

Illustrating the Multiple Facets and Levels of Fidelity of Implementation to a Teacher Classroom Management Intervention

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Published online: 1 May 2013
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Abstract Many school-based interventions to promote student mental health rely on teachers as implementers. Thus, understanding the interplay between the multiple domains of fidelity to the intervention and intervention support systems such as coaching and teacher implementation of new skills is an important aspect of implementation science. This study describes a systematic process for assessing multiple domains of fidelity. Data from a larger efficacy trial of the Incredible Years Teacher Classroom Management (IY TCM) program are utilized. Data on fidelity to the IY TCM workshop training sessions and onsite weekly coaching indicate that workshop leaders and the IY TCM coach implemented the training and coaching model with adequate adherence. Further, workshop leaders' ratings of engagement were associated with teacher implementation of specific praise, following training on this content. Lastly, the IY TCM coach differentiation of teacher exposure to coaching was evaluated and found to be associated with teacher implementation of classroom management practices and student disruptive behavior.

Keywords Fidelity · School-based intervention · Implementation · Coaching

Introduction

Much literature in implementation science has focused on the importance of fidelity, or the amount and quality of

implementation of any new program or practice (Gresham et al. 1993; Perepletchikova and Kazdin 2005; Schoenwald and Hoagwood 2001). Fidelity is now viewed as a multi-dimensional, multi-tiered construct that is essential for understanding the adoption and dissemination of evidence-based practices in schools (Power et al. 2005). In this paper, after providing an overview of the topic and defining terms, we illustrate the multiple facets and levels of fidelity by describing our efforts defining fidelity to a multicomponent program, the Incredible Years Teacher Classroom Management (IY TCM) intervention and the coaching model embedded within IY TCM utilized to support teachers' implementation of new skills. In addition, we describe a systematic process of evaluating fidelity to the intervention as well as the coaching infrastructure in place to support teachers. Understanding the process of fidelity and implementation across the multiple dimensions of IY TCM and similar interventions, which rely on training teachers to deliver intervention strategies, will help to inform the interplay among fidelity, implementation, and associated student outcomes.

Despite the importance of fidelity, intervention papers rarely monitor and report the multiple aspects of the construct. In fact, we know of no other paper that has described and reported the multiple dimensions of fidelity in school settings across multiple levels of implementation. We hope to provide a model for measuring and reporting these key aspects of implementation science.

Overview and Rationale

A significant number of children in schools have mental health problems (Greenwood et al. 2008; World Health Organization 2004). If children receive any type of mental

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health services, the vast majority receive these supports at school (Rones and Hoagwood 2000). For some children mental health needs manifest as disruptive behavior. Disruptive behavior problems are a significant concern to teachers. For instance, research has documented that 48 % of teachers reported disruptive classroom behavior problems to be their largest concern in school (Walter et al. 2006). In a recent survey of almost 300 teachers of early childhood and elementary aged children, 97 % of teachers reported concerns with disruptive behavior in the past year and many requested additional training and supports in effective classroom management (Reinke et al. 2011). Importantly, research has demonstrated that teacher classroom practices are linked to student disruptive behaviors (Leflot et al. 2010). Furthermore, students in classrooms where behavior is poorly managed receive less academic instruction (Weinstein 2007) and are more likely to have long-term negative academic, behavioral, and social outcomes than students in well-managed classrooms (Ialongo et al. 2001; Kellam et al. 1998; National Research Council 2002). Therefore, interventions that provide training to teachers in implementation of effective classroom management have the potential to improve teacher skills and outcomes for students.

It is clear that the quality of implementation matters. Only when interventions or practices are implemented as intended will they produce favorable outcomes for students (Durlak and DuPre 2008). Thus, a key challenge in supporting teachers' acquisition and use of new classroom practices is understanding the factors and processes that influence the quality of implementation of these practices (Aarons et al. 2011; Leff et al. 2009). Abundant evidence suggests that teachers need support systems and infrastructure beyond simply attending professional development workshops in order to implement new practices, however, relatively little research has specified the amount, type, or qualities of supports that are needed (Domitrovich et al. 2008; Landsverk et al. 2011).

Fidelity of Implementation

Fidelity, also known as integrity or treatment integrity, refers to the degree to which practices or interventions are delivered as planned or designed (Gresham et al. 1993; Perepletchikova and Kazdin 2005; Schoenwald and Hoagwood 2001). Fidelity can be conceptualized to include both how much of the intervention was implemented and how well the intervention was implemented (Power et al. 2005). Thus, several domains of fidelity can be assessed, including adherence and exposure (how much) and quality of delivery and participant engagement (how well)

(Gresham 2009; Power et al. 2005). Adherence refers to the extent to which the training delivers core intervention content and is implemented in line with program guidelines (as specified in training manuals and/or by a conceptual model). Exposure, or dosage, refers to the amount of the intervention participants receive and if they receive the intervention in the recommended sequence (Perepletchikova 2011). Quality refers to the preparedness, enthusiasm, attitude, and skill level of the interventionists when using the training methods, processes and learning principles employed in the original intervention model. Participant engagement reflects the level of the participants' responsiveness to the intervention including their level of participation, enthusiasm, and attentiveness (Gresham 2009; Perepletchikova 2011; Power et al. 2005). The fifth dimension of fidelity, program differentiation, has been defined essentially as a manipulation check to ensure different treatment conditions were exposed to differing levels or types of intervention (Dane and Schneider 1998). More specifically, program differentiation involves "identifying unique features of different components or programs so that these components or programs can be reliably differentiated from one another (p. 204; Dusenbury et al. 2003)". In our view, differentiated coaching fits under this aspect of fidelity. If a given model conceptualizes ongoing coaching supports that tailor the program to match teacher competence and needs as an essential component, then fidelity to the model would be demonstrated by evidence that differentiated coaching occurred.

