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# An Implementation Science Framework for Conceptualizing and Operationalizing Fidelity in Early Childhood Intervention Studies

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An implementation science framework is used to differentiate between two types of practices (implementation and intervention) and to describe how the fidelity of the two practices are related and would be expected to influence outcomes of interest. The two practices are the methods and procedures used by implementation agents (e.g., a coach) to promote adoption of early childhood intervention practices and the methods and procedures used by intervention agents (e.g., early childhood practitioners) to influence changes or improvements in individual or group outcomes. Data from a study using an evidence-based adult learning practice to promote Head Start staff use of an evidence-based naturalistic instructional practice are used to illustrate the applicability of the fidelity framework.

***Keywords:*** *implementation science, fidelity, adherence, early intervention, preschool special education*

The importance of measuring fidelity in research on early intervention and preschool special education has been emphasized by a number of early childhood experts (e.g., Halle, 1998; LeLaurin & Wolery, 1992; Odom & Strain, 2002; Wolery, 2011). Fidelity has been defined in conceptually similar ways. Dane and Schneider (1998) defined fidelity as "the degree to which specified procedures are implemented as planned" (p. 23). Dusenbury, Brannigan, Falco, and Hansen (2003) defined fidelity as the "degree to which [practitioners] and other program providers implement programs *as intended by the program developers*" (p. 240). Similarly, Smith, Daunic, and Taylor (2007) defined fidelity as those "strategies that monitor and enhance the accuracy and consistency of an intervention to ensure it is implemented as planned and that each component [of a program or practice] is delivered in a comparable manner" (p. 121).

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A number of different frameworks have been proposed for conceptualizing fidelity (e.g., Carroll et al., 2007; Century, Rudnick, & Freeman, 2010; Power et al., 2005; Rudnick, Freeman, & Century, 2012). These frameworks, for the most part, focus on the fidelity or integrity of a program or practice that is expected or is hypothesized to have intended effects or benefits with intended recipients (e.g., children or parents). Fidelity of the methods or procedures used to promote practitioner adoption and use of a program or practice is generally not explicitly part of existing models or frameworks or receives only tangential mention.

The purpose of this article is to describe a framework for differentiating between the fidelity of two different kinds of practices and to illustrate how the two are conceptually and procedurally related. This is accomplished using an implementation science framework (Blase, Van Dyke, Fixsen, & Bailey, 2012) for conceptualizing and operationalizing fidelity to have a better foundation for measuring adherence to different but procedurally related practices. The framework is premised on the need to take into consideration the fact that efforts to promote the use of any type of early childhood intervention practice require attention to not only the fidelity of the practice but also the fidelity of the methods used to promote the use of the intervention practice. Metz and Bartley (2012), for example, described the differences between these two types of practices by noting that "early care educators [who can] skillfully implement effective early care and education strategies [require] the provision of skillful, timely training, and performance assessment" (p. 15) by supportive administrative personnel. As described in this article, *effective early care and education strategies* are intervention practices and *skillful, timely training, and performance assessment* are implementation strategies.

## Implementation Science and Research

Implementation science and research focus on the adoption and use of evidence-based intervention practices and the evidence-based methods and procedures used to promote end users' (e.g., practitioners or parents) utilization of the intervention practices (Eccles & Mittman, 2006). According to Kelly and Perkins (2012), implementation science is concerned with an understanding of the processes, procedures, and conditions that promote or impede the transfer, adoption, and use of evidence-based intervention practices in the context of typical, everyday settings (e.g., early childhood classrooms). Eccles et al. (2009) describe implementation research as the "scientific study of methods to promote the systematic uptake of clinical [intervention] research findings and other evidence-based practices into routine practice" (p. 18).

The term *evidence-based practices* is used in this article to refer to practices that have been scientifically investigated with a focus on the key features or active ingredients of the practices that are empirically related to hypothesized outcomes in which the relationships between the characteristics and consequences of the practices have been replicated under a variety of different conditions (Dunst & Trivette, 2009c; Dunst, Trivette, & Cutspec, 2007). An implementation science approach to research presumes that the intervention and implementation practices that are the focus of investigation are both evidence based (Dunst & Trivette, 2009c) or evidence informed (Cordingley, 2008).

