (daily). In addition, SMHP ratings of teacher adherence also assessed adherence quality: “what is the teacher’s overall adherence to the program?” rated on a 5-point Likert scale ranging from 1 (not at all) to 5 (a great deal). Given the high correlation between the two items ($r = .839, p < .001$), a composite SMHP teacher adherence score was calculated by averaging DRC frequency and overall program quality items.

DRC Implementation The percentage of school days the DRC was implemented was calculated based on the number of completed DRC forms from those collected (i.e., photographed by research staff) out of the overall count of possible school days during the intervention. Scores could range from 0 to 100, wherein a 100 indicated that the DRC was completed every school day since the first day the DRC was implemented during the intervention period. School holidays (coded from the online student calendar for each school), child absence, special school events/field trips and substitute teacher days (when noted on the DRC) were not included in the overall count of possible school days during the intervention. Other school days with blank or missing forms were scored as nonadherent. Parent involvement with DRC implementation was operationalized by calculating the percentage of parent signatures based on the number of days that the teacher completed the DRC. On average, parents signed 68% of

DRCs ($SD = 25\%$; range 0–100%). The majority of parents (80%) signed the DRC on at least 50% of possible school days.

DRC Target Domains Three doctoral level research assistants independently coded DRC target behaviors as either (mutually exclusive): (1) academic (e.g., work completion, study habits), (2) behavioral (i.e., following rules, interrupting), or (3) social-emotional (e.g., using kind words, asking a peer to play). Inter-rater reliability between the three trained coders was excellent (i.e., $ICC > .90$); when discrepancies emerged, coders met with the lead author to resolve differences. All children had at least two but no more than three target behaviors on their DRC, with academic targets being the most common (55.4%), followed by behavioral targets (22.5%) and social-emotional targets (22.1%). The majority of students (91.7%) had at least one academic target on their DRC. Given that prior research indicates the largest treatment effects within the first month of the DRC (Owens et al., 2012), a weighted score for each category (i.e., academic, behavioral, and social-emotional targets) was computed for the first month by multiplying the average ratings for a given category by the number of DRCs completed in the first month (e.g., academic weighted score = average ratings received for academic target behaviors, on a 0–2 scale multiplied by the total number of DRCs completed in the first month of the intervention). We calculated weighted scores to facilitate comparisons across students and to best capture (1) performance on individual targets (i.e., ranging from 0 = target not met to 2 = target goal fully met) and (2) how often they were exposed to that target in the first month, when most improvements occur (Owens et al., 2012).

Teacher Background Teacher background was assessed via a project-derived questionnaire that included three items assessing experience with using school-based accommodations and two items assessing knowledge about working with students with ADHD ($\alpha = .79$). Specifically, teachers were asked to rate their prior experience using: (1) classroom-based accommodations for students with attention or behavioral issues (e.g., extended time for tests/assignments, modified homework or classwork, preferential seating), (2) school-home report cards or something similar in which target behaviors are identified for the student and rewards given by the parent at home for meeting goals each day (or week), and (3) student contracts, behavior charts with classroom rewards/incentives for meeting target behavior or academics on a 0 (none/zero students) to 3 (many students) scale. Teachers also rated items assessing their knowledge about working with students with ADHD (i.e., how would you assess your knowledge of how to work with students with attention and/or behavior problems?) and general knowledge about ADHD (i.e., how would you assess your general

knowledge about attention and/or behavior problems?) on a 1 (very little knowledge) to 5 (a lot of knowledge) scale.

Student Outcome Measures

Organizational Problems Teachers and parents completed the Children's Organizational Skills Scale (COSS; Abikoff & Gallagher, 2009) which assesses organizational skills problems. Items are rated on a 4-point scale (1 = hardly ever or never to 4 = just about all the time) with higher ratings indicating greater organizational impairment. The COSS has adequate psychometric properties, including excellent internal consistency in parent and teacher versions (α s = .98 and .97, respectively) and test–retest reliability (r s = .99 and .94, respectively). In the present study, the COSS total score was used which had adequate internal consistencies across both parent and teacher ratings (α = .90–.94).