In schools, the study of fidelity is complicated by the multiple levels at which it occurs. For instance, fidelity can be assessed at the level of the (1) teacher training workshop (i.e., did the trainers deliver the workshop as intended); (2) coaching or ongoing consultations after the workshop (i.e., was the coaching model delivered as intended); and (3) teacher skill implementation (i.e., did the teacher implement the new skills as intended). Low adherence at any of these levels could undermine the impact of the intervention. As evidence-based interventions targeting teachers as implementers are disseminated into real world settings, assessment of intervention fidelity across training and coaching sessions and classroom level implementation is crucial to ensuring the production of desired intervention outcomes and high-quality professional practice (Forman et al. 2009).

Fidelity of implementation at the training level is critical to ascertain whether the trainers presented the intervention content with integrity. When interventions include a coach or technical assistance resource in school and classroom settings, it is important to determine the fidelity with which these individuals are following procedures or a specific protocol for how they use their time and interact with teachers. Related to social behavior interventions involving

coaching, there is a clear need for more details regarding key coaching features, systems to support collection of fidelity data, and how these then relate to teacher implementation of new skills and student outcomes (Driscoll et al. 2011; Stormont et al. 2013).

Many implementation studies collect data on one specific dimension of fidelity, such as trainer adherence or teacher exposure, but do not collect data on multiple influences on implementation and how these influence teacher implementation and student outcomes (Driscoll et al. 2011). For example, in terms of dosage, attending sessions may not be enough to gauge whether participants are learning the material and/or are motivated to use key principles. This underscores the importance of assessing fidelity across multiple domains. For instance, teacher engagement in sessions should be examined to determine if engagement is related to teacher implementation.

Furthermore, it is important to collect information on how coaches use their time and if they spend more time and resources with teachers who need them the most. In a recent review of the literature, it was clear that more information is needed on the fidelity of the coaching process and if coaches implement key intervention principles with integrity (Stormont et al. 2013). Of particular importance, only 31 % of interventions with coaching included an assessment of the coaching process. The only aspect of coaching that has been clearly isolated and linked with positive student and teacher outcomes is the use of ongoing performance feedback (Stormont et al. 2013). Thus, it is important to collect data on coach fidelity to the intervention protocol, including the sequential introduction of key concepts, and supporting teachers' use of these strategies in their classroom. It is also important to understand the challenges and needs of teachers and students across different classrooms. Coaches need to be able to deliver key content while remaining flexible enough to differentiate between teachers who needs more support. Very little information has documented how coaches spend their time and what specific strategies that are associated with more positive teacher and student outcomes.

Incredible Years Teacher Classroom Management (IY TCM) Intervention

The IY TCM provides a useful model for considering the multiple aspects of fidelity given that it involves the implementation of a training program, ongoing coaching supports, and teacher implementation of skills. The foundation of IY TCM includes a 6 day group-based professional development training for teachers and other school personnel in supporting use of effective classroom management and working with students with disruptive or other

problem behaviors (Webster-Stratton 1994). The training workshops focus on validated classroom management skills that decrease problem behaviors and increase social-emotional development and positive teacher-child interactions (Snyder et al. 2011; Webster-Stratton et al. 2004). The IY TCM intervention targets key classroom management strategies including encouragement and praise, use of incentives, proactive teaching, and other strategies that target decreasing inappropriate behaviors, increasing social competence, and fostering problem-solving in the classroom (Webster-Stratton 2001). The intervention is based on social learning theory in which video modeling, role plays, and practice are positively reinforced first in the training workshops and then in classrooms by the IY TCM coach to increase teacher self-efficacy in implementing these skills in their classroom (Bandura 1977, 1982).

Research to date has consistently supported the IY TCM intervention and has documented increases in teacher use of effective classroom management strategies and decreases in student problem behaviors (Webster-Stratton et al. 2001, 2004, 2008). For instance, Webster-Stratton et al. (2004) randomly assigned families to one of six conditions: parent training (PT); parent plus teacher training (PT + TT); child training (CT); child plus teacher training (CT + TT); parent, child, plus teacher training (PT + CT + TT); or wait list control. The results from group comparisons indicated that teachers who received training used more praise, were more nurturing and consistent, and reported more confidence in teaching. Additionally, the children in classrooms of trained teachers were observed to be significantly less aggressive and more cooperative (Webster-Stratton et al. 2001, 2004).

Coaching Supports

One integral part of the IY TCM intervention is the rigor in which teachers are supported in learning key concepts across multiple trainings and then subsequently supported in using them with ongoing one-on-one sessions with IY TCM coaches in their classrooms. Driscoll et al. (2011) reported teachers were 13 times more likely to implement an intervention when granted access to additional supports, such as a consultant, quality teaching descriptions and video demonstrations. Furthermore, research has also documented that when provided additional intervention support, such as coaching, teachers are more effective intervention implementers and report greater self-efficacy and sustainability (Forman et al. 2009; Ransford et al. 2009; Wenz-Gross and Upshur 2012). The additional support coaching sessions offer teachers as part of the IY TCM intervention is often cited as desirable and necessary to intervention implementation fidelity and success (Driscoll et al. 2011; Forman et al. 2009; Noell et al. 2002; Ransford et al. 2009; Wenz-Gross and Upshur 2012).