## Implementation and Intervention Practices

An implementation science framework includes an important distinction between implementation practices and intervention practices. Fixsen, Naoom, Blasé, Friedman, and Wallace (2005), in their review and analysis of the state of implementation science research, differentiated between these two types of evidence-based practices and the outcomes of the practices. Implementation practices refer to the methods, procedures, or activities used to promote adoption and use of intervention practices, and intervention practices refer to the methods, procedures, or activities used to promote improvements or changes in outcomes of interest. Accordingly, implementation practices are defined as the methods and procedures used by implementation agents (e.g., coaches, supervisors, instructors, trainers) to promote end users' (e.g., practitioners or parents) adoption and use of evidence-based intervention practices, whereas intervention practices are defined as the methods and procedures used by intervention agents (e.g., early childhood teachers, early interventionists, parent educators, parents) to influence changes or produce desired outcomes in individuals or a group of recipients (e.g., preschool children).

The difference between implementation and intervention practices is illustrated by the many different types of home visiting programs that are used to promote parents' provision of development-enhancing child learning opportunities (e.g., Azzi-Lessing, 2011; Korfmacher et al., 2008). The activities and instructional practices that parents use to enhance child learning are, by definition, intervention practices. The methods that home visitors use to coach, train, or mentor parents to use the intervention practices are, by definition, implementation practices. The adoption and use of the intervention practices by the parents are the outcomes of the implementation practices, and improvements or changes in child learning and development are the outcomes of the intervention practices.

## Practice Characteristics

From an applied perspective of implementation science and research, it is of practical value to have as clear an understanding as possible of the active ingredients (Clark, 2009) or key characteristics (Dunst & Trivette, 2009c) of both evidence-based implementation practices and evidence-based intervention practices. Any implementation or intervention practice can be conceptualized and operationalized as "made up" of different features and elements in which certain characteristics or combination of characteristics of the practices prove to be more important than others as determinants of outcomes of interest. For example, as part of a meta-analysis of the characteristics of adult learning methods (an implementation practice) associated with improved learner outcomes, we were able to identify six categories of practices and specific practices in each category that best explained optimal learner benefits (Dunst, Trivette, & Hamby, 2010). These included the methods used by a coach or trainer to introduce and illustrate the key characteristics of a practice, the procedures used to have a learner utilize and evaluate the consequences of the practice, and the strategies used to engage the learner in reflection on and assessment of mastery of the key characteristics of the practice. Findings also showed that the use of five or six of the most effective practices as part of instruction or coaching were associated with the largest effect sizes on learner outcomes when the practices were used on multiple occasions (Dunst & Trivette, 2012b).

The early childhood intervention literature includes many different descriptions of implementation practices for promoting practitioner or parent use of evidence-based intervention practices (e.g., Campbell & Sawyer, 2009; Landry, Anthony, Swank, & Monseque-Bailey, 2009; Neuman & Cunningham, 2009; Powell, Diamond, Burchinal, & Koehler, 2010; Zaslow, 2009). These as well as other implementation methods include procedures that operationally define the key characteristics of different approaches to both preservice and inservice professional development (e.g., Bruder, Mogro-Wilson, Stayton, Smith, & Dietrich, 2009; Snyder et al., 2012) used to promote adoption and use of evidence-based early childhood intervention practices.

As is the case with implementation practices, any intervention practice can also be conceptualized and operationalized as consisting of key characteristics (e.g., Guralnick, 2001; Justice & Pullen, 2003; Odom & Wolery, 2003; Sandall, Hemmeter, Smith, & McLean, 2005). For example, a content analysis of six different naturalistic teaching strategies and interactional styles identified six key characteristics of this approach to teaching (Dunst, Raab, & Trivette, 2011). The key characteristics included sensitivity to a child's initiations, following the child's lead, contingent responsiveness to child behavior, efforts to promote elaborations and expansions in the child's behavior repertoire, and caregiver support and encouragement of child competence. Research reviews and meta-analyses of the relationships between the key characteristics of these practices and different child outcomes found that they were associated with a number of positive child benefits (e.g., Dunst & Kassow, 2008; Kaiser & Trent, 2007; Trivette, 2007; Warren & Brady, 2007).

