Outcome Evaluation of Mind in the Making, Vroom and Circle Time Games
October 15, 2017

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OVERVIEW

The first exploratory Randomized Control Trial (RCT) evaluating Mind in the Making, Vroom, and Circle Time Games in Evansville, Indiana was successful, with findings revealing improvements in low-income children's executive function skills and applied problem math scores and in low-income parents' executive function skills. In addition, there were decreases in parenting behavior characterized as over-controlling.

FINDINGS FROM THE RCT

An Exploratory Randomized Control Trial (RCT) Targeting Executive Function Skills (Mind in the Making, Circle Time Games, and Vroom) in a Midwest Community: Child and Parenting Results

Executive function (EF) skills provide a foundation for learning and adaptation and allow children to pay attention and learn more effectively. Many children enter school without adequate EF skills. Fortunately, research suggests that EF skills are malleable, and can be promoted through a variety of practices. As our evaluation for the Kellogg project, we conducted an exploratory Randomized Control Trial (RCT) (or rapid cycle iterative learning trials) of a comprehensive EF-focused intervention that combines Mind in the Making (MITM), Circle Time Games, and Vroom to prepare preschool teachers and families to help their children develop stronger, more effective EF skills. This evaluation took place in one of our Kellogg sites, Evansville, Indiana, It was conducted by three of the leading researchers in executive function: Dr. Philip David Zelazo, the Nancy M. and John E. Lindahl Professor at the Institute of Child Development in the University of Minnesota; Dr. Stephanie M. Carlson, Distinguished McKnight University Professor and Director of Research at the Institute of Child Development, University of Minnesota; and Dr. Megan McClelland, Katherine E. Smith Endowed Professor in Child Development,

Oregon State University.

Mind in the Making offers families and professionals (working with children 0-8 years old) access to developmental research on EF-based skills by engaging them in an active process of professional development in improving these skills in themselves and in children. Vroom is an outreach and communication initiative that brings "brain-building tips" to communities, inviting parents to participate in the science of early learning through partnerships with trusted entities. Both of these initiatives use collaborative, iterative processes in disseminating findings and implications of child development research. Circle Time Games, developed by Megan McClelland and her colleagues at Oregon State University, provide children with fun but challenging opportunities to practice their developing executive function (EF) skills.

The evaluation was conducted in 12 classrooms in an urban school district in the Midwest. Six of these classrooms were randomly selected as intervention classrooms, and six were selected as control classrooms and received "preschool as usual." Teachers, parents, and children in both groups were assessed before (**pre-test**) and after (**post-test**) the intervention on two direct behavioral measures of EF, the Minnesota Executive Function Scale (MEFS) and the Head-Toes-Knees-Shoulders (HTKS) task. Additionally, children were assessed using the behavioral Theory of Mind (ToM) Scale, and two subtests from the Woodcock-Johnson-III Tests of Achievement, Letter-word Identification and Applied Problems. Parenting quality was assessed via direct observation of parent-child interactions during a dyadic problem-solving task.

A total of 198 preschool children (*M* age = 54 months; *SD* = 5.85; 97 males; 101 females) participated. Most of the children (63%) were Caucasian, with 19% Black or African American, 10% Multiracial, 7% Hispanic/Latino, and less than 1% Asian. The majority of children (76%) qualified for free lunch, with the remainder receiving reduced lunch (8%) or no lunch subsidy (16%).

Based on the random selection of classrooms, 98 children were assigned to the intervention group and 100 to the control group. Children in the intervention group were exposed to four weeks of Circle Time intervention games, which were conducted four times a week for 15 minutes during Circle Time (Schmitt et al., 2015). In addition, 100% of teachers and teacher aides (*n* = 10) and 16% of parents (*n* = 16) in the intervention group received 12 hours of Mind in the Making training together, including research on executive function and life skills, practical application of the research, and a goal setting process. The training was presented in an experiential way in weekly two-hour sessions lasting six weeks. This group

also received the information on downloading the Vroom app with brain-building tips to use between sessions to promote parent-child interactions and EF skills.

