

**Abstract Title Page**  
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**Title:** Evaluating Math Recovery: A Case of Measuring Implementation Fidelity of an Unscripted, Cognitively-Based Intervention

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## **Abstract Body**

*Limit 5 pages single spaced.*

### **Background/context:**

*Description of prior research, its intellectual context and its policy context.*

Included in the recent push for rigorous evaluations of programs that are effective in supporting students' learning and achievement is an emphasis on measuring implementation fidelity and linking those measures to program impacts. Claims of treatment effectiveness may be unjustified and invalid unless the degree to which programs are implemented as intended is defined and assessed. However, despite this emphasis on measuring implementation fidelity, recent reviews of studies in school settings have illustrated that many inconsistencies and omissions in measuring fidelity exist (Dusenbury, 2003; O'Donnell, 2008; Ruiz-Primo, 2005). Furthermore, little is known regarding the feasibility of conducting studies of implementation fidelity of unscripted interventions, where measuring fidelity first requires the identification and operationalization of complex, subtle facets of the intervention (Cordray & Pion, 2006). The field is in need of progress in this area to capitalize on the potential of fidelity studies to identify the most problematic areas of implementing a program and to provide feedback to developers for refining a program (Ruiz-Primo, 2005).

### **Purpose / objective / research question / focus of study:**

*Description of what the research focused on and why.*

In this paper, we describe a case of measuring implementation fidelity within an evaluation of Math Recovery (MR), a pullout tutoring program for low-achieving first-graders. We use this case to address two aspects of implementation fidelity studies: 1) their feasibility with respect to unscripted interventions, and 2) their relationship to ongoing program development. The aim of the MR program is to use children's current understandings of number as bases for providing instruction that will support them in constructing increasingly sophisticated strategies. Therefore, assessing fidelity in this case is not as simple as monitoring adherence to a script, but requires assessing the complex practice of delivering mathematics instruction attuned to a child's current understanding and needs.

Our intentions were to both measure the extent to which the program was implemented as intended, and link the measures to student outcomes. Determining the extent to which the tutoring is enacted as intended requires an explication of 'good' tutoring as defined by the developers and systematically evaluating tutors' practices against that ideal. However, we also go beyond MR's notion of 'good' tutoring by looking for instances of "positive infidelity" (Cordray & Hulleman, 2009) within tutoring sessions. Thus, we view studies of implementation fidelity as potential sources for refining theory and program design.

### **Setting:**

*Description of where the research took place.*

The two-year evaluation of Math Recovery was conducted in 20 elementary schools (five urban, ten suburban and five rural), representing five districts in two states. Each was a 'fresh site' in that the program was implemented for the first time for the purposes of the study.

**Population / Participants / Subjects:**

*Description of participants in the study: who (or what) how many, key features (or characteristics).*

Students were selected for participation at the start of first grade based on their performance on MR's screening interview and follow-up assessment interview. Eighteen teachers were recruited to receive training and participate as MR tutors from the participating districts—all of whom had at least two years of classroom teaching experience. Sixteen of the tutors received half-time teaching releases to serve one school each; two of the tutors served two schools each. All tutoring positions were underwritten by their respective school districts.

**Intervention / Program / Practice:**

*Description of the intervention, program or practice, including details of administration and duration.*

To begin, the MR tutor conducts an extensive video-recorded assessment interview with each child identified as eligible for the program. The tutor analyzes these video-recordings to develop a detailed profile of each child's knowledge of the central aspects of arithmetic using the MR Learning Framework, which provides information about student responses in terms of levels of sophistication. The one-to-one tutoring that follows is diagnostic in nature and focuses instruction at the current limits of each child's arithmetical reasoning. Each selected child receives 4-5 one-to-one tutoring sessions of 30 minutes each week for approximately 11 weeks. Every lesson is video-recorded for purposes of daily reflection and planning. The tutor's selection of tasks for sessions with a particular child is initially informed by the assessment interview and then by ongoing assessments based on the student's responses to prior instructional tasks. The Learning Framework that the tutor uses to analyze student performance is linked to the MR Instructional Framework that describes a range of instructional tasks organized by the level of sophistication of the students' reasoning together with detailed guidance for the tutor.

Guiding the fidelity assessment were what we, in collaboration with program developers, determined to be the unique aspects of Math Recovery tutoring as compared to typical tutoring: (a) the tutor's ongoing assessment of the child's thinking and strategies (both reflective assessment between tutoring sessions and in-the-moment assessment); and (b) the tutor's efforts to provide instruction within the child's zone of proximal development.

**Research Design:**

*Description of research design (e.g., qualitative case study, quasi-experimental design, secondary analysis, analytic essay, randomized field trial).*

The larger evaluation study was a randomized field trial. In each year (2007-08 and 2008-09 academic years), 17 to 36 students deemed eligible (based on an initial MR screening) from each of 20 schools were randomly assigned to one of three tutoring cohorts or to the "wait list" for MR. The cohorts, consisting of three students each, were staggered across different start dates (i.e., Cohort A—September, B—December, C—March). In both years students on the randomly ordered waiting list were selected to join an MR tutoring cohort if an assigned participant left the school or were deemed "ineligible" due to a special education placement. The number of study participants totaled 517 in Year 1 and 510 in Year 2, of which 172 received tutoring in Year 1 and 171 received tutoring in Year 2. Consistent with typical MR practice, all sessions were video-recorded.