Problem Behaviors Children's problem behaviors were assessed via the parent and teacher versions of Problem Behaviors Scale on the Social Skills Improvement System (SSIS; Gresham & Elliott, 2008). Each item is rated on a 4-point scale (1 = never, 2 = seldom, 3 = often, or 4 = almost always). The gender-normed standard score for the Problem Behavior Scale was used in the present study, with higher scores indicating greater problem behaviors. The SSIS has excellent psychometric properties, including high internal consistency (α s > .94), test–retest reliability (r s > .81), and convergent and discriminant validity (Gresham & Elliott, 2008).

Behavioral Observations The Behavioral Observation of Students in School (BOSS; Shapiro, 2004) was used to assess classroom behaviors. The BOSS measures both task engagement (i.e., active engagement and passive engagement) and off-task behavior (i.e., off-task motor behaviors such as drawing/writing unrelated to an academic task, off-task verbal behaviors such as calling out answers before being called on, and off-task passive behaviors, such as looking around the room or staring out the window). Task engagement was rated using momentary time sampling at the beginning of each 15-s interval, while off-task behaviors were coded during the remainder of each interval (partial interval method). Coders completed training in the BOSS which included didactic components and practice coding sessions with an established coder. Two coders independently coded 30% of the observations, and inter-rater reliability was acceptable (κ = .83 for task engagement and .72 for off-task behavior). For each student, observations were coded for up to three time points on separate days (84% had three separate observations, 13% had two observations, and 3% had one observation) at baseline and posttreatment. Composite scores of the percentage of intervals were aver-

aged across observations for task engagement and off-task behavior. Previous studies using the BOSS report high inter-observer agreement and suggest that the BOSS distinguishes between typically developing children and children with ADHD (DuPaul et al., 2004). In the current sample, teacher-rated ADHD severity was significantly correlated with BOSS task engagement, (r [84] = -.26, p = .02) and BOSS off-task behavior (r [84] = .24, p = .02) at baseline.

Report Card Grades School records provided trimester grades for students participating in the intervention. State standards for each grade level were organized by subject (i.e., reading, writing, math, and speaking and listening) and rated on a 1–4 scale, whereby a 1 = “needs more time,” 2 = “approaching,” 3 = “meets standard,” and 4 = “exceeds.” Schools provided individual students' grades for each academic trimester of year(s) students were enrolled in CLS. Grade improvement scores were calculated by comparing students' trimester grades for the grading period immediately preceding (baseline) and following (posttreatment) the CLS intervention.

Data Analytic Plan

Statistical analyses were performed using SPSS 25 (IBM Corp., 2016). First, to characterize the sample, descriptive statistics assessed DRC target behavior characteristics, teacher background, and predictor (teacher adherence) and student outcome variables. Correlational analyses assessed the association between teacher background (i.e., experience and knowledge), DRC implementation (i.e., percent DRC was implemented in total and in the first month, parent signatures on DRC), and teacher's overall adherence rated by SMHPs. Second, mixed linear models, accounting for students clustered within schools, were used to examine whether SMHP ratings of teacher adherence and DRC implementation indices (i.e., DRC percent completion and percent parent signatures on DRC) predicted positive student outcomes. Separate models were evaluated for each posttreatment outcome (i.e., organizational skills, problem behaviors, classroom observation subscales of task engagement and off-task behavior, and report card grades) controlling for pre-treatment scores. Models examining DRC completion and student outcomes also controlled for teacher's prior experience in implementing (a) school–home report cards with home rewards and (b) behavior charts with school rewards, given a significant association between experience and DRC implementation. Finally, exploratory analyses also examined (a) correlations between DRC target behavior type and all other variables of interest (i.e., teacher background variables and teacher adherence variables) and (b) models examining the role of performance on

specific DRC target behaviors (academic, behavioral, or social-emotional) for predicting student outcomes.