Effects of the Intervention on Children

Results indicated that for children who started with lower EF scores (at the median or below) on the MEFS, those who received the intervention showed more improvement on the MEFS between pre- and post-test than those in the control condition, $F(1, 185) = 3.89$, $p = .05$. That is, **the children who had the most to gain in their EF skills benefitted significantly from the intervention.**

Benefits of the intervention were also seen in children's math scores. Regression analyses revealed that condition (intervention vs. control) predicted WJ-III Applied Problems post-test scores ($\beta = 0.12$, $p = .035$), controlling for child age, $F(3, 186) = 40.68$, $p < .001$. This finding indicates that **children in the intervention group showed significantly higher math scores at post-test compared with children in the control group.**

Regression analyses on post-test WJ-III Applied Problems (math) also revealed that condition (intervention vs. control) interacted with pre-test MEFS to predict math outcomes (Table 1). Pre-test EF was less strongly related to post-test Applied Problems in children receiving the intervention. This finding suggests that **following the intervention, those children who began school with low EF skills had math scores similar to those children who began school with high EF skills.** In contrast, in the control condition, children who started school with low EF skills continued to perform worse in math than their peers with high EF. Thus, the intervention helped "level the playing field" for math performance for those children who began school with lower EF skills (see Figure 1, Appendix).

Finally, regression analyses showed that pre-test HTKS scores ($\beta = 0.38$, $p < .001$) predicted post-test math on the WJ-III Applied Problems. **Across the two groups, children who started off with higher EF scores as measured by the HTKS showed significantly higher math scores at post-test, compared to children with lower pre-test HTKS scores.**

In sum, although preliminary, these results suggest the promise of MITM, Circle Time Games, and Vroom to help promote engaged learning and life skills in children in authentic learning contexts. These results are currently being prepared for publication and dissemination.

Effects of the Intervention on Parenting

The training was designed as an experiment in redefining family engagement. Rather than the usual approach of having professionals provide parenting information to parents, the parents in the treatment group were invited to join the teachers and the teacher aides so that they could learn about the research and application of EF-based skills together and jointly set goals for themselves and goals for how they can promote these skills with the children in their lives. It was hoped that between 15% and 20% of parents would participate in this exploratory trial to determine if bringing parents and professionals together on what we call a "learning journey" is an effective approach. During every session of this training program, each participant was encouraged to download and use Vroom.

Within the treatment group, there were parents who completed the MITM training (defined as attending four or more of the six training sessions) and parents who did not participate or complete the training (defined as attending one or fewer training sessions). No parents only attended two or three sessions. Due to these differences, we broke the training group into two subgroups – "No Training", i.e. one or fewer MITM sessions (n = 29) and one or fewer introductions to Vroom, and "All Training," i.e., Vroom + MITM training (n = 16). Distinguishing between these groups has provided critical insight into parenting improvements, parent EF, and possible approaches for the next iteration of the intervention and its evaluation.

At baseline (pre-test), those who completed All Training had marginally better parent EF as measured by the MEFS compared with those who received No Training ($t(43) = 1.93$, $p = .06$). The All Training group also showed significantly higher baseline levels of autonomy supportive parenting behaviors ($t(38) = 2.89$, $p < .01$), and lower levels of controlling parenting behaviors ($t(38) = 2.04$, $p < .05$), than did the No Training group. These are important findings because autonomy-supportive parenting (vs. controlling behavior) is linked to better EF skills in children. We also found, however, that parents with better EF skills and parenting skills were more likely to complete MITM training. Parents who completed All Training significantly improved on the MITM knowledge assessment ($F(1,14) = 5.94$, $p < .05$). Furthermore, there were group differences in pre- to post-test changes in controlling parenting behaviors. Past research has shown that controlling parenting behaviors are associated with lower EF skills in preschoolers. **Compared to parents in both the control group and the No Training group, parents in the All Training group showed greater decreases in controlling parenting behaviors (**$F(1, 64) = 3.88$, $p < .05$). **Finally, parents who attended All Training significantly improved in their own EF from pre- to post-test, whereas parents in the No Training group did not** ($F(1,77)$ =

4.57, $p < .05$).

In sum, these preliminary data reveal that MITM training and Vroom improved MITM knowledge and parent EF skills from pre- to post-test. An article on Autonomy Support based on pre-intervention data has been submitted to a journal for publication.

Effects of the Intervention on Classroom Quality

Impacts of the intervention were also examined for changes in classroom quality (as measured by the CLASS). Preliminary results indicate that the intervention was related to increases in the language modeling dimension of the CLASS. In addition, classrooms had significantly higher average regard for student perspectives at post-test compared to pre-test. Finally, change in regard for student perspectives predicted post-test HTKS. This suggests that improvements in student perspectives were related to stronger EF as measured by the HTKS (see Appendix for detailed results). A paper outlining these results is currently being prepared for publication.