In a recent review of the literature on coaching teachers on delivering social behavioral interventions, 83 % of interventions that utilized coaching as a component of an intervention yielded positive results (Stormont et al. 2013). One component of coaching that is clearly linked to improved teacher integrity of implementation and sustained implementation is the delivery of performance feedback (Reinke et al. 2013; Stormont et al. 2013). The IY TCM incorporates ongoing coaching including the use of the evidence-based component of delivery of performance feedback. Other elements of the coaching model include modeling, co-teaching, problem-solving, and emotional support (see Reinke et al. 2012). Although the use of coaching has been associated with positive outcomes in research, the specific elements of coaching need more research to substantiate their effectiveness, as well as and the contextual factors that influence when and why a coaching strategy is used.

Teacher implementation of new skills learned through the IY TCM workshop sessions and on-site coaching are likely impacted by the fidelity of the model during

workshop trainings and coaching sessions. In turn, the level of teacher implementation of skills learned in the workshop sessions and supported by coaching will be associated with student outcomes (See Fig. 1). In prior studies of IY TCM, as is true for most similar programs, fidelity has only been measured at the training workshop session phase. Measures of fidelity at the training phase have included trainer completion of self-assessments regarding their implementation of core components as well as the intervention developer's review of video tapes followed by detailed feedback on implementation fidelity. Further the relationship between levels of fidelity, including adherence, exposure, quality, participant engagement, and differentiation during the workshop training sessions and coaching, and teacher implementation of skills has not yet been explored.

Present Study

The purpose of this study was to explore multiple domains of intervention fidelity across IY TCM workshop training and coaching, and teacher classroom level implementation of targeted skills. Specific research questions included:

1. What is the level of adherence, exposure, quality, and engagement to the core intervention content for the workshop trainings?
2. Was teacher engagement in intervention workshop training sessions related to teacher implementation of practices in the classroom?
3. What is the level of adherence to coaching sessions?
4. Did the IY TCM coach differentiate the exposure of coaching based on teacher need for supports? If so, is exposure to coaching associated with increases in teacher implementation of skills and decreases in student disruptive behavior post-intervention?

Method

Thirty-four elementary school teachers trained in the IY TCM intervention from six urban schools serving primarily African American (74 %) students participated. These teachers were part of a large-scale group randomized trial evaluating the efficacy of IY TCM. A total of 70 K to 3rd grade teachers in participating elementary schools were eligible to participate with 68 consenting to be in the study. Two-third grade teachers opted to not participate (97 % consent rate). Teachers consenting to participate were randomly assigned to intervention versus control conditions (34 intervention, 34 control). For the purposes of this study, only teachers who received the IY TCM intervention were

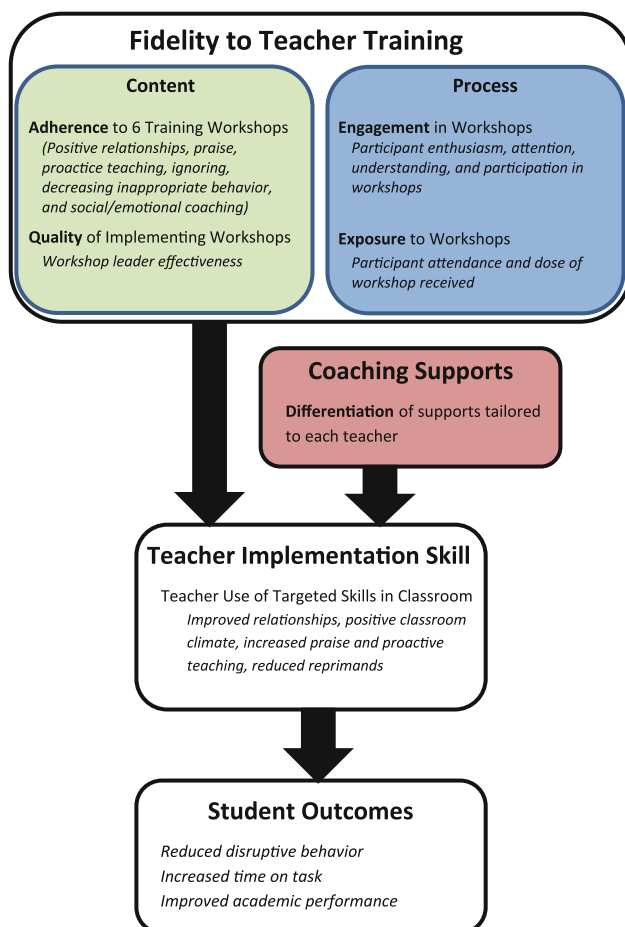


Fig. 1 Multidimensional aspects of intervention fidelity and implementation

included. Most teachers were female (91 %), and White (76 %). 24 % of teachers were African American. A total of 8 teachers taught Kindergarten, 10 taught First grade, 7 taught Second grade, and 9 taught Third grade. Participants' years of teaching experience ranged from 1 to 29 years, with an average of 12.28 years (range = 1–29 years). Teachers were provided six workshop sessions of IY TCM training followed by ongoing on-site coaching across two cohorts. Each cohort consisted of 17 teachers. Cohort one was trained a year prior to cohort two. All study procedures were reviewed and approved by the University and participating school district's institutional review board (IRB) prior to implementation.

Two certified IY TCM leaders provided the IY TCM workshop trainings. One leader was a White male with a doctoral degree in Counseling Psychology. The second leader was a White female with a doctoral degree in Special Education. The second leader also provided weekly on-site coaching to each teacher in the intervention. Both leaders were trained in IY TCM by the intervention developer. Further, all IY TCM workshop sessions were videotaped. These videotapes were then reviewed by the intervention developer for fidelity to the intervention. She provided supervision and written feedback to the leaders. Thus, the IY TCM leader training and supervision were one method for ensuring high fidelity to the IY TCM workshop sessions.