Very little data were missing at baseline or posttreatment for all outcome variables of interest (i.e., 1–2%), so none were imputed. The only exceptions were report card data, which were not available for CLS-S participants ($n = 12$; 14% missing) and SMHP ratings of teacher adherence (12% missing). Teachers with missing SMHP-rated adherence or grades did not differ on any student outcomes or DRC completion ($ps < .05$). Missing cases were not included in the analyses for the models examining SMHP-rated teacher adherence or grades, respectively.

Results

Descriptive Statistics

Teacher Background

Just over half of the teachers (54.7%) reported zero to very little experience implementing daily report cards with home-based rewards, and 35.7% reported zero to very little experience in using student contracts/behavior charts with classroom rewards. The vast majority of teachers (83.3%) reported using general classroom accommodations with “some” to “a lot” of students. Few teachers reported having little knowledge about working with children with ADHD (1.2% rated having very little knowledge, 8.3% reported a little knowledge), while 48.8% reported average knowledge, and 41.6% reported having greater than average knowledge. A similar pattern emerged when teachers were asked to report their overall knowledge regarding ADHD: 2.4% reported having a little knowledge, 59.5% reported having average knowledge, and 38.1% reported having greater than average knowledge.

Teacher Adherence

SMHP-rated teacher adherence ($M = 4.30$; $SD = .92$) to the CLS program was high ($M = 4.30$; $SD = .92$), averaging between 3 and 4 days/week to daily use. Teachers completed the DRC, on average, 70% of possible days ($SD = 16\%$; range 31–100%). On average, teachers implemented the DRC for students 28 days (range 4 to 48) out of possible school days in treatment ($M_{\text{school days in treatment}} = 39.85$; range 10 to 56). The majority of teachers (85.7%) completed DRCs on at least 50% of possible school days.

Correlations Between Teacher Adherence and Background

Teacher adherence as measured by DRC usage and teacher experience implementing classroom interventions were

significantly correlated (Table 1). In particular, the percentage of DRCs used throughout the study period was positively correlated with percentage of DRCs implemented in the first month ($r = .760$, $p < .01$), percentage of days parents signed the DRC ($r = .371$, $p < .01$), previous experience using school-home report cards with home-based rewards ($r = .298$; $p < .01$), and experience using student contracts/behavior charts with classroom rewards ($r = .235$; $p < .05$). SMHP ratings of teacher adherence were significantly and positively correlated with proportion of DRC implementation on school days ($r = .433$, $p < .001$) and with percentage of parent signatures on DRCs ($r = .243$, $p < .05$). SMHP-rated teacher adherence was not significantly correlated with teacher experience or knowledge.

Mixed Linear Models Evaluating Teacher Adherence as a Predictor of Student Outcomes

SMHP Ratings of Teacher Adherence

Mixed linear models, accounting for students nested within schools, were evaluated for each of the seven student outcomes, to examine the role of SMHP ratings of teacher adherence, after accounting for baseline (pre-treatment) scores of the outcome (Table 2). SMHP ratings of teacher adherence predicted posttreatment teacher- ($B = -1.65$, $p = .038$) and parent-rated ($B = -2.85$, $p = .013$) improvements in organizational skills. SMHP ratings of teacher adherence also predicted improvements in problem behaviors as rated by parents ($B = -1.78$, $p = .004$) and improvements in observed classroom engagement ($B = 2.37$, $p = .012$) and off-task behavior ($B = -3.47$, $p = .001$). SMHP ratings of teacher adherence did not predict improvements in math, reading, writing, or speaking and listening grades ($ps > .05$).