In sum, although preliminary, these results suggest the promise of MITM, Circle Time Games, and Vroom to help promote engaged learning and life skills in children in authentic learning contexts. We were able to successfully complete the goals of our project, which examined the impact of a scalable intervention for improving EF and school readiness in preschool age children. Our results were promising and indicated that the intervention targets teachers, parents, and children to provide feasible and low-cost strategies to train and support EF in young children and adults.

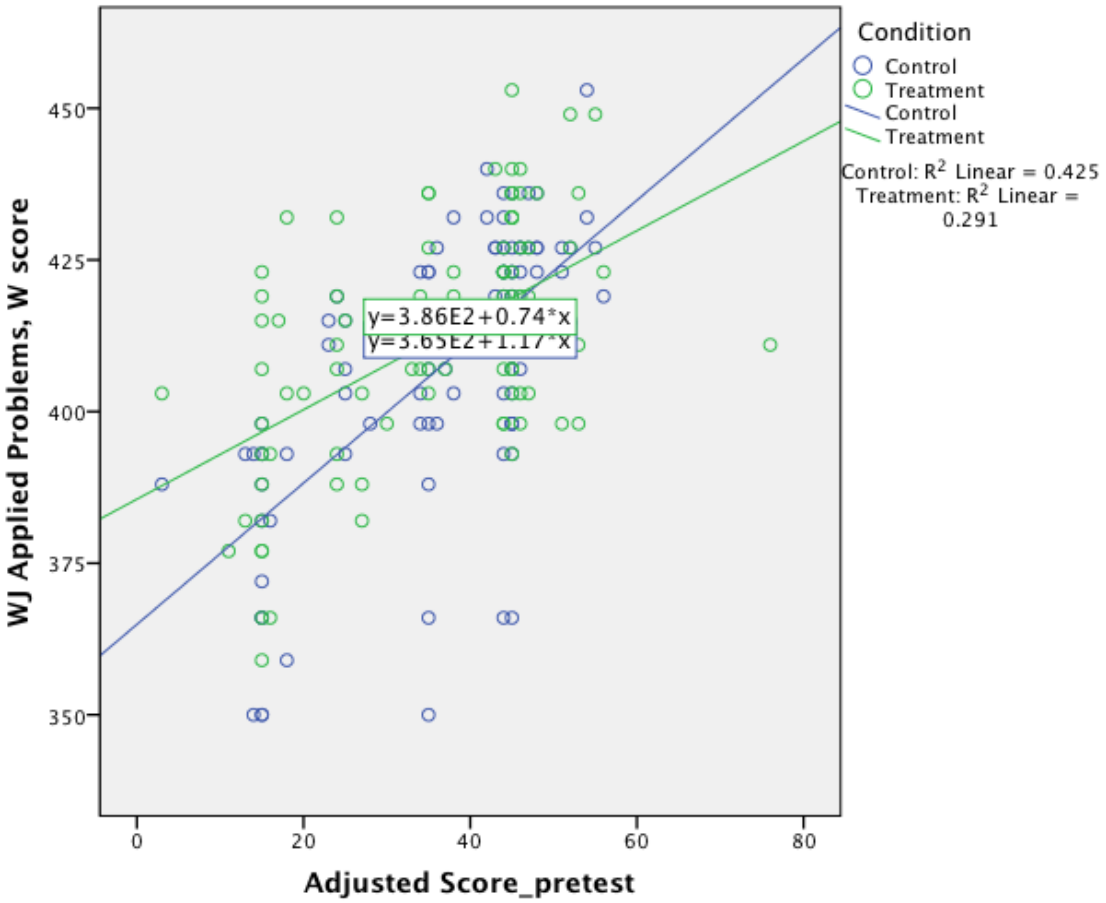
APPENDIX

Effects of the Intervention on Children: Results

Table 1. Multiple linear regression of condition, pre-test EF, and the condition by EF interaction on **WJ Applied Problems W-score Post-test** (controlling for age)

	B	p-value
Condition	**.474**	**.004**
Pre-test MEFS	**.854**	**.000**
Condition x Pre-test MEFS	**-.547**	**.018**

Figure 1. Association between pre-test EF and post-test WJ Applied Problems W-score by condition.