In addition to the IY TCM leader training and supervision described above, fidelity data were gathered across the domains of adherence, exposure, quality, and participant engagement for the IY TCM workshop and coaching sessions (see Power et al. 2005). Fidelity measures included: (a) a workshop fidelity rating scale completed by the leaders, (b) post-training evaluations from teachers of the IY TCM workshops, (c) teacher report of alliance with the coach, and (d) leader report of teacher engagement with the intervention. In addition, direct observations of teacher implementation of classroom management skills were conducted prior to and following IY TCM workshop sessions.

Measures

IY TCM Workshop Measure of Adherence

Following each workshop session, IY TCM trainers completed a *Teacher Group Leader Rating Scale* (Webster-Stratton 2010a, b). The scale assessed trainers use of processes (e.g., begin the discussion of the topic with open-ended questions) and procedures (e.g., complete required practices for session) for leading discussions on content, for showing vignettes, and for practice activities (e.g., role

plays and small group activities). The leaders rated their adherence to the session activities on a 1 to 5 likert scale where 1 = *not at all/not well*, 3 = *sometimes*, and 5 = *frequently/very well*. The overall mean rating of the adherence items were calculated. Leaders are not expected to demonstrate all items on the scale in every session. Thus, in general a rating of 3 or higher was considered adhering to processes and procedures for the IY TCM workshop sessions.

IY TCM Workshop Measures of Quality

Several measures of IY TCM workshop and coaching session quality were gathered. Following each IY TCM workshop teachers completed an *IY TCM Teacher Workshop Evaluation* (Webster-Stratton 2010a, b) consisting of 4 items to which they rated the content of the session, the videotape examples, the leaders teaching, and the group discussions. The teachers rated each item on a 4 point scale in which 0 = *not helpful*, 1 = *neutral*, 2 = *helpful*, and 3 = *very helpful*. Cronbach's alpha for the measure ranged from 0.51 to 0.86 across workshop sessions. The overall mean ratings of the workshop evaluation for each session were calculated. The feedback gained after each session was reviewed by the leaders and areas for improvement were incorporated into subsequent sessions. Further, teachers completed an *IY TCM Teacher Workshop Satisfaction Questionnaire* (Webster-Stratton 2010a, b) at the end of the final workshop. The questionnaire consisted of 37 items about the overall intervention, specific teaching techniques, and an overall evaluation of each IY TCM leader. Teachers rated each item using a 7 point scale. For the purposes of this study three items that related to teacher perceptions of overall quality of the IY TCM content and leaders' teaching were utilized from this questionnaire: 1) My expectation for good results from this workshop was 1 = *very pessimistic*, 4 = *neutral*, and 7 = *very optimistic*, 2) Would you recommend this workshop to another teacher? 1 = *strongly not recommend*, 4 *neutral*, and 7 *strongly recommend*, and 3) I felt the leader's teaching was 1 = *very poor*, 4 = *average*, and 7 = *excellent*. Overall mean scores on each item are provided.

IY TCM Workshop Measure of Teacher Engagement

The IY TCM leaders completed a *Leader Impression of Teacher Engagement Form* (Shepard and Rivera 2009) for each teacher at the end of each workshop session. This form assessed the leaders' impression of the level of teacher participation, engagement with intervention content, openness to the intervention, comprehension of intervention

principles and level of cooperation during each workshop. Each teacher was rated on 7 items using a 3 point scale, *0 = never or seldom/uncooperative*, *1 = sometimes/neutral*, or *2 = frequent/open/very cooperative*. Cronbach's alpha for the measure ranged from 0.69 to 0.78 across workshop sessions. A higher mean rating indicated greater engagement with the workshop content. Leader ratings were aggregated for each teacher and workshop session. The overall mean ratings were utilized in analyses.

IY TCM Workshop Measure of Exposure

Teacher attendance was also recorded for each workshop session. The IY TCM intervention consists of 6 full day workshops. Teachers were expected to attend all sessions to adhere to the amount of dosage considered necessary for teachers to effectively learn IY TCM content. At the start of each workshop teachers signed an attendance sheet. In addition, the IY TCM leaders tracked whether teachers attended the full session. The total number of workshop sessions attended were calculated and compiled for each teacher.

IY TCM Coaching Measure of Adherence

To monitor the adherence of the IY TCM coaching session, the coach completed an *IY TCM Coach Adherence Scale* (Reinke et al. 2012). This scale consists of 23 items encompassed under the following domains: collaboration, goal setting, IY TCM pyramid and core elements, build confidence and efficacy, give attention to internal dialogue, use experiential and self-reflective learning methods, and contextualize the learning process. Following each coaching session, the coach rated each item on a scale from 1 to 5 for level of adherence with *1 = low adherence*, *3 = acceptable adherence*, and *5 = high adherence*. Cronbach's alpha for the measure ranged from 0.92 to 0.97 across coaching sessions. The overall mean ratings of items were calculated. A score of 3 was considered adequate adherence.

IY TCM Coaching Measure of Quality

The *Coaching Alliance Scale* (Wehby 2010) was utilized as a proxy for the quality of coaching. Teachers completed the measure in the spring about their experiences with the coach. Teachers rated 10-items about their confidence and trust in the coach, the approachability and practicality of the coach, and the effectiveness of the coach on a 5 point scale in which *1 = never*, *3 = sometimes*, and *5 = always*. Cronbach's alpha for this measure was 0.54. Overall mean ratings for the scale were calculated.

