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Community translation of the Math Interactive Learning Experience Program for children with FASD

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ABSTRACT

The Math Interactive Learning Experience (MILE), a program designed to address academic and behavioral problems found in children with Fetal Alcohol Spectrum Disorders (FASD), was found to be effective in a randomized clinical trials with results that persisted at a 6-month follow-up. The current study evaluated the effectiveness of a community translation, in partnership with several community sites in the metropolitan Atlanta area. A total of 60 participants were randomly assigned to one of the three treatment groups: the MILE program administered at a specialty care center (Center MILE) or in the community (Community MILE), or to parent math instruction only (Parent Instruction). This study evaluated instructor satisfaction with the training program, knowledge related to FASD and the MILE program, adherence to the MILE teaching methodology, participant math outcomes, and parents' satisfaction with their treatment experience. Instructors reported a high degree of satisfaction with the overall training and mean site fidelity ratings were positively correlated with change in math performance. Those in the MILE intervention groups demonstrated more positive gains in math skills than those in the Parent Instruction group but did not differ from each other. Parents in the Parent Instruction group reported less satisfaction with their intervention than those assigned to the Center MILE group but satisfaction ratings did not differ between those in the MILE intervention groups. These results indicate that the community translation and the MILE instructor training program developed as part of this process were well-received and effective in producing positive treatment outcomes.

1. Introduction

The paucity of effective interventions and lack of availability of services has been a frequent complaint of families who are caring for children impacted by prenatal alcohol exposure (PAE) (Ryan, Bonnett, & Gass, 2006). Fetal Alcohol Spectrum Disorders (FASDs) (Warren et al., 2004)) is an umbrella term used to identify a range of range of physical, cognitive, and behavioral abnormalities associated with PAE of which Fetal Alcohol Syndrome (FAS) is the most severe condition (Stratton, Howe, & Battaglia, 1996). Despite attempts to prevent alcohol consumption during pregnancy, estimates of the prevalence of

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FAS within the United States have ranged from 0.5 to 3.0 cases per 1000 live births (May, Gossage, Smith, et al., 2009) and as many as 1 in 100 live births have been estimated to fall within the spectrum of fetal alcohol effects, known as FASDs (Cordero, Floyd, Martin, Davis, & Hymbaugh, 1994; May, Gossage, Kalberg, et al., 2009; Sampson et al., 1997), suggesting readily available intervention services are needed to attempt to meet the needs of the affected individuals.

Children affected by prenatal alcohol use are at high risk for developmental problems and academic failure, including repeating grades and dropping out of school (Autti-Ramo, 2000; Streissguth, Barr, Kogan, & Bookstein, 1996; Streissguth et al., 2004). Their deficits in academic achievement are often greater than expected for their general intellectual level, and there is a higher incidence of special education services received among children with FASD (Aronson & Hagberg, 1998; Autti-Ramo, 2000; Howell, Lynch, Platzman, Smith, & Coles, 2006; Kerns, Don, Mateer, & Streissguth, 1997; Olson, Feldman, Streissguth, Sampson, & Bookstein, 1998; Streissguth et al., 2004). These outcomes are ultimately determined by complex interactions between the individual's neurodevelopmental status, environmental supports for academic success, and emotional stability. Alcohol-affected children have barriers to academic achievement resulting from neurologically based deficits in overall intellectual ability as well as specific academic skills (Lebel, Rasmussen, Wyper, Andrew, & Beaulieu, 2010; Santhanam, Li, Hu, Lynch, & Coles, 2009). In addition, emotional and behavioral disturbances make it difficult for children to focus on important academic learning concepts, and the typical parent–child interactions that facilitate the development of age-appropriate attentional regulation skills may not always occur. As a result of all these factors, children with FASD are at very high risk for academic problems and the complexity of their problems make it so that their deficits are not easily remediated by traditional models of education intervention.

Among the areas of academic deficit, disruption to math achievement has been identified regularly in both longitudinal and clinical studies of individuals with prenatal alcohol exposure (Coles, 2001; Goldschmidt, Richardson, Stoffer, Geva, & Day, 1996; Howell et al., 2006; Kopera-Frye, Dehaene, & Streissguth, 1996; Rasmussen & Bisanz, 2009; Spohr & Steinhausen, 1984; Streissguth et al., 1994) and math deficits have been linked to alterations in brain structure and function (Lebel et al., 2010; Meintjes et al., 2010; Santhanam et al., 2009). These deficits are believed to be linked to problems with visual–spatial perception, working memory, and executive functioning skills (Jacobson, Dodge, Burden, Klorman, & Jacobson, 2010; Kable & Coles, 2004; Kable, Coles, & Taddeo, 2007; Rasmussen & Bisanz, 2009).

