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Using an Adapted Cover-Copy-Compare Math Intervention in China: A Pilot Study

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Abstract

The math fluency skills of a student with a Full Scale Intelligence Quotient (FSIQ) three standard deviations below the mean were improved using an adapted version of cover-copy-compare (CCC) in China. The student's digits correct per minute and the number of problems correct increased substantially. Evidence of generalization to novel items is also demonstrated. This pilot study suggests that an adapted version of CCC can be effectively used in China, with someone whose FSIQ is three standard deviations below the mean, and that the acquired skill can be generalized.

Keywords: cover-copy-compare; mathematics; fluency; China

Using an Adapted Cover-Copy-Compare Math Intervention in China: A Pilot Study

Math fact fluency is the ability to recall the answers to basic math facts automatically, correctly, and without hesitation (Wendling & Mather, 2008). Cates and Rhymer (2003) identified fluency as a foundational skill for students to achieve conceptual understanding in mathematics. Furthermore, Codding et al. (2007) found that students whose basic math fact fluency levels were in the frustrational range (i.e., more than 10 digits correct per minute [DC/M] and less than or equal to 8 digits incorrect per minute [DI/M]) responded better to the cover-copy-compare (CCC) intervention than the explicit timing intervention. Explicit timing is an intervention used to enhance students' math fluency (Jaspers, McCleary, McCleary, & Skinner, 2017). This intervention includes giving students one minute to complete as many problems as they can. The instructor often provides the students with multiple one minute sprints within each session. Afterwards, students are given performance feedback. Codding et al. (2007) found explicit timing resulted in increased performance when applied to students in the instructional range (i.e., 10 to 19 DC/M and 3 to 7 DI/M). Both interventions provide rapid pacing, corrective feedback, opportunities to respond, and are often modified to include reinforcement contingencies (Skinner & McCleary, 2011). This study examines the effect of the use of CCC as an intervention with a student having characteristics that are seldom included in studies of this strategy.

Cover-Copy-Compare (CCC) Math Intervention

Traditional CCC procedures entail a five-step process: (1) the student examines a math problem and its solution; (2) the student covers the problem and writes the problem and answer in the adjoining column; (3) the student uncovers the first column and compares the problem with the correct solution to the one written; (4) if the problem and answer match, then the student moves to the problem in the next row; and, (5) if the problem and answer do not match, then the student copies the problem and answer into the next three columns before moving to the item in the next row.

CCC provides frequent opportunities to practice solving basic math facts and receive immediate corrective feedback, while working at one's own pace. This pilot study is designed to address two specific limitations in the research. First, only two out of 22 CCC studies included an individual whose IQ is known to be at least two standard deviations below the mean (Carroll, Skinner, Turner, McCallum, & Woodland, 2006; Poncy, Skinner, & Jaspers, 2007). Second, CCC researchers experience difficulty generalizing the skill to novel math items (Codding, Eckert, Fanning, Shiyko & Solomon, 2007). Furthermore, this is the first documented instance of CCC being used outside of the U.S. The purpose of this study is to use an adapted CCC intervention to improve a student's target problems of two-digit minus one-digit problems with regrouping and generalize the skill to different two-digit minus one-digit problems with regrouping and two-digit minus two-digit math problems with regrouping.

Method

We received Institutional Review Board approval from an American university and written approval from the principal of the school the participant attended in China. Informed written consent and assent were also obtained.

Participant and Setting

The participant, who will be referred to as Emily, is an 11-year-old female residing in China, with a reported Full Scale Intelligence Quotient (FSIQ) nearly three standard deviations below the mean. She attends school in a suburban area of Shanghai. Her teacher requested assistance improving Emily's math fact fluency. The initial referral was for solving two-digit minus two-digit problems with regrouping. However, during baseline, the interventionists discovered that Emily had not mastered two-digit minus one-digit problems with regrouping. Thus, in consultation with the teacher, the intervention was changed to target two-digit minus one-digit problems with regrouping and the sum greater than ten. Each intervention session lasted between 10-15 min.

Design and Procedures

This study adapted traditional CCC procedures by adding a row that contained the prerequisite skill of two-digit minus one-digit problems with regrouping and the sum limited to ten, which was inserted before the row with the target item. In addition, a column was added at the start of each row, which required the participant to solve the problem before engaging in the CCC procedures. Furthermore, a 3 min instructional video was shown to the participant before the intervention sessions.