IY TCM Coaching Measure of Exposure

The IY TCM is a universal intervention for teachers, meaning that the intervention is intended for all teachers regardless of skill level. However, the IY TCM coach was able to differentiate the amount of coaching provided to teachers based on their need for supports. Therefore, the exposure, or amount of coaching provided to teachers was tracked by the coach during each coaching session using a handheld computer in which the duration of the session was recorded in real-time. These data provide information about the number of coaching sessions and amount of time spent coaching each teacher. Data on the total amount of coaching provided to each teacher were utilized.

Teacher Implementation of Skills

Independent observers conducted direct observations of teacher implementation using *Multi-Option Observation System for Experimental Studies* (MOOSES; Tapp 2004) interface for hand held computers to gather real time data using the *Brief Classroom Interaction Observation Revised* observation code (BCIO-R; Reinke and Newcomer 2010). The frequency of teacher use of general praise statements, specific praise statements, and reprimands, were gathered simultaneously during each observation. Frequencies of student disruptive behaviors were also recorded. Observations were conducted in classrooms during instructional times for 20-min following IY TCM workshop sessions 1/2 and 3/4 to assess the level teachers implemented effective classroom management practices. In addition, observations were conducted prior to intervention and post-intervention. Reliability checks were conducted for 30 % of the observations. The mean percentage agreement across raters on the BCIO-R was 87 %, ranging from 61 to 100 %. MOOSES utilizes second-by-second comparison of raters to determine reliability and an overall reliability of 80 % is considered acceptable, thus 87 % is considered reliable (Tapp 2004).

IY TCM Training Workshops and Weekly Onsite Coaching

Teachers participated in six, 6 h, workshops spread out across the school year. The purpose for spreading workshop sessions over time is to allow for teachers to work on generalizing workshop content strategies into their classroom with the support of the IY TCM coach. Further, teachers discuss successes and challenges with other teachers at subsequent workshop sessions, permitting for an exchange of ideas among peers. Workshop sessions 1 and 2, which focus on building positive relationships with

students, positive attention, and use of praise, were completed across two consecutive days in the fall. Workshop sessions 3 and 4, which focus on use of incentives and planned ignoring, were completed across two consecutive days in the winter. Workshop sessions 5 and 6, which focus on time-out, emotional regulation, and social-emotional coaching, were completed across two consecutive days in the spring. Teachers did not receive incentives for participation in the workshop trainings, but substitute teachers were hired for days in which teachers attended workshop sessions. Teachers who missed workshop sessions met with the coach to review the missed content. In between each workshop sessions the IY TCM coach observed the teachers in the classroom and met with them individually for up to one hour on a weekly basis. During the individual coaching sessions the coach reviewed workshop content, supported goal setting for use of strategies, provided feedback on teacher skills and interpersonal teaching processes with children, modeled effective practice, role-played potential barriers and challenges, and supported action planning. The coaching model is learner-centered, supportive and collaborative, and focuses on building on teachers' strengths (see Reinke et al. 2012). Coaching sessions followed each workshop sessions and focused on the same content.

Analytic Plan

Descriptive information was compiled for the fidelity domains of adherence, quality, exposure, and engagement for IY TCM workshop sessions. These data provide information about leader adherence to workshop content and principles, teacher exposure to workshop trainings, teacher perception of quality of workshops, and workshop leader perceptions of teacher engagement in the workshop. Next, linear regression analyses were conducted to determine if teacher engagement with workshop sessions were associated with teacher implementation of classroom management skills. Following workshops 1/2 and 3/4, classroom observations were conducted. Therefore, engagement with workshop 2 and 4 were used to predict teacher use of specific praise, overall praise, reprimands, and student disruptions while controlling for baseline levels of the same variables.

Then, descriptive information was compiled for coach adherence to coaching sessions and teacher exposure to coaching. Lastly, to determine differentiation of exposure of coaching to teachers, baseline levels of teacher use of praise, reprimands, and student disruptions were used to predict the duration of coaching provided to teachers using linear regression. In addition, teachers were grouped by level of exposure to coaching by quartiles, then paired

Table 1 Overall mean, range, and standard deviation of group leader ratings of adherence to IY TCM workshop sessions and percent of teachers in attendance

Workshop session #	Mean	Range	SD	% Attendance
1	3.61	3.42–3.81	0.27	100
2	3.56	3.43–3.68	0.18	100
3	3.90	3.74–4.07	0.23	100
4	4.13	3.97–4.29	0.22	100
5	3.69	3.33–4.05	0.51	97
6	3.73	3.72–3.74	0.01	88

Note Possible range is 1–5. Score of 3 or higher indicates adequate adherence

sample *t* tests were conducted to evaluate the association between teacher exposure to coaching and implementation of praise, reprimands, and rates of student disruptive behavior post-intervention.

Results

IY TCM Workshop Adherence

Table 1 provides the overall mean level of adherence for each session of the IY TCM workshops as recorded by the IY TCM leaders. There was little variability in leader ratings of their adherence to IY TCM procedures and processes. On average the leaders reported adequate ratings of adherence (i.e., 3 or higher) for each session.

IY TCM Workshop Quality

Table 2 provides data on teacher evaluations of the IY TCM workshop sessions and their overall evaluation of the IY TCM content and IY TCM leader teaching. The lowest workshop evaluations occurred for session 1, which focused on building relationships with students. The second workshop session, which focused on teacher attention and praise, had the largest range of scores. The highest ratings were for session 6, which focused primarily on teaching student's emotional regulation and social skills. In general the ratings for IY TCM content signify the quality of the IY TCM workshops and leader training was high.

