Using Brief Experimental Analysis to Select Effective Math Interventions
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Introduction
- National Assessment for Education Progress (2011) reports that 18% of 4th Graders and 27% of 8th Graders demonstrate below basic level performance in math.
- The 2001 No Child Left Behind Education Act requires school districts to make yearly progress towards 100% student proficiency in math by 2014.
- National Research Council (2001) posits there is not enough programmatic, empirical research within mathematics.
- Brief Experimental Analysis (BEA) can be a valuable method for selecting interventions with a likelihood of success.
- BEA rapidly evaluates interventions using a single-subject design, the effects of each intervention are compared to baseline data in the academic area to determine the most effective intervention for each student.
- BEA has demonstrated success at identifying effective interventions for reading fluency (Burns & Wagner, 2008).
- To date, four studies have been published examining the effectiveness of using BEA procedures to identify effective math fluency interventions.
- Burns (2011) suggests that a conceptual versus procedural heuristic can be used to better understand math difficulties.
- A conceptual understanding is defined as an understanding of the math concepts, operations, and relations.
- A procedural understanding is defined as the skill to carry out math procedures accurately and efficiently.

Method
- Experimental Design and Procedures
- A Survey Level Assessment, comprised of a series of mixed math problems was used to determine the target skill for each individual student.
- Baseline
  - Each student was given three CBM-math fluency probes comprised of the target skill to determine their mean DCPM.
- Following baseline, the BEA was conducted.
- Brief Experimental Analysis
  - A single-case alternating treatments design was used during the BEA.
  - The BEA exposed each student to four intervention conditions. Each intervention was implemented for twenty minutes each session.
  - Students were given the same CBM-math fluency probe before and after each 20 minute intervention session to assess the increase in DCPM from before to after the intervention.

Intervention Conditions
1. Procedural intervention: Incremental Rehearsal (IR)
   - IR builds student fluency in basic math facts by pairing unknown computation items with a steadily increasing collection of known items at a ratio of 1 to 8 (Burns, 2005).
2. Conceptual Intervention (CI)
   - The CI involves visually representing math word problems with small wooden blocks with methods outlined by Learning Resources (n.d.-a), (Burns, 2005).
3. IR + Contingent Reinforcement (IR+CR)
   - Following the intervention session, a higher preferred reward was earned when the participant met a goal of 25% DCPM higher on the post intervention CBM-math fluency probe, and a lower preferred reward was earned when the participant met 15% DCPM higher (Campbell, DeLapp & Axelrod, 2012).
   - For CBM-math fluency probes with 20 problems, 25% DCPM resulted in a gain of 5 DCPM from pre to post, and 15% DCPM resulted in a gain of 3 DCPM.
4. CI + Contingent Reinforcement (CI+CR)

Results
- The purpose of this study was to evaluate how BEA procedures using interventions within a conceptual versus procedural heuristic can be used to predict a promising math intervention.
- Across sessions, performance was greatly varied for all four participants.
- The BEA was able to differentiate between the four intervention conditions, however multiple repetitions were required.
- In summary, the selected intervention was successful at increasing DCPM over baseline for all but one student (I.e. Carl) during the extended analysis phase.
- The results suggest using a conceptual versus procedural heuristic within a BEA may help practitioners identify math fluency interventions that better match student needs.

Limitations
- In addition to the 20 minute intervention sessions, students were receiving typical math instruction during the school day.
- Math probe difficulty and student behavior could explain the variance in performance across sessions.
- Research has yet to determine what a meaningful improvement in DCPM over baseline would be.
- More research is needed regarding the applicability of the BEA process to other areas of math skills such as multiplication.

Discussion

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