DRC Implementation

Mixed linear models, accounting for students nested within schools, were also conducted to examine whether the percent of days the DRC was implemented predicted each of the seven student outcomes, controlling for baseline measures of the outcome, experience using school-home report cards with home-based rewards, and experience using behavior charts with classroom rewards (Table 2). Frequency of DRC implementation predicted improvements in parent-rated organizational skills ($B = -26.77$, $p = .034$). Similar results emerged for the model examining DRC implementation during the first month, which predicted improvements in parent-rated organizational skills ($B = -19.20$, $p = .032$). DRC implementation (in total and in the first month) was not associated with any other student outcomes including grades ($ps > .05$). Mixed linear models also revealed that percentage

Table 1 Correlations between teacher adherence measures, DRC target behaviors, teacher experience, and ADHD knowledge

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Teacher adherence: total DRC completed	–										
2. Teacher adherence: total DRCs completed in month 1	.760**	–									
3. Percentage of days parents signed DRC	.371**	.287**	–								
4. Teacher adherence: SMHP's ratings	.433**	.379**	.243*	–							
5. Academic weighted score	.485**	.571**	.358**	.330**	–						
6. Rules and consequences weighted score	.023	.076	–.111	–.083	.107	–					
7. Socioemotional weighted score	.147	.111	.114	.175	.214	.095	–				
8. TB experience in using classroom-based accommodations	.214	.177	–.081	.005	–.034	–.024	–.193	–			
9. TB experience in using school-home report cards with home rewards	.298**	.325**	.185	.034	.104	–.047	–.203	.399**	–		
10. TB experience in using behavior charts with classroom rewards	.235*	.313**	.188	–.016	.101	–.017	–.178	.382**	.622**	–	
11. TB knowledge of how to work with students with ADHD	.205	.228*	.018	–.113	.044	.039	–.065	.153	.096	.364**	–
12. TB general knowledge of ADHD	.178	.070	–.060	–.059	.046	.107	–.266*	–.003	.126	.208	.642**

TB teacher background questionnaire

** $p < .01$, * $p < .05$

of parent signatures on the DRC predicted teacher-rated organizational skills ($B = -14.01$, $p = .013$), but not other student outcomes including grades ($ps > .05$).

Exploratory Analyses of Target Behavior Classifications

Correlational analyses revealed that academic weighted scores were significantly and positively correlated with percentage of DRCs used throughout the study period ($r = .485$, $p < .01$), with percentage of parent signatures on DRCs ($r = .358$, $p < .01$) and with SMHP ratings of teacher adherence ($r = .330$, $p < .01$). A series of exploratory mixed linear models were conducted to examine whether target behavior domains (i.e., academic, behavioral, social-emotional) and student outcomes were significantly associated. Higher academic target scores on the DRC during the first month predicted parent-rated improvement in organizational skills ($B = -.41$, $p = .035$). Behavioral and social-emotional target scores on the DRC did not significantly predict student outcomes ($ps > .05$).

Discussion

This study examined the role of teacher adherence to the school component of a school-home intervention on student outcomes. The study extends previous findings documenting the efficacy of the intervention (Piffner et al., 2016, 2018; Haack et al., 2019) by focusing specifically on associations between teacher adherence to treatment and student outcomes across multiple domains and methods of measurement. We found partial support for our hypotheses. SMHP ratings of teacher's overall adherence to the CLS school component predicted improvement across teacher- and parent-rated organizational skills, parent-rated problem behaviors, and classroom observations of task engagement and off-task behavior but did not predict improvements on report card grades. Teacher adherence as measured by percentage of DRC implementation during treatment significantly predicted improved parent-rated organizational skills but not other student outcomes. Percentage of parent signatures on DRC significantly predicted improved teacher-rated organizational skills but not other student outcomes. Exploratory analyses revealed that greater performance on the academic targets on the DRC during the first month predicted improved parent-rated posttreatment organization. Consistent with other studies (Martinussen et al., 2011), many (54.7%) teachers reported zero to very little previous experience using school-home DRCs with home rewards. Teacher experience with DRCs and classroom reward systems was correlated with DRC use, but not SMHP ratings of adherence.

