Background/Context

We have conducted seven randomized control trials to test and replicate findings on the Individualizing Student Instruction (ISI) classroom reading intervention. Here we present the two studies conducted with second graders to illustrate how replication can inform theory and practice.

One reason that students fail to achieve proficient reading skills is that they do not receive the amounts and types of reading instruction they need. For example, in first grade, students who have weaker decoding and vocabulary skills make greater gains when they receive exponentially more time in both teacher- and student-managed code-focused instruction compared to students with stronger skills. That is, the effect of literacy instruction depends on characteristics that students bring to the classroom (i.e., child characteristic by instruction interactions) (Connor, Morrison, & Katch, 2004; Juel & Minden-Cupp, 2000).

To test whether these child X instruction interactions are causally implicated in observed individual differences in reading achievement, we developed the Individualizing Student Instruction (ISI) classroom reading intervention. The heart of the ISI-reading intervention is Assessment to instruction (A2i) software, which uses computer algorithms to translate each student’s vocabulary, decoding, and comprehension scores into recommended amounts of code- and meaning-focused instruction that will support their achievement (at least grade level and one school-year gain). The algorithms were derived from correlational studies of first grade classroom reading instruction that revealed child characteristic by instruction interactions (Connor et al., 2004; Foorman et al., 2006; Juel & Minden-Cupp, 2000). Classrooms teachers received professional development to help them individualize reading instruction during their dedicated block of time devoted to literacy instruction; how to use assessment to inform instruction; and how to organize classroom instruction using small flexible learning groups. Our results revealed that child X instruction interactions do appear to be causally implicated in explaining both within and between classroom individual child differences in literacy learning. That is, there were significant treatment effects (Connor, Morrison, Fishman, Schatschneider, & Underwood, 2007) and the more closely aligned students’ instruction was with the A2i recommended amounts, the greater were their decoding and reading comprehension skill gains (Connor, Piasta, et al., 2009). We successfully replicated these first grade results in a second set of schools (Connor et al., 2011).

After successfully replicating treatment effects for the first grade ISI-reading instruction intervention in 2005-2006 and 2006-2007 (Connor, Morrison, Fishman, et al., 2007; Connor et al., 2011), we developed a second grade version of the ISI-
reading intervention. Algorithms for second grade A2i relied on correlational data from two studies – one conducted in Illinois (Connor, Morrison, & Underwood, 2007) and the other in Florida (Connor, Jakobsons, Crowe, & Meadows, 2009). Both correlational studies revealed child X instruction interactions in second grade.

**Purpose/Objective**

The purpose of this presentation is to present the results of two studies and how we learned from the failure of the first study (i.e., no treatment effect on student reading outcomes) and improved the intervention, which was tested in the second study.

**Setting and Research Design**

Both studies were conducted in Florida but in two different districts. Districts served economically and ethnically diverse student bodies in urban, suburban, and rural communities. Both studies utilized an alternative treatment design with teachers within classrooms randomly assigned to the ISI-reading classroom intervention or to an alternative treatment condition. In study 1, this was a vocabulary intervention and in study 2, this was a math intervention.

**Participants**

The first study was conducted in 8 Florida schools in 27 classrooms with 482 students. The second study was conducted in a different Florida school district with 5 schools, 36 classrooms and 568 students.

In both studies, approximately 50% of the students qualified for the US free and reduced lunch program (FRL). In study 1, approximately 45% of the students were African American, 50% were White, and 5% belonged to other ethnicities. Approximately 15% of the children received special education services. In study 2, about 75% of students were white, 20% African American, and about 5% other ethnicity. Approximately 13% of students qualified for special education.

All teachers were fully certified. School percentages of students qualifying for FRL ranged from 17% to 98%. Within studies, all teachers used the same core literacy curriculum and received similar amounts of professional development. This included a half-day workshop before the start of school, monthly meetings as communities of practice, and bi-weekly in-class coaching. All professional development was provided by researchers.

**Intervention**

The ISI-reading classroom intervention has three components: (1) Teacher professional development; (2) Assessment-to-instruction (A2i) software; and (3) Implementation in the classroom. Teacher training for both reading and vocabulary/mathematics interventions (depending on the study) used a coaching model and included half-day workshops at the beginning of the school year, monthly meetings with other teachers commonly referred to as communities of practice (Bos, Mather, Narr, & Babur, 1999), individual meetings as needed, and biweekly classroom-based support provided by research assistants who were also certified teachers.
The A2i software uses three test scores for each student, word-reading, comprehension, and vocabulary, in dynamic forecasting intervention models (i.e., algorithms) to compute recommended amounts for each of four types of literacy instruction. Using A2i, teachers access the recommended amounts of instruction, students’ test scores, and recommended student groupings. There are also planning web pages and access to training materials and discussion boards. Teachers could view their students’ scores and track progress over time throughout the school year using A2i. Paper reports of the scores were provided to teachers in the alternative control group in November, February and May.