Systematic identification of the evidence-based characteristics of an intervention practice and the use of those characteristics by intervention agents to promote changes or improvements in performance or expected outcomes has been accomplished for many different early intervention and preschool special education practices (see, for example, Bailey & Wolery, 1992; Guralnick, 2005; Odom, Brown, Schwartz, Zercher, & Sandall, 2002; Odom, Favazza, Brown, & Horn, 2000). These as well as other kinds of early childhood intervention practices can be unpacked and unbundled to identify the particular characteristics of a practice that "make up" an intervention intended to have hypothesized or expected outcomes or benefits (Lipsey, 1993). The characteristics identified as most important then become the active ingredients of an intervention practice used to produce desired changes or consequences (Dunst & Trivette, 2009c).

## A Word on Terminology

The implementation science framework described in this article differentiates implementation from intervention practices following the description by Fixsen et al. (2005) of the two types of practices and the expected or hypothesized relationship between the practices. This distinction has rarely been made as part of implementation or intervention research explicitly and, in fact, the two terms more often than not have been used interchangeably. We suggest that progress in promoting the adoption and use of evidence-based intervention practices would be better served if we limit the use of the term *implementation* to "a specific set of [professional development] activities designed to put into practice an [intervention] activity of known dimensions" (Fixsen et al., 2005, p. 5).

Although the term *implementation practices* is used in this article to refer to different types of evidence-based professional development activities used by an implementation

agent to promote intervention agents' use of any type of evidence-based intervention practices, the term applies to any number of practices used to promote adoption and use of an intervention practice. For example, capacity-building family-centered practices used by practitioners to support and strengthen parents' use of development-enhancing learning activities with their children would, based on the framework described in this article, also be considered an implementation practice (Cattaneo & Chapman, 2010; Dunst & Trivette, 2009a; Trivette & Dunst, 2007).

## Implementation and Intervention Fidelity

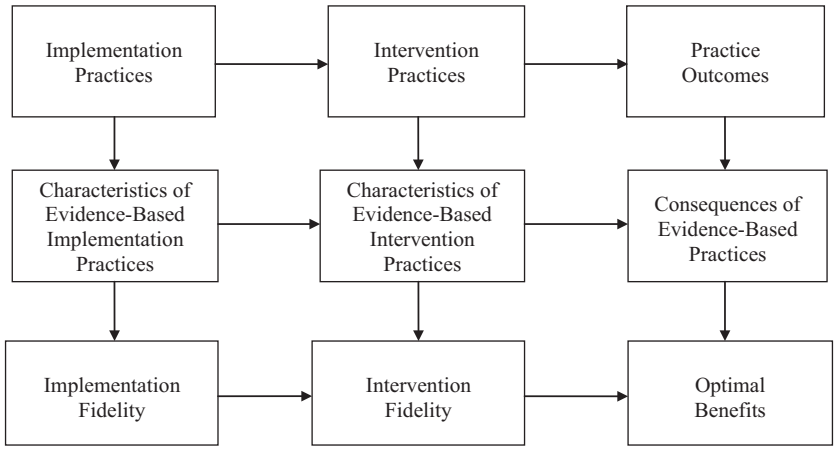
The term *fidelity* is often used interchangeably with adherence, integrity, and similar terminology. Fidelity, as used in this article, refers to the use of the key characteristics of an evidence-based practice in a manner that mirrors what was learned from research about the relationship between the characteristics and consequences of a practice. An implementation science perspective of fidelity indicates the need to consider adherence to the key characteristics of both implementation and intervention practices. Accordingly, implementation fidelity refers to the degree to which coaching, in-service training, instruction, or any other kind of evidence-based professional development practice is used as intended and has the effect of promoting the adoption and use of evidence-based intervention practices (Trivette & Dunst, 2011). In turn, intervention fidelity refers to the degree to which evidence-based intervention practices are used as intended by early childhood practitioners or other intervention agents (e.g., parents) and have expected or intended benefits (Dunst et al., 2008).