Table 2 Teacher adherence, percentage of parent signatures on DRC, and student outcomes at posttreatment

Dependent variable	<i>B</i>	SE	<i>p</i>	95% CI
<i>COSS organizational skills total score (teacher)</i>				
SMHP ratings of teacher adherence to program	-1.652	.781	<i>p</i> = .038	-3.209, -.095
Percentage of DRCs administered	-9.513	8.152	ns	-25.742, 6.716
Percentage of parent signatures on DRC	-14.013	5.841	<i>p</i> = .013	-24.357, -3.091
<i>COSS organizational skills total score (parent)</i>				
SMHP ratings of teacher adherence to program	-2.846	1.116	<i>p</i> = .013	-5.073, -.620
Percentage of DRCs administered	-26.768	12.370	<i>p</i> = .034	-51.429, -2.107
Percentage of parent signatures on DRC	-9.627	7.940	ns	-25.453, 6.200
<i>SSIS problem behavior standard score sex-specific (teacher)</i>				
SMHP ratings of teacher adherence to program	-.546	.553	ns	-1.648, .557
Percentage of DRCs Administered	-1.075	5.728	ns	-12.476, 10.327
Percentage of parent signatures on DRC	-2.127	4.171	ns	-10.434, 6.180
<i>SSIS problem behavior standard score sex-specific (parent)</i>				
SMHP ratings of teacher adherence to program	-1.780	.594	<i>p</i> = .004	-2.964, -.596
Percentage of DRCs administered	-5.421	7.186	ns	-19.734, 8.891
Percentage of parent signatures on DRC	-3.582	4.531	ns	-12.611, 5.446
<i>BOSS mean engagement</i>				
SMHP ratings of teacher adherence to program	2.367	.918	<i>p</i> = .012	.536, 4.917
Percentage of DRCs administered	2.529	9.811	ns	-17.002, 22.060
Percentage of parent signatures on DRC	-.753	6.884	ns	-14.464, 12.958
<i>BOSS off-task behavior</i>				
SMHP ratings of teacher adherence to program	-3.468	1.024	<i>p</i> = .001	-5.511, -1.425
Percentage of DRCs administered	-8.6464	11.156	ns	-30.675, 13.746
Percentage of parent signatures on DRC	.729	7.996	ns	-15.200, 16.657

COSS Children's Organizational Skills Scale, *SSIS* Social Skills Improvement System, *BOSS* Behavioral Observation of Students in School, *SMHP* School Mental Health Provider, *DRC* daily report card. Models adjusted for teacher experience, school clustering, and baseline measures

Findings of association between SMHP ratings of teacher's overall adherence and student outcomes are particularly noteworthy given the consistency across multiple outcome domains and methods of assessment including parent and teacher report and blinded observations of student behaviors in the classroom. As such, these findings cannot be attributed to reporting bias. In contrast, teacher adherence measured by DRC implementation was associated with only parent-reported organizational skills. DRC completion rates may be limited as a sole index of teacher adherence since these rates do not represent the accuracy or quality of DRC implementation or teacher's engagement in other aspects of the program. It shows that teacher adherence to the overall school component of the program, rather than quantity of DRCs completed per se, may be more important in predicting the broadest range of student outcomes. SMHP ratings of teacher's overall adherence may better capture the quality of DRC implementation, the teacher's use of other classroom management strategies in addition to the DRC, or other factors such as reinforcement of child skills taught during the child group or effective communication between SMHP, parent, and teacher.