A two-phase experimental design was used. DC/M and percentage of correct problems (PC) were measured as dependent variables. Three different assessment and intervention packets were compiled and used on alternating days. The three packets contained 72 target items, altogether. An additional 36 generalization items were created and put into two different packets, which were also alternated. The target items were 72 two-digit minus one-digit problems with regrouping. Among them, 36 problems were two-digit minus two-digit problems with regrouping and the sum limited to ten. Each intervention session included a packet containing five pages. The first page was the assessment sheet that measured DC/M and PC. The second page contained the practice items. Pages 3-5 contained the intervention sheets that included 18 target items, altogether. Emily was given a two-page packet of generalization worksheets after the intervention phase concluded. The first page contained two-digit minus one-digit problems with regrouping and the second page contained two-digit minus two-digit problems with regrouping. Emily was instructed to finish as many problems as she could in one minute on the assessment and generalization sheets.

Interobserver Agreement and Fidelity

Inter-observer agreement (IOA) was completed on 30% of the worksheets. IOA was calculated by dividing the number agreements by the number of agreements plus disagreements and multiplying by 100. The raters agreed 100%. The teacher who implemented the intervention completed a fidelity checklist during each session. She reported 100% fidelity. Given the distance between the researchers and the teacher, fidelity was not verified by another individual.

No-Assumption Effect Size

A no-assumptions effect size (NAES; Busk & Serlin, 1992) was calculated by subtracting the baseline mean from the intervention mean and dividing the result by the standard deviation of the baseline. The NAES for two-digits minus one-digit problems is 11.77. Burns and Wagner (2008) reported a mean NAES of 2.87 for interventions considered effective.

Results and Discussion

During baseline, Emily's DC/M ranged from 0 to 3 on two-digit minus two-digit problems and 1 to 3 on two-digit minus one-digit problems. In contrast, her DC/M during intervention ranged from 3 to 27 with 94% of nonoverlapping data points (see Figure 1) for two-digit minus one-digit problems.

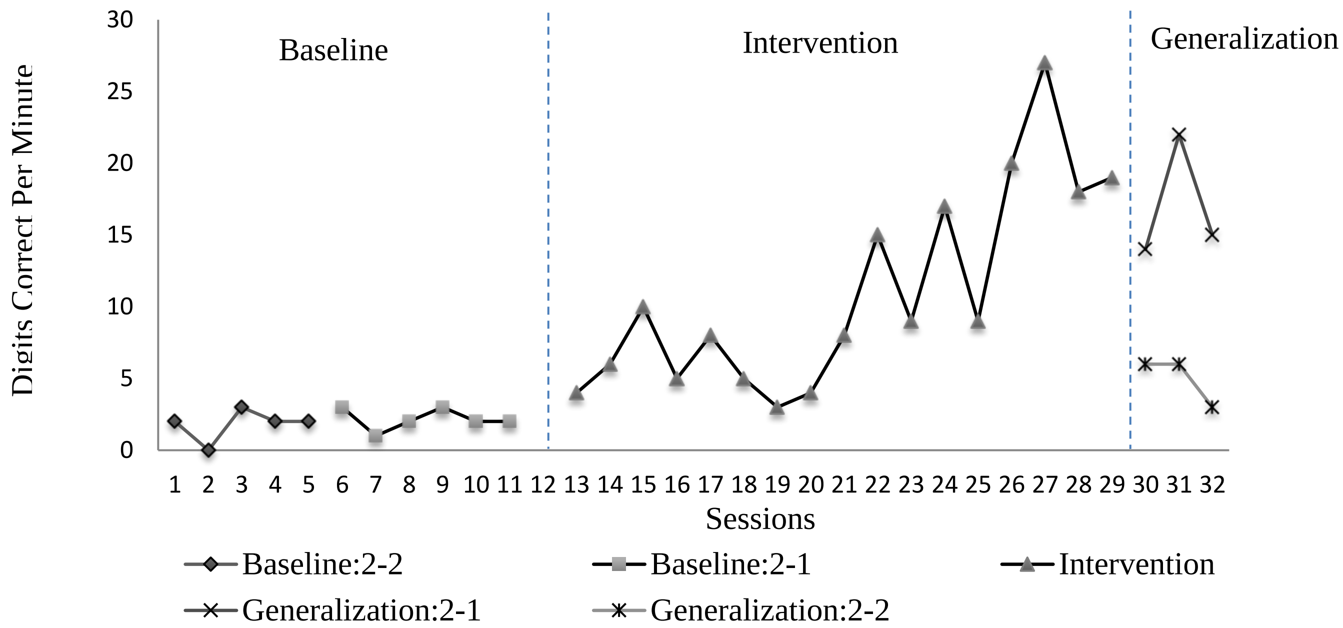

Figure 1. Digits correct per minute (DC/M) across conditions.