IY TCM Workshop Exposure

The percentage of teachers who attended each session is provided in Table 1. Thirty of the 34 teachers received the full dose of IY TCM by attending all six sessions (88 %); three teachers missed only workshop 6, and one teacher missed workshop 5 and 6. Each of the four teachers

Table 2 Mean, range, and standard deviation for teacher overall evaluations of IY TCM workshops and leader teaching

Teacher overall ratings	Mean (SD)	Range
Expected good results	6.35 (0.54)	5.00–7.00
Would recommend to other teachers	6.41 (0.50)	6.00–7.00
Leader 1 teaching	6.82 (0.39)	6.00–7.00
Leader 2 teaching	6.79 (0.41)	6.00–7.00

Note Possible range for overall ratings were 1–7

Table 3 Mean, range, and standard deviation for teacher evaluations of IY TCM workshops and leader ratings of teacher engagement for each workshop

Workshop session and content	Teacher workshop evaluation		Leader ratings of teacher engagement	
	Mean (SD)	Range	Mean (SD)	Range
1: Building relationships	1.97 (0.51)	1.00–2.75	6.68 (1.58)	4.50–10.00
2: Teacher attention and praise	2.30 (0.58)	0.50–3.00	7.81 (2.02)	2.00–11.00
3: Using incentives	2.44 (0.40)	1.50–3.00	9.46 (1.52)	6.00–12.00
4: Ignoring and redirecting	2.45 (0.36)	1.75–3.00	8.64 (1.34)	3.50–10.00
5: Time-out and teaching calm down	2.54 (0.36)	1.75–3.00	8.87 (1.13)	6.00–10.50
6: Emotional regulation, social skills	2.66 (0.36)	1.75–3.00	9.42 (0.79)	7.50–10.50

Note Possible range for workshop session ratings were 0–3. Possible range for engagement was 0–12

attended meetings with the IY TCM coach to review missed content.

IY TCM Workshop Engagement

Following each IY TCM workshop session leaders rated teachers on their level of engagement during the session. Table 3 provides the mean ratings of teacher engagement during each workshop. Similar to teacher ratings of the workshop quality, leaders rated teachers as having lower levels of engagement during sessions 1 and 2.

In addition to summarizing the ratings of teacher engagement, we evaluated the association between leader ratings of engagement with observations of teachers' use of praise, reprimands, and level of classroom disruptions. Teacher levels of engagement from the workshop just prior to the observation of teacher implementation of skills were used to predict use of overall praise, specific praise,

reprimands, and rate of student disruptions while controlling for baseline levels of observed variables. Teacher engagement with workshop session 2, which focused on providing students attention and praise, was positively associated with teacher use of specific praise after controlling for baseline levels of specific praise ($\beta = 0.34$, $p = 0.03$). Overall rates of praise were also positively associated with teacher engagement ($\beta = 0.36$, $p = 0.03$). Teacher use of reprimands ($\beta = 0.25$, $p = 0.07$) and student disruptions ($\beta = 0.28$, $p = 0.08$) were not associated with teacher engagement with workshop 2. Additionally, teacher engagement with workshop 4, which focused on use of ignoring and redirection, was not associated with teacher use of specific praise ($\beta = 0.08$, $p = 0.65$), overall praise ($\beta = -0.22$, $p = 0.15$), reprimands ($\beta = -0.15$, $p = 0.27$), or student disruptions ($\beta = -0.13$, $p = 0.35$).

IY TCM Coach Adherence

Coach ratings of items from the *IY Principle Coach Adherence Scale* were aggregated across all coaching sessions and analyzed by item to determine adherence to IY TCM principles. Any item with a 3 or higher was considered to meet acceptable levels of adherence. The maximum possible range for each item was 1 to 5. The overall range of scores across the 23 items was 2.40–4.53. The adherence items with the highest average score were the following items: Coach uses open-ended questions to facilitate discussion (mean = 4.53), and Coach provides praise/affirms teacher statements (mean = 4.43). Overall, the IY TCM coach reported acceptable ratings across all items but three. The three items were: Coach demonstrates/models implementation of various teaching practices (mean = 2.40), Coach uses practice opportunities to provide feedback to teacher (mean = 2.42), and Coach encourages the teacher to reflect on which practices fit best with their style (mean = 2.98).

IY TCM Coaching Quality

Teachers reported high levels of alliance with the IY TCM coach. The mean rating for overall alliance with the coach was 4.91 (range = 4.20–5.00; SD = 0.20), indicating that teachers felt the coaching relationship was effective and of high-quality.

IY TCM Coaching Exposure

The IY TCM coach met with the teachers between IY TCM workshop sessions on a weekly basis. However, over the course of the year the coach met with some teachers more than others. The mean number of coaching sessions for teachers in the sample was 7 (range = 3–12), and the

average amount of time the coach spent coaching teachers was 6 h (range = 3–13 h).

Baseline rates of observed reprimands, disruptions, and overall praise were regressed on the total duration of coaching to determine if the IY TCM coach differentiated her use of coaching by providing more coaching to those teachers in greater need of support. Teacher use of reprimands ($\beta = 0.41, p = 0.01$) and rate of student disruptions ($\beta = 0.42, p = 0.01$) were positively associated with the amount of time the IY TCM coach met with teachers; teachers with higher rates of reprimands and student disruptions received more coaching. Rate of praise at baseline did not predict amount of coaching for teachers ($\beta = 0.30, p = 0.08$). It was expected that lower levels of praise would predict higher levels of exposure to coaching, but this was not the case.