DRC completion rates as well as inclusion of academic targets on the DRC did, however, have specific associations with student's organizational skills as rated by parents but not teachers. These findings suggest that there may be a unique relationship between performance on academic targets and organizational skills in the home setting. It is possible that having greater exposure to academic targets on the DRC (i.e., has materials necessary for task) prompted children to continue using newly learned organizational skills at home (i.e., having an organized backpack), and gave parents more opportunities to successfully scaffold and reinforce their child's overall organizational skills at home. Interestingly, our results also indicate that percentage of parent signatures on DRCs predicted teacher-rated, and not parent-rated, organizational improvements. This finding suggests that there may be a unique relationship between parent signatures and teacher ratings, perhaps parent signatures on DRCs reinforced teachers to continue implementing DRCs and therefore motivated them to continue promoting use of organizational skills in the classroom. Improved organizational skills are particularly relevant for youth with ADHD, as they often yield further improvements in

academic achievement and performance (Langberg, Epstein, Urbanowicz, Simon, & Graham, 2008). The current findings also suggest that selection of academic target behaviors may promote greater improvement in organizational outcomes.

It is possible that the duration of treatment limited potential effects of DRC usage on other student outcomes. On average, teachers had one or two DRC consultation meetings and the DRC was completed for an average of approximately 2 months prior to gathering posttreatment measures. Stronger associations may have been found with a longer duration of DRC implementation. However, a prior study found that treatment over the course of a full school year yielded non-significant associations between DRC completion rates and rule violations (Fabiano et al., 2010), and another study showed that the strongest effects of DRC intervention were observed during the first month of treatment (Owens et al., 2012). These findings suggest that limited treatment duration may not be a sufficient explanatory factor.

Importantly, other published studies (Fabiano et al., 2010; Murray et al., 2008) also find potent treatment effects for the DRC in spite of limited associations between student outcomes and DRC completion rates per se. It is possible that rates of teacher adherence were sufficiently high (average usage on 70% of possible school days) to improve outcomes for most students. Alternatively, it could be that the consistent use of contingencies for the DRC (i.e., parent reinforcement), rather than teacher DRC completion rates, may be a more important predictor of student outcomes (Fabiano et al., 2010). Rates of parent signatures on the DRC in the current study are consistent with those observed in other studies. However, we did not gather a measure of whether a reward was provided if earned and therefore could not directly test this hypothesis. It should also be noted that parent involvement with DRC was impacted by both teacher use of DRC and by child adherence to their role in the DRC procedure as well (e.g., remembering to take the DRC home and bring it back to school each day). Adherence by all parties is likely important to facilitate school-home collaboration and optimal child outcomes.

Neither of the teacher adherence measures predicted improvements across math, reading, writing, and speaking and listening standard grades. This pattern of results is similar to other studies finding that DRC completion did not predict improvements in academic achievement (Fabiano et al., 2010). DRC adherence may not have impacted grades given the short duration of the intervention or because the DRCs did not specifically target academic skills per se. Adjunctive academic skills interventions are likely required to improve outcomes such as learning, grades, and academic achievement (e.g., Tamm et al., 2017).

The association between teacher experience with school-home report cards and DRC implementation is consistent with prior studies demonstrating teacher knowledge

(about the intervention being implemented) had a positive impact on student success and outcomes (Sherman et al., 2008) and increasing teacher knowledge in classroom-based behavioral interventions predicts improved ADHD symptoms (Miranda, Presentación, & Soriano, 2002). Taken together, these findings point to the importance of assessing teacher experience and incorporating more education about their effective use, since knowledge and experience are likely to lead to better adherence and, in turn, better student outcomes.