The Math Interactive Learning Experience (MILE) program is an intervention program that targeted learning behavior and math development in children with FASDs (Coles, Kable, & Taddeo, 2009; Kable et al., 2007). The program focused on the core deficit of mathematical competence found in many alcohol-affected individuals (e.g., Howell et al., 2006) but dealt also with underlying issues that influenced child and family functioning along with the child's ability to learn from math instruction. *Learning readiness*, defined as preparing the child's physical and social environment and behavioral functioning to support optimal learning, was one of the components of the program. Math instruction was individualized based on the child's performance at baseline and involved teaching math concepts experientially through physical exploration of objects and their relationships. The instructional strategy used in the program incorporated a slower pace of instruction, interactive learning experiences, and feedback regarding patterns of errors and mediation to improve integration of the math concepts.

An important element of the program was the incorporation of a *meta-cognitive control technique* during the instruction to teach children to be more reflective in their problem-solving skills. This element was necessary because of the deficits in affective and cognitive control (or executive functioning) that characterize FASD (Kodituwakku, Kalberg, & May, 2001). The meta-cognitive control technique was adapted from the "plan-do-review" methodology developed by the High-Scope Perry Preschool Project, which was found to have positive long-term consequences on academic achievement and educational attainment (Luster & McAdoo, 1996; Schweinhart & Weikart, 1997) among high-risk children and to be beneficial in cognitive rehabilitation programs for children with acquired brain damage (Ylvisaker, 1998). The strategy, entitled Focus and Plan, Act, and Reflect (FAR), provided a metacognitive tool for regulating attentional focus and mental effort while engaging in mathematical problem-solving.

The results of the initial MILE intervention are published in two articles (Coles et al., 2009; Kable et al., 2007). Children randomized to the MILE treatment condition demonstrated greater gains on standardized math tests than did the comparison sample who received standard psychoeducational care through their school systems (Kable et al., 2007). After 6 months, with no further intervention services, children were retested. After controlling for math functioning before the intervention and overall intellectual ability, significantly higher gains were made by those in the math intervention group than by those in the psychoeducational group. The clinical significance of these gains was explored by evaluating gain on the individual outcome measures. Such gain was defined by performance at one and a half standard deviation units above the mean of the group. In this analysis, those in the math intervention group had more clinically significant gains from pretest performance (68.4%) than did those in the contrast group (38.5%). Among the math treatment group, 25.0% made a clinically significant gain on two or more math measures and 39.3% made a gain on one measure as compared to 16% and 24%, respectively, of the contrast group (Coles et al., 2009).

Although the MILE program was successful when administered through a center specializing in the care of children with an FASD, there is a need to make services for children with an FASD available much more widely. Therefore, training materials were developed to incorporate the teaching methodology into existing schools or tutoring programs so that it could be implemented by community instructors. This study focused on the evaluation of the training process and compared the outcomes of those who received the MILE math instruction from a community instructor to those who received the instruction at a specialty care center and to a minimal intervention control group who received only Parent Instruction.

2. Materials and methods

2.1. Participant recruitment

Participants were recruited from a multidisciplinary FAS diagnostic clinic in the Atlanta metropolitan area using an archival clinical database and active case logs collected during the recruitment period. Children qualifying for the study were identified by clinicians from medical records under a HIPAA partial waiver. Information in the form of letters and pamphlets regarding the program were sent to the homes of the children or presented at the conclusion of a clinic visit by study personnel. After an initial screening ($n = 68$), parents or guardians completed a consent procedure and signed an informed consent document approved by the Human Subjects Committee of the Emory University School of Medicine. All participants were required to have a clinical diagnosis of FAS or partial FAS using the Institute of Medicine criteria (Stratton et al., 1996) or significant levels of alcohol-related dysmorphia. The assessment of the physical effects of prenatal alcohol exposure was done using a standard pediatric dysmorphia checklist (Coles, Fernhoff, Lynch, Falek, & Dellis, 1997) completed by a pediatric geneticist with specialized training in assessing alcohol-related dysmorphic features. The checklist uses differential weighting of dysmorphic features based on their saliency for the diagnosis (e.g., hypoplastic philtrum is a "3"), which are then summed with scores greater than 10 indicating significant levels of alcohol-related dysmorphia. The checklist has been evaluated repeatedly as part of longitudinal research studies from birth to adolescence with individuals prenatally exposed to alcohol receiving higher total scores in comparison to non-exposed controls (Coles et al., 1991; Coles, Platzman, et al., 1997). Children were not eligible for the study if they had an IQ score $<$50, were diagnosed with mental health problems that would interfere with learning (i.e., autism, severe conduct disorder), or were not in a stable placement (i.e., with the same caregiver for 6-months and expected to remain there for the next 6-months).