The consequences of not considering the fidelity of both implementation and intervention practices as part of early childhood research are illustrated with findings on home visiting programs and practices (Azzi-Lessing, 2011). Nearly all home visiting program models include methods and procedures that home visitors are expected to use to promote parents' use of intervention practices with their children (e.g., Drummond, Weir, & Kysela, 2002; Korfmacher et al., 2008). Yet, in the absence of intentional training to promote practitioners' use of the home visiting practices, research shows that large numbers of home visitors often do not use required or prescribed home visiting practices with parents (e.g., Hebbeler & Gerlach-Downie, 2002; Peterson, Luze, Eshbaugh, Jeon, & Kantz, 2007; Roggman, Boyce, Cook, & Jump, 2001). For example, in a study of the capacity-building practices used by Individuals With Disabilities Education Act (IDEA) Part C early intervention program providers, Dunst, Bruder, and Espe-Sherwindt (in press) found that only half of the providers in their study engaged parents in home visiting in a manner that had capacity-building characteristics. One would therefore not expect parents to use the home-based early intervention practices with fidelity if the practitioners are not using home visiting implementation practices with fidelity.

### Relationships Between Implementation and Intervention Fidelity

Figure 1 shows a framework for depicting the relationships between evidence-based implementation and intervention practices and how the use of the evidence-based characteristics of both practices with fidelity would, in turn, be expected to have hypothesized

**Figure 1**
**Framework for Showing the Relationships Between the Fidelity of Evidence-Based Implementation and Intervention Practices and the Outcomes and Consequences of the Practices**



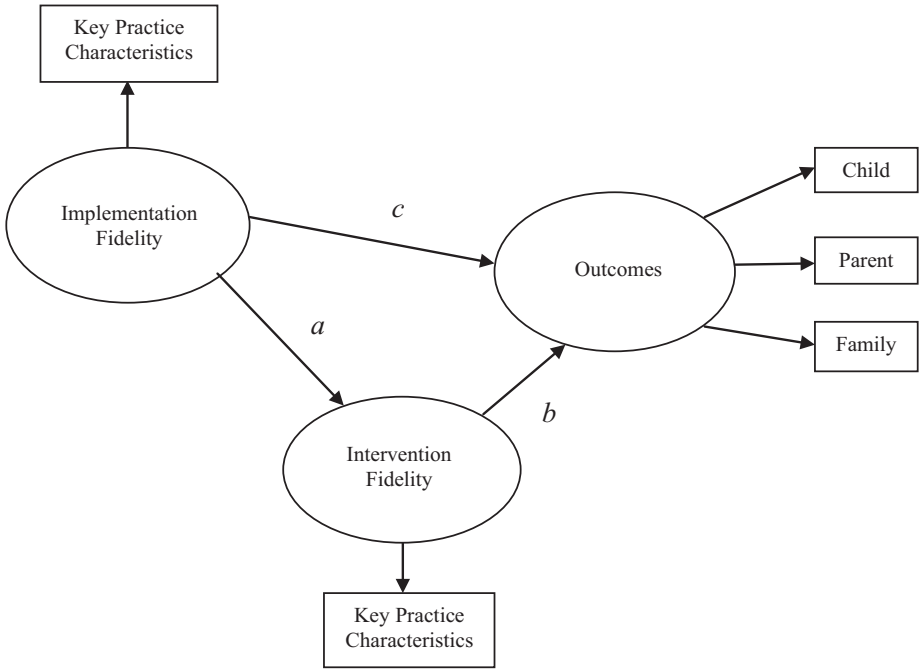

benefits and outcomes. The framework is based on Bronfenbrenner's (1992, 1999) model for differentiating between the characteristics of learning opportunities and experiences afforded to developing persons and the behavioral and developmental consequences or outcomes of those experiences and opportunities. The framework extends Bronfenbrenner's conceptual model by emphasizing the need to consider explicitly the evidence-based characteristics of implementation and intervention practices and how the fidelity of use of the practice characteristics would be expected to be related to outcomes of interest.