Limitations

Our results should be interpreted in the context of several limitations. First, our measure of DRC usage does not represent how accurately the teacher implemented the DRC. Similarly, the teacher background questionnaire only assessed experience with classroom management strategies and did not account for the *quality* or consistency of their past DRC use. Given prior research demonstrating significant variability in teachers' implementation of DRC programs (e.g., Chafouleas, Riley-Tillman, & Sassu, 2006; Hart et al., 2017), it is important that future research considers the impact of teacher's implementation quality in predicting student outcomes. Teachers consistent implementation of DRCs may well be linked to improved student outcomes. Second, most students had academic target behaviors on their DRCs; fewer included behavioral or social-emotional targets, limiting statistical power to detect significant associations for the latter categories. Third, insufficient parent reinforcement of the DRC, rather than teacher lack of adherence, may account for the limited association of DRC use and student outcomes. Parent signatures were gathered on 68% of DRCs, but verification that rewards were provided when earned was not available. Future research should consider if parent delivery of rewards (and not just reviewing the DRC) yields stronger treatment effects. Fourth, the current study was conducted in the context of a larger intervention with multiple components (i.e., parent and child skills group); therefore, it is unclear how findings may generalize to interventions with only a DRC. We also did not examine whether teacher adherence predicted student outcomes at the follow-up assessment during the subsequent school year because DRC implementation was not required or systematically measured during the maintenance period. Lastly, the current sample included elementary schools in an urban school district; student demographic factors and teacher experience may not be representative of other schools in other regions. The majority (75%) of participants in the study were male, which precluded examining gender differences. Further study of gender differences may be indicated given prior findings that teachers may be more likely to accept DRCs as

an effective treatment for girls compared to boys (Pisecco, Huzinec, & Curtis, 2001).

Clinical Implications

The current findings highlight the important role of teacher adherence to behavioral intervention on student outcomes. Brief, global ratings by school clinicians of overall teacher adherence may be especially useful indicators of student response to intervention. Given the brevity and low cost, such a measure may be easily implemented across school sites that have clinicians (or educators) available who are aware of teacher practices and DRC implementation. These measures could be used to monitor and adjust interventions as needed over time. DRCs with academic targets appear to be particularly useful for students having attention and behavior problems given their specific association with improved organization at home. Although DRC usage per se was only related to parent-rated organizational skills, the efficacy of DRCs for improving a wide range of student outcomes is well substantiated. The majority of cases in the current study appeared to have adequate DRC implementation. However, in approximately 15% of cases, DRCs were implemented far less consistently. Inadequate or inconsistent use of the DRC is a common concern (e.g., Owens et al., 2012), and current results also point to the need to support teacher's DRC adherence (e.g., assessing prior DRC use and knowledge, educating and consulting teachers about DRCs, regularly monitoring accuracy of teacher adherence and tracking student progress, and ensuring rewards are provided consistently at home). Clinical efforts should also prioritize optimizing DRC coordination between parents and teachers, which may yield greater cross-setting improvements. Given other studies linking parent contingencies to student outcomes (Fabiano et al., 2010), efforts to improve parent adherence to the DRC process (e.g., reviewing with child and providing earned rewards) are indicated.

Future Directions

Current findings suggest several avenues for future research. First, increased understanding of aspects of teacher adherence most important for student outcomes is needed. In particular, studies of DRC implementation quality (rather than quantity) may identify stronger associations with student outcomes. An important direction for future research would also be to examine the long-term effects of DRC interventions and continuous implementation on student outcomes. In addition, further development of multimethod assessment strategies for assessing teacher adherence to school-home programs, such as ratings from school staff, self-evaluations,

or validated adherence checklists, may be needed to best capture those aspects of teacher adherence predictive of student outcomes. Second, teacher experience appears to be related to DRC utilization. Consideration of these and other teacher factors may guide efforts to promote increased adherence. Third, developing standardized and sustainable methods for DRC delivery are needed. For example, recent efforts in developing digital DRCs may facilitate consistent adherence and communication between teachers, parents, and students over time (Owens et al., 2019). Given the multiple responsibilities that school teachers face, it will be important that such interventions are feasible and acceptable to teachers. Fourth, in addition to monitoring teacher adherence, a critical examination of target behaviors on the DRC can potentially elucidate *which* target behaviors are important for various functional outcomes in children with attention and behavioral problems. Lastly, next steps include replicating these findings in diverse populations and elucidating adaptations for various classroom structures and resources, gender, ethnicity/race, language, and other socioeconomic backgrounds.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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