Effects of the Intervention on Parenting: Results

Descriptives

85 parents participated in the study (40 control; 45 treatment)

- 13 fathers and 72 mothers
- 21.25 years – 70.5 years (Mean = 33.58 years)

Attendance and Knowledge Quiz Descriptives (n=45)

- 29 parents in "Take Home Friday Tips only", who attended 1 or fewer MITM training sessions
- 0 parents attended either 2 or 3 training sessions
- 16 parents attended 4 or more training sessions and were classified as having completed the MITM training.

	Range	Mean
MITM Pre-test score (n = 20)	9 – 18	14 (2.62)
MITM Post-test score (n = 15)	9 – 20	16.9 (3.20)

**Max score on quiz is 20 points

- Repeated Measures ANOVA on quiz improvement (n = 15)
    - Parents significantly improved on the MITM knowledge assessment ($F(1, 14) = 5.943$, $p < .05$).

Parenting Interaction Descriptives (treatment and control)

	Range	Mean
Autonomy Support pre-test (n = 74)	1 – 5	3.41 (1.13)
Autonomy Support post-test (n = 77)	1.25 – 5	3.31 (1.06)
Control pre-test (n = 74)	1 – 5	2.40 (1.17)
Control post-test (n = 77)	1 – 4.33	2.30 (.92)
Laissez-faire pre-test (n = 74)	1 – 5	1.57 (.84)
Laissez-faire post-test (n = 77)	1 – 4.25	1.73 (.80)

**Note: there were more code-able interactions in the post-test because we added the instruction, "if you speak more than one language, please

speak in English for this task." In the pre-test there were a number of videos we could not code because another language was spoken.

Parenting Interaction by Condition

Treatment (n = 40)

	Range	Mean
AS pre	1 – 5	3.4 (1.1)
AS post	1.5 – 5	3.4 (1.0)
Control pre	1 – 5	2.3 (1.2)
Control post	1 – 4	2.2 (.88)
LF pre	1 – 4.33	1.5 (.83)
LF post	1 – 4.25	1.8 (.88)

Control (n =34)

	Range	Mean
AS pre	1 – 5	3.3 (1.2)
AS post	1.25 – 5	3.2 (1.1)
Control pre	1 – 4.67	2.4 (1.1)
Control post	1 – 4.33	2.4 (.96)
LF pre	1 – 5	1.6 (.85)
LF post	1 – 3.33	1.6 (.71)

Test-retest of Parenting Behaviors

- Autonomy Support ICC: .788
- Control ICC: .708
- Laissez-faire ICC: .515

Repeated Measures ANOVA on parenting interaction

	N	F value (TIME)	p-value (TIME)	partial h^2 (TIME)	F value (TIME x COND)	p-value (TIME x COND)	partial h^2 (TIME x COND)

Autonomy Support		.781	.380	.012	.942	.335	.014
Control	32						
Treatment	35						
Control		4.31	.514	.007	.836	.364	.013
Control	32						
Treatment	35						
Laissez-faire		.808	.372	.012	1.28	.262	.019
Control	32						
Treatment	35						

Student Outcome Measures

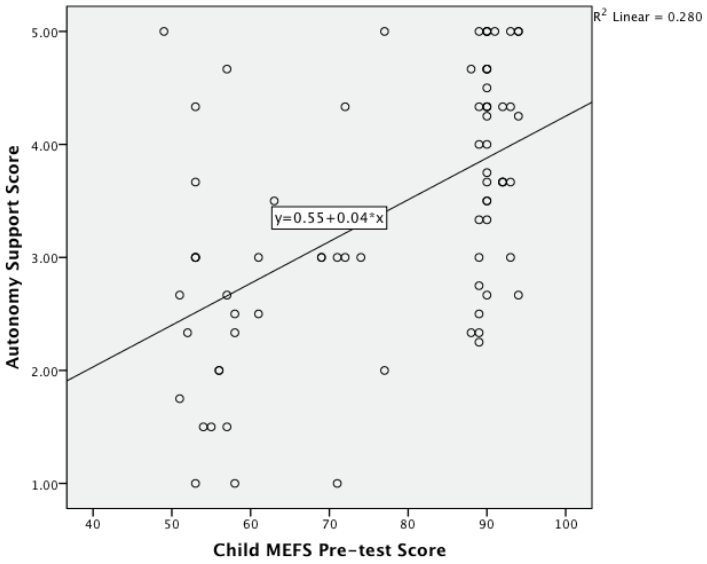
- Parent pre-test MEFS scores are not significantly correlated with student pre-test MEFS scores ($r = .060$, $p = .595$).
- Parent post-test MEFS scores are not significantly correlated with student post-test MEFS scores ($r = .174$, $p = .133$).
- Parent participation in intervention:
    - Repeated measures ANOVA with **student MEFS score** as the dependent measure and parent participation (1, no participation, 2. participation in the control group, or 3. participation in the treatment group) revealed no significant effect of parent participation on MEFS improvement in the students; $F(2, 185) = .355$, $p = .701$).