The relationships depicted in Figure 1 lead to a number of hypotheses that can be tested to evaluate the relationship between the fidelity of both implementation and intervention practices (Dunst, 2012; Dunst & Trivette, 2012a) and, in turn, to determine the extent to which variations in implementation and intervention fidelity are related to variations in early childhood intervention outcomes (Dunst, 2012). Neither implementation nor intervention practices, no matter the research evidence, are likely to have intended effects if they are not used in a manner that includes the evidence-based characteristics of both types of practice as described earlier for home visiting programs.

The hypotheses that could be tested using the framework shown in Figure 1 to assess fidelity include the following:

- *Variations in implementation fidelity should be related to variations in intervention fidelity.* Tests of this hypothesis would include evaluation of how different indices of implementation fidelity are related to differences in the adoption and use of evidence-based intervention practices. Relating variations in a coach's use of the key characteristics of a training procedure (implementation practice) to variations in a preschool teachers' use of the key characteristics of responsive teaching (intervention practice) is an example of a test of this hypothesis.

**Figure 2**
**Framework for Testing the Direct and Indirect Effects of Implementation Fidelity on Child, Parent, or Family Outcomes**




- *Variations in intervention fidelity should be related to variations in practice outcomes*. Tests of this hypothesis would include evaluation of which evidence-based characteristics of an intervention practice are associated with the greatest amount of variation in recipient outcomes. Relating variations in preschool teachers' use of the key characteristics of responsive teaching (intervention practice) to variations in children's language production is an example of a test of this hypothesis.
- *Variations in intervention fidelity should mediate the relationship between implementation fidelity and practice outcomes*. Tests of this hypothesis would include evaluation of the direct and indirect effects of implementation fidelity on intervention outcomes with a focus on the manner in which intervention fidelity mediates the relationship between implementation fidelity and intervention outcomes. Relating variations in a coach's use of the key characteristics of a training procedure (implementation practice) to variations in children's language production mediated by preschool teachers' use of responsive teaching (intervention practice) is an example of a test of this hypothesis.

Figure 2 shows a model for testing the hypotheses. If variations in implementation fidelity were related to variations in the fidelity of intervention, there would be a statistical or functional relationship for Pathway *a.* If variations in intervention fidelity were related to variations in changes or improvements in outcomes of interest, there would be a statistical or functional relationship for Pathway *b*. If variations in implementation fidelity were directly related to variations in changes or improvements in outcomes of interest, there

would be a statistical or functional relationship for Pathway *c*. If variations in implementation fidelity on outcomes of interest were mediated by variations in intervention fidelity, there would be statistical or functional relationships for both Pathways *a* and *b.* The model shown in Figure 2 is described by MacKinnon and Fairchild (2009) as a single-mediated model. According to these researchers, the relation between an antecedent (implementation) variable and a dependent (outcome) variable in this type of mediated model is indirect and mediated through a second independent (intervention) variable.

The mediated or indirect effects of implementation practices on outcomes of interest could be either complete or partial (Kenny, 2012). The mediated or indirect effect would be *complete* when the value of *c* is zero (or near zero) and the indirect effect ($a \times b$) accounts for the relationship between implementation fidelity and changes in outcomes of interest. If the effect sizes of *c* and $a \times b$ are similarly valued, then the effects of implementation fidelity on outcomes of interest would be *partially* mediated by intervention fidelity. This would show that there is both a direct and indirect effect of implementation fidelity on outcomes of interest. The total effect of implementation fidelity on outcomes of interest is $c + (a \times b)$.

## Measuring Implementation and Intervention Fidelity

There are a number of excellent frameworks and models for conceptualizing the measurement of fidelity (e.g., Carroll et al., 2007; Dane & Schneider, 1998; Gearing et al., 2011; Rudnick et al., 2012; Warren, Fey, & Yoder, 2007). Two common features of most frameworks and models are *how much* and *how well* a practice was used as intended. How much is typically measured in terms of the frequency, amount, number, or other indicators of the dose of a practice. How well is typically measured in terms of the use of a practice in a manner that includes or mirrors the evidence-based characteristics of a practice. How much and how well are sometimes described, respectively, as the *quantity* and *quality* of the fidelity of a practice (Dane & Schneider, 1998).