In this paper, we focus our attention on the implementation fidelity component of the project, for which we followed the five-step method outlined by Cordray (2007): 1) describe the intervention change and logic models; 2) create indices to measure the fidelity of the implemented intervention to constructs identified in the models; 3) determine the reliability and validity of indices; 4) combine indices in the analysis; and 5) link fidelity measures to outcomes. Here, we report primarily on step three, the process of determining the reliability and validity of fidelity indices.

At the outset, we included program developers in conversations to identify key implementation components (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005) and initial schemes for measuring those constructs. The research team finalized the instruments through an iterative refinement process, grounded in MR's guiding principles. A team of coders, trained in both MR tutoring (by MR expert trainers) and video coding (by the research team), were assigned a random selection of twelve tutoring sessions from one student per tutor per cycle (a total of 108 students). For purposes of external validation, a subset of tutoring sessions spanning a range of indices of implementation fidelity as determined by our coding scheme were sent to 20 MR experts, who rated the tutoring practices based on their own notions of high-quality MR practice.

### **Data Collection and Analysis:**

*Description of the methods for collecting and analyzing data.*

Guided by the unique aspects of Math Recovery tutoring listed above (i.e., the tutor's ongoing assessment of the child's thinking and efforts to provide instruction within the child's zone of proximal development), our goal in assessing implementation fidelity was to answer a set of key questions regarding tutors' assessment and instruction: (a) Was the initial assessment done? If so, was it done correctly? (b) In instructional lessons, did the tutor choose procedures (i.e., sets of related tasks) that were in the child's zone of proximal development (according to the MR Frameworks)? (c) Did the tutor utilize/implement the procedures/tasks well?

Regarding the first question, we identified two possibilities for breakdown: the tutor might have 1) presented the incorrect assessment tasks (or tasks that were misaligned with those printed in the assessment), or 2) used poor judgment in interpreting the results (i.e., assigned a profile to the student that conflicted with our external assessment of the child's current understanding). For each of these we defined what constituted a *minor error*, a *major error*, or *no error*.

To answer the second question, regarding tutors' *choice* of procedures, coders first viewed up to three previous tutoring sessions to locate the child's thinking at that point on the MR Learning Framework, and then determined whether the tutor's choice of procedures matched the child's placement on the MR Learning Framework. That is, did the tutor's choice of procedures align with what the MR Instructional Framework suggested? Often tutors utilized procedures as described in the MR handbook, but when they incorporated procedures from other sources, coders located those procedures on the Instructional Framework based on the procedure's focus (e.g., arithmetical strategies, number word sequences, etc.), and the level of difficulty of the tasks within the procedure, including number range and the extent to which the tasks were scaffolded.

Lastly, to answer the question pertaining to tutors' *implementation* of tasks (within procedures), coders examined the extent to which tutors followed established "rules" within the MR program (e.g., things a tutor is supposed to do, or prohibitions). For example, tutors are

expected to consistently solicit students' strategies for solving problems (if the strategy is not already visible), and are expected to avoid merely eliciting particular behaviors.

After four weeks of refinement work (described above), agreement percentages plateaued at an inadequate level—largely due to differences in how coders 'chunked' the lessons they were coding (e.g., Was it one big task, or two?) Therefore, the evaluation team identified a representative aspect of the MR Instructional Framework about which coders' structural decisions had consistently agreed and for which all codes would remain relevant. Of the six aspects included in the MR Learning Framework, two of them (Stages of Early Arithmetical Learning, and Tens and Ones) represent the heart of the theory underlying the MR program. Although lessons typically include practice on other aspects such as number word sequences or numeral identification, it is these two aspects that pertain directly to MR's unique aspects listed above. Therefore, video coding focused on instances of activities aimed at supporting students in developing more sophisticated *strategies*, rendering the fidelity assessment process more tractable without sacrificing any attention to core implementation components.

### **Findings / Results:**

*Description of main findings with specific details.*

Throughout the coding process (after the initial refinement phase), coders maintained an average percent agreement of 0.80. Furthermore, MR experts' ratings validated our coding schemes, with sufficiently high correlations between their ratings and those based on fidelity indices ( $\alpha = .75$ ,  $p < .05$ ).

### **Conclusions:**

*Description of conclusions and recommendations based on findings and overall study.*

Our findings suggest it is possible to create a reliable instrument to measure implementation fidelity for differentiated interventions—an endeavor that has, heretofore, been largely avoided in evaluations of educational interventions. Many potentially high-quality interventions are un-scripted, instead relying on teacher knowledge and professional development, requiring considerable differentiation by implementers. As we work to rigorously evaluate such programs, we need to develop reliable fidelity measures that are both feasible and true to program components, so that evaluators can adequately link measures of treatment integrity to outcomes, to more accurately determine the relative strength of interventions (Cordray & Pion, 2006).

Secondly, in coding for instances of "positive infidelity" we have identified "local additions" (Blakely et al., 1987) that could possibly strengthen the design of the program. Members of the research team have already provided feedback (e.g., at Math Recovery practitioner conferences) to challenge developers' current conceptions and support them in improving the program.

This paper outlines the development and use of a fidelity measure as a case of how such instruments might be developed and used in the future. Critical aspects of the process included 1) the identification of the core implementation components of the intervention; 2) close work with program developers to operationalize those components; 3) training of coders in both the program itself and the coding schemes/process; and 4) collaborating with the coding team to further refine operationalizations and coding decisions, to strike a balance of feasibility and adherence to program components.

## Appendices

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### Appendix A. References

*References are to be in APA version 6 format.*

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**Appendix B. Tables and Figures**  
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