The ISI reading intervention characterizes reading instruction across two dimensions: content and management. Content of reading instruction may be code focused – activities designed to teach the alphabetic principle -- or meaning focused – activities that support the extraction and construction of meaning from text. Management identifies who is focusing the students’ attention on the learning activity – the teacher and student together – teacher/child managed (TCM) or the student alone or with peers – child managed (CM). These dimensions operate simultaneously to describe four types of literacy instruction – TCM-code-focused, TCM-meaning-focused, CM-code-focused, and CM-meaning-focused instruction. The recommended amounts of instruction were provided to students with similar reading skills in small groups during the dedicated block of time devoted to literacy instruction (i.e., flexible learning groups). Using their core curriculum and other resources (e.g., FCRR Center Activities, www.fcrr.org), most teachers used a center or station approach where the teacher met with small groups of students while other students worked independently or in small peer groups. Schools provided one of several core reading curriculums, including Reading Mastery and Open Court in study 1 and Houghton Mifflin in study 2, that were indexed to the four types of instruction. Thus teachers used instructional materials with which they were familiar and learned how to individualize reading instruction for students when using these materials.

A2i uses computer algorithms to recommend daily minutes of small-group TCM-code- and meaning-focused and CM-code- and meaning-focused activities, with substantially different algorithms for second grade compared to first.

The computer algorithms are analogous to those used by meteorologists to predict, for example, the paths of hurricanes (Rhome, 2007). For each student, the algorithms use a target-outcome (end-of-grade-level equivalent or a school-year’s gains, whichever is greater), month of the school year, and students’ letter-word, vocabulary, and passage comprehension grade-equivalent scores to compute recommended amounts of each type of instruction. These recommended minutes/day are displayed in the A2i classroom view. Research shows that the more precisely children received the recommended instruction, the greater were their reading gains with large effects (Connor et al., 2011; Connor, Piasta, et al., 2009).

Data Collection and Analysis

Student Assessments: In both studies, we used the Woodcock Tests of Achievement-III (WJ-III, Woodcock, McGrew, & Mather, 2001) Picture Vocabulary (PV), Letter-word Identification (LW), and Passage Comprehension (PC) tests, which
were individually administered fall, winter and spring each school year. Raw scores were converted to W scores, which are a variation of Rasch scores and provide equal intervals. A W score of 500 (SD = 15) is the expected score for a 10-year-old child. Students’ LW scores were highly correlated with PC ($r = .869, p < .001$). These scores were used to drive the A2i algorithms to compute recommended amounts for each type of literacy instruction.

**Classroom Observation:** In both studies, classrooms were observed and video-taped in the fall, winter, and early spring during the literacy block. The videos were coded using the ISI/Pathways coding system (Connor, Morrison, et al., 2009), which records amounts and types of literacy instruction for each student in the classroom. In study 1, we specifically recorded the amount of time (min) each student spent in small group and whole class instruction for the four types of instruction recommended in the A2i software: teacher/child-managed code- and meaning-focused and child/peer-managed code- and meaning-focused instruction.

**Analysis:** We used hierarchical linear modeling (Raudenbush & Bryk, 2002) to analyze the data in both studies because students were nested in classrooms.

**Findings/Results**

In study 1, the results of analyses revealed no significant effect of treatment. That is, students in the ISI-reading classroom intervention demonstrated reading skill gains (i.e., residualized change) that were not significantly different from students in the vocabulary control group. Teacher fidelity to the ISI intervention was adequate, based on observation and records of A2i use. Hence the lack of a significant effect of treatment was not due to poor fidelity. Nor was the study underpowered.

Using the classroom observation data along with the assessment data, we conducted HLM analyses to examine whether there were child X instruction interactions and there were. Moreover, these interactions were substantially different than the interaction effects observed in the previous correlational studies. This suggested that the A2i computer algorithms used to generate recommended amounts were actually recommending incorrect amounts of each type of instruction. Using these data, we developed revised second grade recommendation algorithms and used these revised algorithms in Study 2.

In study 2, HLM revealed that students in the ISI-reading condition achieved significantly stronger LW and PC reading outcomes compared to the treated control in second grade ($d = .44$ and $.43$ respectively). These constitute small to moderate effects (Hill, Bloome, Black, & Lipsey, 2008) and represent about a 2 month advantage in skills by the end of the school year. Notably, the A2i recommendations were the only difference in the intervention across studies.

**Conclusions**

The successful second study (i.e., positive treatment effect) was a direct result of carefully analyzing potential active ingredients including teachers’ use of the A2i software, the A2i computer algorithms, and teachers’ classroom implementation in the first study to inform improvement in the ISI intervention. Together, the results of the two studies reveal the centrality of the A2i algorithm
recommendations to the efficacy of the ISI reading classroom intervention. Hence, Study 1 might be considered a successful failure.