Both implementation and intervention fidelity can be measured in terms of how much and how well evidence-based practices were used where variations in fidelity data could be used to test the hypotheses stated earlier. The fidelity of the methods and procedures used by an implementation agent to promote end users' adoption of an evidence-based intervention practice would provide the necessary information to determine whether an implementation practice is used in a way consistent with the evidence-based characteristics of the practice. The fidelity of the methods and procedures used by intervention agents to promote or change the behavior of a recipient of the intervention would provide the necessary information to determine whether intervention practices are used in a way consistent with the evidence-based characteristics of the practice. Variations in the fidelity of both types of practices could then be examined to determine the nature of the relationships between the two measures and outcomes of interest.

### Illustrative Example

The methods and procedures used in a study to promote Head Start teacher and teacher assistant use of an evidence-based instructional practice are used to illustrate how

implementation and intervention fidelity can be measured and related in the manner described in this article (Trivette & Raab, 2011; Trivette, Raab, & Dunst, 2012). The study included 36 teachers and teacher assistants in 18 Head Start classrooms. The average number of children in each classroom was 19 (*SD* = 1, range = 17-20). The training afforded to the classroom staff was conducted on-site in the Head Start programs almost entirely in the preschool classrooms. The trainer (coach) met with each teacher and teacher assistant once a week for 8 weeks in sessions lasting 60 min as part of promoting staff use of the instructional practice constituting the focus of training with the children in the classrooms.

The evidence-based implementation practice was a Participatory Adult Learning Strategy (PALS; Dunst & Trivette, 2009b) based on findings from a meta-analysis of different adult learning methods (Dunst & Trivette, 2012b; Dunst, Trivette, & Hamby, 2010) and lessons learned from outreach training projects using an earlier version of the implementation practice (e.g., Dunst & Raab, 2010; Dunst, Trivette, & Deal, 2011). Key features of the implementation practice included active learner involvement in using an evidence-based intervention practice; coach feedback, guidance, and support; coach-guided learner reflection on and self-assessment of mastery of the practice; and frequent and distributed opportunities to use the intervention practice (Dunst & Trivette, 2012b). The particular evidence-based instructional practice that the Head Start staff were taught to use was responsive teaching (Raab & Dunst, 2009). The instructional practice included five key characteristics: following a child's lead, interpreting a child's behavior as an intent to interact with others, adult contingent responsiveness to child behavior, reciprocal child–adult interactions, and adult efforts to promote and support child behavior elaborations. The child outcomes that were the focus of investigation included, but were not limited to, child engagement with people and materials and social skills.

Fidelity of the implementation practice was assessed by the number and frequency of on-site, classroom-based coaching (training) sessions and by a checklist that included the key characteristics of PALS. Fidelity of the intervention practice was also assessed using a checklist that included behavioral indicators of the responsive teaching procedure. The checklist used to assess the fidelity of PALS included items measuring the introduction of responsive teaching; coach illustration and demonstration of the practice; staff opportunities to use the instructional practice; coach-facilitated staff evaluation and reflection on their use, understanding, and mastery of the practice; and the types of opportunities for staff to use the practice with all of the children in the classroom. The checklist used to assess the fidelity of responsive teaching included items measuring staff use of the key characteristics of the practice described earlier and were obtained from observations of the classroom staff during interactions with the children. The fidelity measures of both the implementation and intervention practices that were obtained at the completion of 8 weeks of training are used here to illustrate the relationships between the two measures. Examples of the indicators on both checklists are included in Dunst, Trivette, and Raab (in press).

The child outcome measures used for illustrative purposes were the child competence subscale on the Children's Engagement Questionnaire (de Kruif & McWilliam, 1999) and the child behavior problems subscale on the Social Skills Rating System (Gresham & Elliott, 1990). They were obtained on three occasions during the 8 weeks of training. The measures taken at the completion of the 8 weeks were used as the outcome measures for the implementation and intervention practices.