Participants were assigned randomly to one of three treatment conditions after completing two parent workshops of which one was basic education about the neurodevelopmental characteristics of children with FASDs and the second about strategies to deal with their behavioral regulation problems. All participants were given a manual discussing math learning in children with FASDs and strategies for facilitating math learning in the home environment. For parents assigned to the Parent Instruction group, no additional intervention was provided. Those assigned to one of the MILE intervention groups received 15-weeks of tutoring services. The program was expanded from 6 weeks to 15 weeks in the community translation as this was more consistent with models of tutoring in the community. Parents and instructors were encouraged to complete the program within a given academic school year. The first condition (Center MILE) consisted of receiving the MILE intervention at a center-based clinical laboratory where the intervention had been previously carried out (Kable et al., 2007). Instructors at this site received feedback after each session and on-going consultation regarding behavioral and learning difficulties encountered during the session. The second condition (Community MILE) consisted of receiving the MILE intervention at one of five community sites. Four of the community partners were private schools for children with learning disabilities in the Atlanta area and one was another local university that established a community tutoring service. Instructors trained at the community sites ranged from licensed teachers with years of experience to college students with no formal teaching experience. Instructors received training from the center staff and were provided feedback on three sessions that were observed in person or via videotape by the investigators. All caregivers in the math intervention groups also received instruction in supporting math learning at home and weekly home assignments to complement the individualized tutoring sessions. Instructors at the community sites were paid $20 for each tutoring session to reimburse them for the time they had to devote to completing all of the forms used to document the session and the child's progress.

2.2. Instructor training

Instructor training was formalized. First, a group session was held at each site to introduce the instructors to the program and the FAR teaching methodology. Instructors were given an instructor training manual to read and then provided 2 weeks to complete several modules of self-paced online instruction. The modules included the following topics: (1) math development, (2) understanding FAS, (3) active learning, (4) neurodevelopmental problems that impact on learning, (5) tools and strategies to overcome neurodevelopmental problems impacting math learning, (6) the instructional session, (7) materials, (8) cognitive foundation skills, and (9) interactive learning. A second group workshop was then provided to address questions from the manual and online instructional materials. The curriculum and procedures for selecting the appropriate curriculum content for a given child were discussed. In addition, videos of sessions were presented and mock sessions were carried out.

2.3. Assessment procedures

Children and caregivers were evaluated prior to group assignment and after completion of the children's last tutoring session. Participants in the Parent Instruction group were scheduled for a post-test evaluation as close in time as was possible, preferably in the same week, as a child from one of the treatment groups whose pretest was carried out within a 2 week interval of their pretest to control for the interval between assessments. Children were evaluated by a psychologist or psychology trainee who was blind to group status. Caregivers completed questionnaires and a structured interview with a staff member while their child was being assessed.

2.3.1. Instructor satisfaction, knowledge, and fidelity

Instructor satisfaction with the training process was assessed using Likert scale responses to questions regarding their experiences with the training materials, including the manuals, online training modules, and interactions with the trainers. The scales ranged from 0 to 4 with 4 indicating ''strongly agree'' and 0 indicating ''strongly disagree''. To assess attainment of the knowledge of the teaching methodology, a 10-item multiple choice questionnaire was also administered to instructors (6 from the Center and 31 from the Community MILE instructors) after completing the training process. As a control measure, the questionnaire was also completed by employees of the center who were not trained in the MILE program ($n = 14$).