Figure 2 shows the percentage of problems correct. In baseline, Emily correctly completed 0% of the problems.

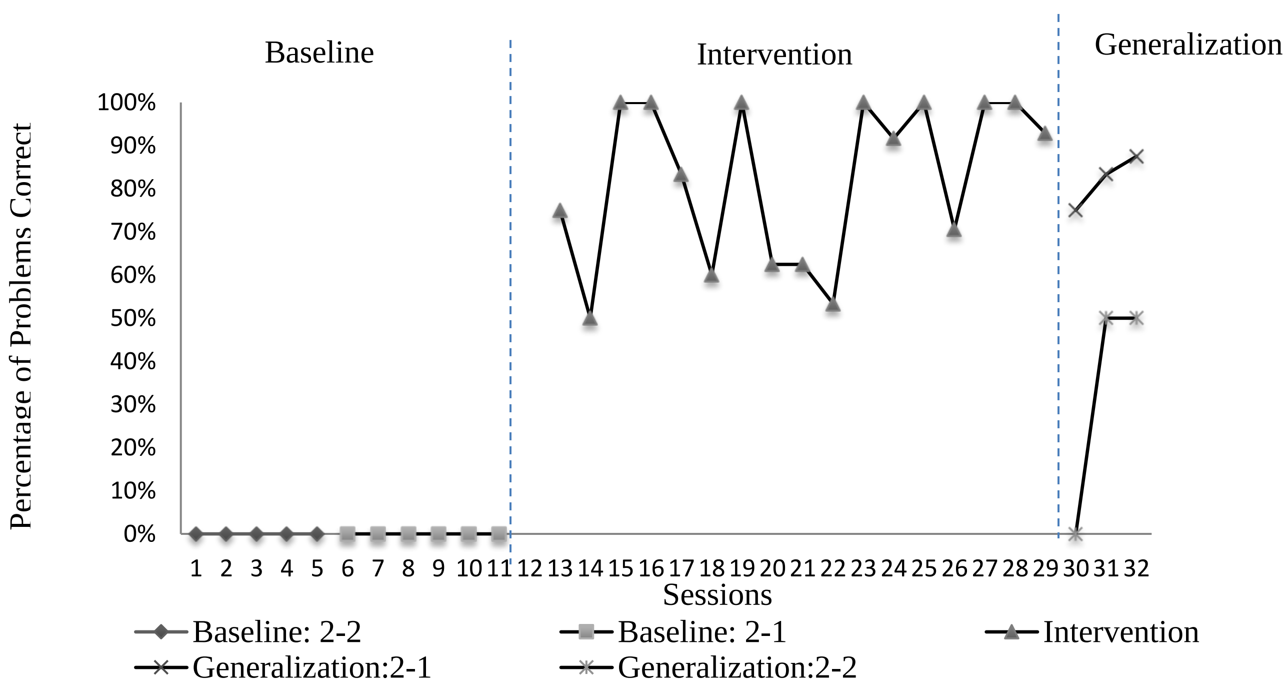

Figure 2. Percentage of problems correct (PC) across conditions.

During intervention, she correctly completed 50 to 100% of the two-digit minus one-digit problems. In addition, a generalization phase was implemented to determine if the intervention generalized to two-digit minus one-digit items not included in the intervention packets. DC/M during the three generalization sessions ranged from 14 to 22 and PC ranged from 75 to 88%, which indicates Emily generalized the skills learned during the intervention phase to novel problems requiring the same procedural steps. Furthermore, generalization data was collected on two-digit minus two-digit problems that were not explicitly taught during the intervention. Emily's DC/M ranged from 3 to 6 and her PC was ranged from 0 to 50%. The researchers completed an item analysis on these items and determined Emily could accurately complete the items in the ones column, a skill taught during intervention, but not in the tens column, a skill she had not been taught. In conclusion, the participant improved her fluency and generalized the skill to non-target items. Although an A-B design with a generalization phase does not provide control of the intervention over the dependent variables, we view the pilot study results as promising and the adaptions of the intervention, setting, and participant characteristics as unique. Future studies should involve more complex designs (e.g., multiple baseline, multielement) and more participants.

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