Implementation fidelity was first determined for all teachers and teacher assistants combined in terms of the overall percentage of adherence to the PALS practices and the degree of variation in the use of the practices. Intervention fidelity was also determined by the percentage of responsive teaching practice indicators used by the teachers and teacher assistants in terms of the overall percentage of adherence and the degree of variation in the use of the practices.

We also computed for each classroom the percentage of adherence to both PALS practices and responsive teaching, which were used as predictors in the analyses of the relationships between the measures described before. For illustrative purposes, we computed standardized structured coefficients for the relationships between the implementation, intervention, and child outcome measures to show how the proposed fidelity framework can be used to discern the relationships among the measures.

*Implementation fidelity.* Fidelity of the use of the key characteristics of PALS averaged 95% for the individual indicators on the fidelity checklist for all classrooms and all staff combined. The percentage of indicators that met the criteria for adherence to the individual indicators (checklist items) of the implementation practice ranged between 91% and 97%. Fidelity was achieved in 14 classrooms as determined by the percentage of indicators meeting an investigator-established a priori criterion (85%) for concluding that implementation fidelity was reached (Dunst et al., in press). The variability in the implementation fidelity measure, as described next, nonetheless permitted tests of the relationship with the responsive teaching and child outcomes measures.

*Intervention fidelity.* Fidelity of the teachers' and teacher assistants' use of the responsive teaching practices averaged 88% (range = 79%-95%) for the individual indicators for all classrooms and all staff combined at the completion of training. Fidelity was achieved in 13 of the classrooms as determined by the percentage of indicators meeting an investigator-established a priori criterion (85%) for concluding that the intervention practice was used with fidelity by the teachers and teacher assistants (Dunst et al., in press). As was the case with implementation fidelity, variations in staff use of the responsive teaching intervention practice permitted tests of the relationships between both types of fidelity and the child outcomes.

*Relationships among measures.* Structural equation modeling (Joreskog & Sorborn, 2001) was used to evaluate the relationships among the variables in the model shown in Figure 2. The nature of the relationships among the variables was estimated by standardized structural coefficients which can range from −1.0 to 1.0. These are indices of the direct effects of one variable on another variable in the model. Procedures as part of the LISREL software (Joreskog & Sorborn, 2001) were used to test the indirect effect of implementation fidelity on the child outcomes mediated by intervention fidelity.

Table 1 shows the means and standard deviations for the PALS and responsive teaching fidelity measures and the standardized structural coefficients for the relationships among the implementation fidelity, intervention fidelity, and two child outcome measures. As hypothesized, variations in PALS were related to variations in teacher and teacher assistant use of the responsive teaching practice. As also hypothesized, variations in responsive

**Table 1**
**Standardized Structural Coefficients for the Relationships Between the Fidelity Measures and Child Outcomes**

| | Descriptive statistic | | Child outcome | | |
|---|---|---|---|---|---|
| Fidelity measure | *M* % | *SD* | Responsive teaching | Child engagement | Child behavior problems |
| Implementation practice | | | | | |
| PALS | 92.63 | 9.26 | .25** | .22* | .15 |
| Intervention practice | | | | | |
| Responsive teaching | 88.42 | 25.22 | — | .23* | −.48** |

*Note.* PALS = Participatory Adult Learning Strategy.
*$p < .05$. **$p < .0001$.

teaching were related to variations in both child outcomes (more positive child engagement and fewer child behavior problems). These findings provide evidence for the direct effects of PALS (implementation practice) on the use of responsive teaching (intervention practice), and the direct effects of responsive teaching on variations in the child outcomes.

The relationship between PALS and the child outcome measures was different depending on the child outcome. The results indicated that the influences of PALS on child engagement was direct ($\beta = .22$, $p = .0262$) but not indirect as evidenced by a nonsignificant mediated term ($\beta = .25 \times .23 = .06$, $p = .1190$). In contrast, the influences of PALS on child behavior problems was indirect and almost entirely mediated by responsive teaching ($\beta = -.48 \times .23 = -.11$, $p = .0500$), as evidenced by the fact that the relationship between PALS and child behavior problems was nonsignificant ($\beta = .15$, $p = .0871$).