The association between exposure to coaching and teacher implementation of skills post-intervention were evaluated. Teachers were split into quartiles based on the total amount of coaching they received across the year. Teachers falling into the lower quartile on average received 4 h 14 min of coaching. Teachers in the mid-quartile on average received 5 h 14 min of coaching. Teachers in the highest quartile on average received 8 h 50 min of coaching. Interestingly, the coach did not utilize role-play or modeling with any of the teachers receiving the least exposure to coaching. Whereas, the combined amount of modeling and role playing used by the coach with teachers in the mid and highest quartile ranged from 0 to 19 min,

and 0 to 46 min accordingly. Across all groups, regardless of the level of exposure to coaching received, teacher implementation of classroom management practices improved, with the exception of use of general praise for teachers in the lower quartile, for which general praise remained stable for this group. In addition, student disruptive behavior decreased across all groups at post-intervention. Interestingly, for the group receiving the most exposure to coaching, rates of reprimands and rates of disruptive behavior dropped significantly. The group receiving the lowest exposure to coaching demonstrated a significant improvement in use of specific praise. The group receiving the moderate or average amount of exposure to coaching demonstrated significant improvement in their use of specific praise, overall praise, use of reprimands, and had a significant reduction in disruptive classroom behaviors (See Table 4).

Discussion

This study is one of the first to examine the multiple dimensions and levels of fidelity to the IY TCM intervention. We found evidence of adequate rates of adherence, quality, participant engagement, and exposure in the group training sessions. Further, adherence to the coaching model was found to be adequate and teacher reported high levels of alliance with the coach. Moreover, the data suggested that two understudied aspects of fidelity, ratings of teacher engagement and differentiation of exposure to coaching, could be operationalized, measured, and associated with teacher implementation of practices in classrooms as well as student outcomes.

The findings are an important step forward for establishing standards for evaluating fidelity within multi-faceted interventions like IY TCM. Often, intervention fidelity is treated as a unitary construct that is either present or not. In contrast, this study examined multiple dimensions of fidelity and found evidence that each provides an important lens through which to consider fidelity. Adherence and quality are two aspects of fidelity that are commonly reported in studies providing professional development training to teachers. As coaching is a common component of these teacher interventions, it is important to disentangle fidelity to this unique aspect as well. For instance, it is possible for the training of an intervention to be delivered with high adherence and quality but to have low level of adherence and quality to the coaching aspect (or vice versa). Presumably both facets of intervention delivery are important to maximize outcomes and behavior change.

In this study we asked workshop leaders and coaches to complete measures of adherence to the trainings and coaching models. Findings indicated that group leaders

Table 4 Results of paired sample *t* tests and means (SD) for pre–post classroom observation variables by teacher exposure to coaching

	Pretest mean	Posttest mean	<i>t</i>	<i>p</i>
Lower quartile (<i>n</i> = 8)				
Specific praise	0.08 (0.06)	0.24 (0.20)	−2.70*	0.03
General praise	0.50 (0.08)	0.46 (0.38)	0.46	0.66
Overall praise	0.57 (0.09)	0.70 (0.15)	−1.35	0.22
Reprimands	0.76 (0.32)	0.54 (0.38)	1.61	0.15
Disruptions	0.76 (0.33)	0.60 (0.35)	1.28	0.24
Mid-quartile (<i>n</i> = 18)				
Specific praise	0.14 (0.04)	0.38 (0.67)	−4.37*	0.00
General praise	0.49 (0.08)	0.67 (0.38)	−1.53	0.14
Overall praise	0.63 (0.45)	1.05 (0.47)	−3.81*	0.001
Reprimands	0.80 (0.42)	0.43 (0.30)	−4.37*	0.001
Disruptions	0.87 (0.44)	0.51 (0.30)	4.14*	0.001
Upper quartile (<i>n</i> = 8)				
Specific praise	0.19 (0.08)	0.29 (0.10)	−1.10	0.31
General praise	0.57 (0.41)	0.60 (0.49)	−0.27	0.79
Overall praise	0.76 (0.57)	0.89 (0.66)	−0.98	0.36
Reprimands	1.13 (0.69)	0.64 (0.46)	2.79*	0.03
Disruptions	1.14 (0.68)	0.75 (0.46)	2.46*	0.04

* Indicates statistical significance

were able to implement the workshop sessions with fidelity. In addition, the IY TCM coach reported adequate levels of adherence to the coaching model across most domains. The coach reported less than optimal adherence on three domains of the coaching model, modeling, provision of practice opportunities, and encouraging teacher reflection. The ratings were only slightly below what is considered adequate. These three areas of the model align with the IY TCM principle to use experiential and self-reflective learning methods. It is possible that modeling and opportunities to practice transferred into the coaching sessions only when the coach felt they were needed to reinforce, clarify, or enhance the fluency of a particular strategy that was previously trained. For instance, the coach did utilize role-play and modeling strategies the greatest with teachers who received the most exposure to coaching. However, these coaching strategies are integral to the IY TCM coaching model and are expected to occur throughout the coaching sessions. These coaching strategies, however, require more time than others. Coaching within the school context can be challenging and making time to set up modeling and practice opportunities can be difficult. In addition, both teachers and coaches may find role-play to be uncomfortable, making it less likely to occur. This has been reported in past research involving coaching as well (see Shernoff et al. 2011). Ongoing supervision and performance feedback to the coach may have improved fidelity to the model. For instance, suggestions for impromptu role-play and modeling opportunities that are concise yet relevant might support adherence to the model.

Further, this IY TCM coach tended to report adherence to the model at the acceptable level and was less likely to report implementing aspects of the model with high adherence. After discussion with the coach, this may be in part because the coach felt that reporting high adherence meant that she was coaching at an above average level, which she was not comfortable self-reporting. An independent evaluator rating of the coaching sessions may have indicated higher rates of adherence than the coach. Future studies could include the use of an independent evaluator to rate adherence to the coaching and workshop sessions. Training and coaching sessions could be video-taped and later coded for adherence. Further, feedback to the coach and workshop leaders about their delivery of IY TCM intervention could be provided to increase fidelity to the model.

