

The Impact of Sequencing of Math Problems on Math Anxiety and Performance

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Abstract

In a prior study, we examined whether different sequencing orders of mathematical problems would help alleviate math anxiety and increase math performance. Math anxiety refers to the fear and apprehension one feels when exposed to anything math related (Maloney & Beilock, 2012). Math anxiety can affect an individual's performance by inducing worrisome thoughts that occupy and limit one's working memory capacity (Ashcraft & Krause, 2007; Ramirez, Gunderson, Levine, & Beilock, 2013). Problem fluency and problem difficulty could also impact math anxiety and performance. Fluent (i.e., easier to process) problems should reduce math anxiety and improve performance relative to disfluent problems (Oppenheimer, 2008). Similarly, easier problems should reduce anxiety and enhance performance more than difficult problems (McDonald & Ardoin, 2007). Crossing fluency and difficulty yielded four types of modular arithmetic problems (e.g., $9 \equiv 6 \pmod{3}$) labeled as easy-fluent (EF), easy-disfluent (ED), difficult-fluent (DF), and difficult-disfluent (DD). Working memory (WM) is increasingly involved in problem solving as the numbers in a math problem grow larger. Math anxiety can negatively impact individuals' performance on math tasks, especially those tasks with high working memory demands (Ashcraft & Krause, 2007).

Analyses in this prior study revealed that performance improved across blocks as participants gained familiarity with the task, regardless of problem type. We reasoned that perhaps the first block of problems served as practice, yielding increased performance after participants became familiar with the problems, regardless of problem type. The present study examined this possibility by having participants complete a practice block of 20 problems before they solved 40 new sequenced modular arithmetic problems sequenced. We found that anxiety increased across blocks as participants transitioned from solving easy to difficult problems, while performance remained similar across blocks. In contrast, anxiety decreased across blocks as participants shifted from solving difficult to easier problems, with performance improving across blocks. The data thus support the need for participants to become familiar with the task before testing the impact of problem sequencing.

Hypotheses

- Participants are expected to report higher anxiety for difficult and disfluent items than for easy and fluent items.
- Performance was expected to be higher for easy and fluent items and lower for difficult and disfluent items.
- Participants were expected to give higher RCJs for easy and fluent items than for difficult and disfluent items.

Method

Participants

N = 70 (M Age= 21.14, SD = 4.27)
39% Female

Design

- 4 x 2 x 2 x 2 (Trial by Condition by Difficulty by Fluency)
- Within Subjects
 - Trial: Trial 1, Trial 2, Trial 3, Trial 4
 - Difficulty: Easy, Difficult
 - Fluency: Fluent, Disfluent
- Between Subjects
 - Condition: Easy-First, Difficult-First

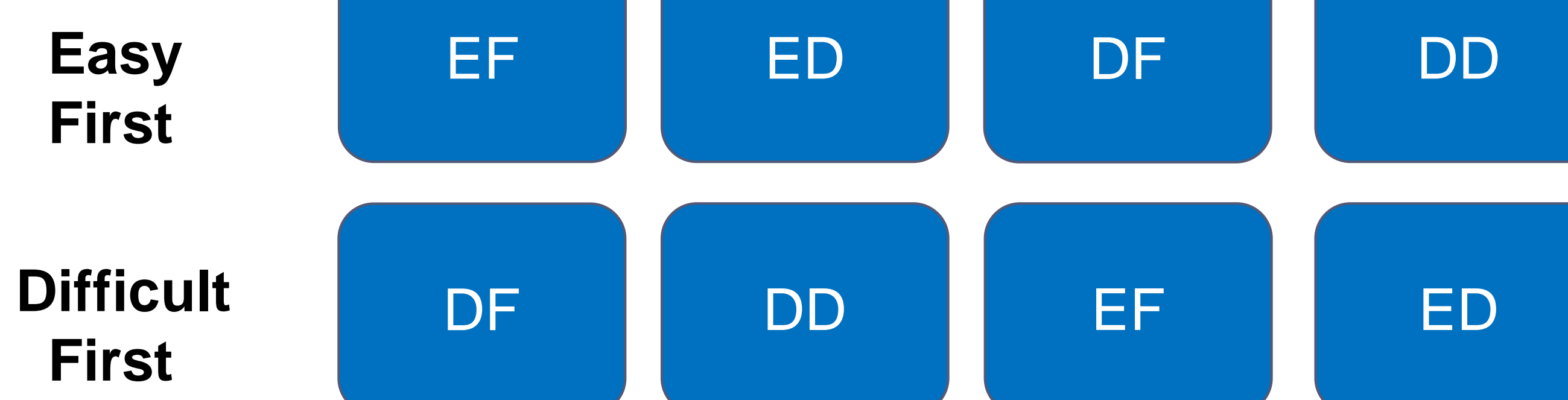
Materials & Procedure

- Participants were asked to mentally solve 40 modular arithmetic problems (10 of each type – EF, ED, DF, DD)
- Retrospective confidence judgments (RCJ; 0 = no confidence 100 = complete confidence answer is correct) were collected after each problem.
- Anxiety ratings were collected after each trial.