The value of the fidelity framework is based on the fact that it can be used to evaluate both the direct and indirect effects of variations in implementation fidelity on outcomes of interest as illustrated with the data from the Head Start study. The use of the framework to test the hypothesized relationships among the variables shown in Figure 2 can help elucidate the nature of the relationships between the two types of fidelity and different kinds of child, parent, and family outcomes. The model could easily be expanded to include contextual variables that mediate or moderate the relationships between implementation and intervention fidelity as well as include other mediating variables (e.g., practitioner self-efficacy beliefs). The interested reader is referred to Trivette, Dunst, and Hamby (2010) for a description of the manner in which variations in the fidelity of use of capacity-building, family-centered practices (implementation practice) were indirectly related to parents' use of a responsive interactional style (intervention practice) mediated by a number of different contextual and process variables.

## Extensions of the Framework

The analyses briefly presented here could be extended by examining the relationships among the fidelity of specific characteristics of implementation practices, specific characteristics of intervention practices, and different child outcomes to identify which characteristics

of both types of practices matter most in terms of explaining the relationships among the measures. For example, disaggregation of the results from the meta-analysis of the research used to develop PALS (Dunst & Trivette, 2011) and research identifying the most important characteristics of a responsive interactional style (Dunst & Kassow, 2008; Nievar & Becker, 2008) suggest that particular characteristics of both practices are more important than others in explaining adult and child outcomes, respectively. The yield from these types of analyses would be a better understanding of which particular characteristics of implementation and intervention practices should be emphasized as part of promoting the use of practices by implementation and intervention agents.

Although the application of the implementation science framework for conceptualizing and operationalizing fidelity was described and illustrated with group data, the framework could easily be extended to single-participant design research studies by mapping changes in intervention fidelity onto measures of adherence to an implementation practice to determine at what point fidelity of an implementation practice is associated with discernible changes in intervention fidelity. Similarly, outcomes of interest could be mapped onto changes in the fidelity of an intervention practice to determine when and how much intervention fidelity is necessary to produce observed changes or effects. Raab, Dunst, Wilson, and Parkey (2009) used this type of behavioral mapping to demonstrate the relationship between child contingency detection and a child's sense of mastery of his or her response-contingent learning capabilities. This same approach could easily be used to evaluate the relationship between implementation and intervention fidelity as described in this article.

## Conclusion

The framework we described for conceptualizing and operationalizing the fidelity of both implementation and intervention practices, and relating variations in both types of practices to changes or improvements in outcomes of interest, provides a way of expanding the manner in which fidelity is measured in early childhood intervention research. The need for and value of having fidelity measures for both types of practices is based on a simple fact. No intervention practice, irrespective of its evidence base, is likely to be adopted and used routinely by intervention agents if the implementation practices used by instructors, coaches, and other implementation agents are not evidence based and used with fidelity to promote intervention agents' use of evidence-based practices. Findings from several studies we have conducted suggest, for example, that the benefits of different types of training afforded to early intervention practitioners are differentially effective depending on how many of the PALS practices are incorporated into the trainings (Dunst & Raab, 2010; Dunst et al., 2011). Similar results have been reported by others investigating the differential effects of contrasting types of training opportunities (see, e.g., Dunst, Trivette, Meter, & Hamby, 2011; Sohn, Ismail, & Tellez, 2004; Sykes & Temple, 2012).

As part of a review of the effects of teacher professional development on student achievement, Yoon, Duncan, Lee, Scarloss, and Shapley (2007) contended,

> To substantiate the empirical link between professional development [on student outcomes], studies should ideally establish two points. One is that there are links among professional

development, teacher learning and practice, and student learning. The other is that the empirical evidence is of high quality—that the study proves what it claims. (p. 3)

The framework described in this article provides one way for taking these points into consideration as part of early childhood intervention research by evaluating the link between implementation practices and intervention practices and the link between intervention practices and outcomes of interest, doing so by collecting and analyzing fidelity data in a manner that demonstrates the nature and strength of the links.

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