Parent Outcome Measures

- ICC between pre- and post-test **parent MEFS score** is .690
- Repeated measures ANOVA with **parent MEFS** as the dependent measure revealed a significant effect of time on MEFS improvement ($F(1,78) = 8.50$, $p = .005$), but no significant effect of condition ($F(1,78) = .000$, $p = .994$)
- A regression with **parent change in MEFS** as the dependent measure revealed that parent pre-test MEFS was a significant predictor ($\beta = -.776$, $p = .015$), but there was no significant MEFS pre-test by condition interaction ($\beta = .327$, $p = .522$)

Parenting and Child EF

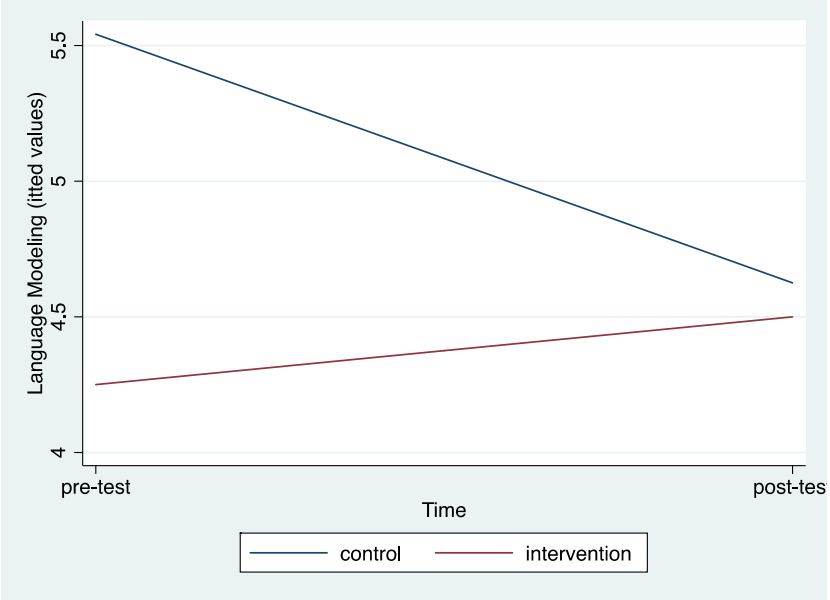
Parent autonomy support predicted child pre-test MEFS performance, even after controlling for age (standardized β = .532, p < .001).



Effects of the Intervention on Classroom Quality: Results

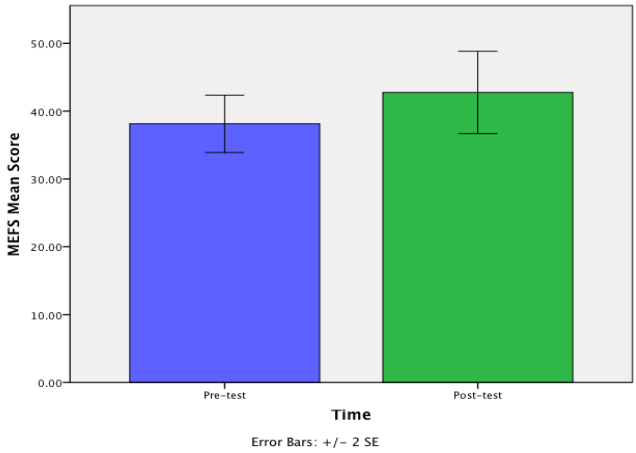
Language Modeling

The intervention was related to significantly higher average **language modeling** at post-test compared to pre-test (z = 2.21, *p* = .027).



Regard for Student Perspectives

Paired t-tests showed the mean of the CLASS dimension **regard for student perspective** was significantly higher at post-test, compared to pre-test (t = 2.85, p = .017).



In addition, **change in regard for student perspectives** predicted post-test **HTKS** (z = 2.13, p = 0.033), after controlling for pre-test HTKS and age.