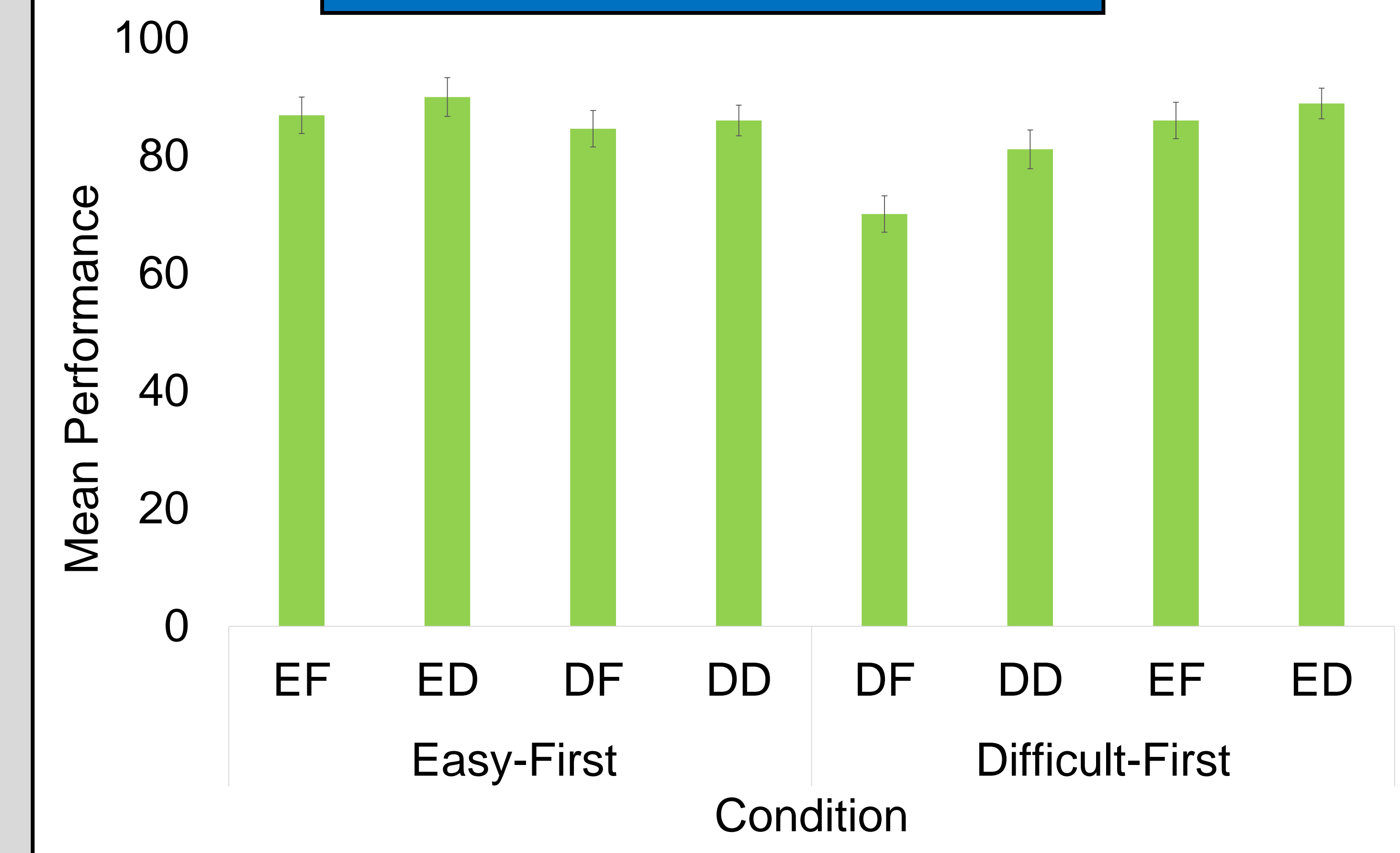
Modular Arithmetic

	Easy	Difficult
Fluent	$9 \equiv 6 \pmod{3}$	$50 \equiv 10 \pmod{5}$
Disfluent	$5 \equiv 1 \pmod{3}$	$43 \equiv 18 \pmod{5}$

Sequencing



Problem Solving Performance



RCJs



Discussion

- Anxiety: As the problems became easier, participant anxiety decreased. In contrast, as problems became more difficult, anxiety levels increased.
- Performance: Disfluent items yielded higher performance in the Easy-First condition, whereas performance increased across trials in the Difficult-First condition.
- RCJs: Participants' confidence increased as problems became easier and decreased as they became more difficult.
- These results highlight the importance of including ample practice problems before examining sequencing effects.

References

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Anxiety