In this study, we asked the workshop leaders to rate the engagement of teacher participants in each training session. Engagement as a measure of fidelity is an important construct to consider, particularly with regard to professional development of teachers. For instance, similar to disengaged students in a classroom setting, teachers who are disengaged during professional development sessions are

less likely to incorporate strategies or information offered during the meeting into their repertoire of classroom behaviors. Notably, we found some evidence that these brief ratings predicted teacher behavior change. In particular, teacher level of engagement in the training session focused on praise predicted independently observed changes in teacher use of praise after the training session. This provides some evidence of the validity of this method of defining engagement. The advantage of this approach is that it is simple and cost effective. On the other hand, engagement ratings in other workshop sessions did not predict changes in teacher behaviors related to the workshop content. It is possible that more complex rating systems or direct observations of teacher engagement could yield stronger relationships for these aspects of teacher changes.

Teacher participants' completed quality ratings after every workshop session. Quality ratings of the workshop sessions were found to be relatively high across the workshops. Teachers reported the lowest rating for workshop sessions 1 and 2. The ratings for session 2 had the widest range of ratings, indicating potential room for improvement. The content of sessions 1 and 2 focuses primarily on building positive relationships, teacher attention, and praise. Interestingly, IY TCM leaders also reported the lowest levels of teacher engagement during sessions 1 and 2. The lower ratings may be in part due to the fact that some teacher may have felt that they already had many of the strategies presented in these workshops in place in their classrooms. Lower teacher engagement in the first sessions may also be due to the format of the workshops, which require active engagement and participation; this format, while effective, may feel intrusive to teachers at first. Interestingly, teachers who were rated as being more engaged during workshop 2 were also more likely to demonstrate an increase in their use of specific praise.

Prior research indicates that additional intervention support, such as coaching, improves teacher reported self-efficacy and helps teachers to be more effective intervention implementers (Forman et al. 2009; Ransford et al. 2009; Wenz-Gross and Upshur 2012). In the current study, the IY TCM intervention training is presented throughout the academic year to teachers within the intervention group. Research indicates that for teacher trainings that require many sessions over time, it is essential to have readily available teacher support for the purpose of effective implementation and teacher engagement (Forman et al. 2009). The IY TCM intervention provides this support through ongoing coaching sessions.

We were very interested in operationalizing the construct of differentiation of exposure to coaching. We found that total amount of time spent in coaching sessions was related to baseline levels of teacher use of reprimands and

student disruptions. In other words, the coach was appropriately differentiating supports by spending more time with teachers who had higher rates of reprimands and classroom disruptions. In a prior study, teacher use of reprimands and student level of disruptions was also related to teacher self-reports of self-efficacy and emotional exhaustion (Reinke et al. 2013). Further, teachers who received the most coaching showed pre-post improvements in reprimands and disruptions. Teachers' who received the least coaching, started with the lowest levels of reprimands and disruptions, but also with the lowest use of specific praise, which improved significantly post-intervention. Those teachers who received moderate or midlevel amounts of coaching improved across multiple domains of skill implementation. Unfortunately, no clear decision rules were used to determine who received more or less coaching. The frequency and duration of coaching sessions was influenced by the coach's perception of teacher need (e.g., high rates of disruptive behavior or students with intense needs), the willingness of the teacher to set goals and work collaboratively to meet those goals, and scheduling constraints. Future studies are needed to identify specific decision rules employed by coaches as they differentiate supports to teachers (see Stormont et al. 2013).

A few limitations should be noted. Teachers included in this study were from schools in one district from one state. The characteristics of teachers may not generalize to other areas and future research should replicate this study with teachers from different types of districts (e.g., rural) and geographic locations. Teachers in this study primarily worked with diverse students and within a school district that employed system wide initiatives to support professional development to improve children's outcomes. Thus the buy-in for the teachers may have been higher due to the nature of the district. This study is also limited by the inclusion of a small group of participating teachers, two trainers, and one coach. The coach in this study was someone very skilled in both coaching and the intervention workshop content. Thus, findings may not generalize to other coaches. Further, the IY TCM workshop leaders were provided with supervision from the program developer. This type of supervision toward supporting fidelity to the intervention may not be readily available other implementing similar practices in the field. Lastly, several of the measures utilized in this study were investigator created thus there is no psychometrics on validity for these measures. In addition, a coaching alliance measure was used as a proxy to teacher report of coaching quality. While this measure does address whether teachers perceive the coaching relationship as effective, teachers who like the coach and enjoy spending time with them may report higher levels of alliance. In addition, the direct observation of teacher implementation may lack sensitivity to some strategies targeted by IY TCM. However, we believe the

methods utilized in this small study can illuminate new directions for building a stronger intervention and implementation science, and build momentum toward future studies with a better balance between process and outcome research.

In sum, intervention fidelity is a multidimensional and multi-domain construct that can be operationalized and related to meaningful indicators of behavior change. Intervention studies need to routinely gather data to assess these various aspects of fidelity. In turn, these studies will provide guidance in determining the essential aspects of fidelity, and their minimum threshold needed for intervention effects to occur. In practice settings, these details will be useful to guide decisions about how best to monitor fidelity and determine if these thresholds are exceeded. A systematic process of evaluating fidelity and implementation quality will inform the interplay between the two and associated student outcomes.

Acknowledgments The research reported here was supported by the Institute of Educational Sciences, U.S. Department of Education, through Grant R305A100342 to the first author. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

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