Adherence to the MILE teaching methodology was monitored with the use of the *MILE Instructor Fidelity Instrument* (see Fig. 1). Each behavior was rated as being present (2 points) or partially/sometimes present (1 point), or absent (0 points). A total of 30 points were possible for a given session. For each child enrolled, three observations of sessions were provided with one occurring in the first five sessions, the second in the middle five sessions, and the third in the final five sessions. The results of this assessment were also discussed with the instructor to assist them in further developing their MILE teaching skills after each session.

2.3.2. Academic outcomes

Math achievement was assessed at pretest and at post-test, using several measures. All children were administered the Test of Early Mathematical Ability, 2nd edition ((Ginsburg, 2003); TEMA-2), a standardized test for assessing early mathematical development, and selected math related subtests from the Bracken Early Concept Scales Revised (Bracken, 2006). For children 5 and over, the Key Math-R/NU (Connolly, 2007) was also administered, which is a standardized test measuring several distinct areas of mathematical concepts for school-age children. Parallel forms of the KeyMath-R/NU were used to minimize practice effect. For children under 5 years, developmental testing of pre-math concepts such as more/less, same/different, intuitive numbering, conservation, and sequential organization of objects along intensity and magnitude was conducted. This measure was adapted from math concepts administered as part of the Bayley Scales of Infant Development, 2nd edition (Bayley, 1993). Finally, the quality of number writing was assessed in all the children using an instrument developed in our previous work (Kable et al., 2007). The instrument consists of 7 items that assess order, orientation, neatness, consistency, and general recognizability of the numbers. Instructors were given feedback on the child's baseline level of performance to assist them in identifying the child's skill level to appropriately tailor their initial curriculum choices for the child.

2.3.3. Parent satisfaction

At the post-test, caregiver satisfaction was assessed using Likert scale responses to questions regarding their experiences with the treatment. The scale ranged from 0 to 4 with 4 indicating strongly agree and 0 indicating strongly disagree.

MILE INSTRUCTOR FIDELITY INSTRUMENT

Instructor ID#______________	Client # _______________	DoS____________________
Evaluator ID#______________	DoE _______________	Session #________________

	yes	partial	no
The instructor's materials were readily available			
The instructor allowed the child to choose some aspect of the Math FunWork			
The instructor presented the FAR overview			
A plan for the activity was developed			
The child assisted in the plan			
The instructor discussed breaks and any behavioral contracts with child			
The child actively participated in the Math FunWork			
The instructor praised the child's efforts			
The instructor praised the child's attentional focus			
The instructor encouraged the child to think before responding			
The instructor used appropriate supports to assist the child in time perception			
The instructor was not harsh or punitive with the child			
The instructor used FAR within problems			
The instructor facilitated reflection of the Math FunWork			
The child actively participated in the reflection process			

Fig. 1. The *MILE Instructor Fidelity Instrument* is an instrument that has 15 items that are coded while observing a MILE session as either consistently present, partial/sometimes present, or not present.

3. Results

3.1. Attrition

Sixty-eight participants were initially recruited for the study but eight participants were excluded during the initial assessment phase of the project. Three participants were excluded because their level of intellectual functioning was too low, one had a disruption in placement prior to group assignment, one person who originally expressed interest could not be reached, one person had previously participated in our intervention studies, and one person had significant levels of behavioral disturbance. The latter was asked to initiate individual behavioral therapy prior to participation but did not then re-contact the study providers for enrollment. A total of 60 participants were randomly assigned to one of the three treatment groups with 20 being assigned to the Center MILE, 19 to the Community MILE, and 21 to the Parent Instruction group. See Fig. 2 for additional details regarding the flow of participants. Of the 60 participants, 8 participants (13.3%) withdrew prematurely from the study with 2 being in the Center MILE and Parent Instruction groups each and 4 being in the Community MILE group. Although the rate of attrition was highest in the Community MILE group, the difference was not statistically significant. Participants withdrew due to travel or scheduling conflicts ($n = 4$), financial problems that created household stress ($n = 1$), and for unknown reasons ($n = 3$). There was a trend for a group effect ($F(2, 49) = 2.41$, $p < .10$)) on days between pretest and post-test with the Community MILE group taking longer than the Center MILE treatment group (parameter estimate: $\beta = 59.1$, $t = 2.19$, $p < .030$, partial eta squared = 0.089; Center MILE = 252.7 (52.7), Community MILE = 310.8 (80.6), Parent Instruction = 279.6 (92.3)). The range of the days to completion was large with some completing in 122 days (Center MILE) and some completing in 569 days (Parent Instruction). Group differences were found in the

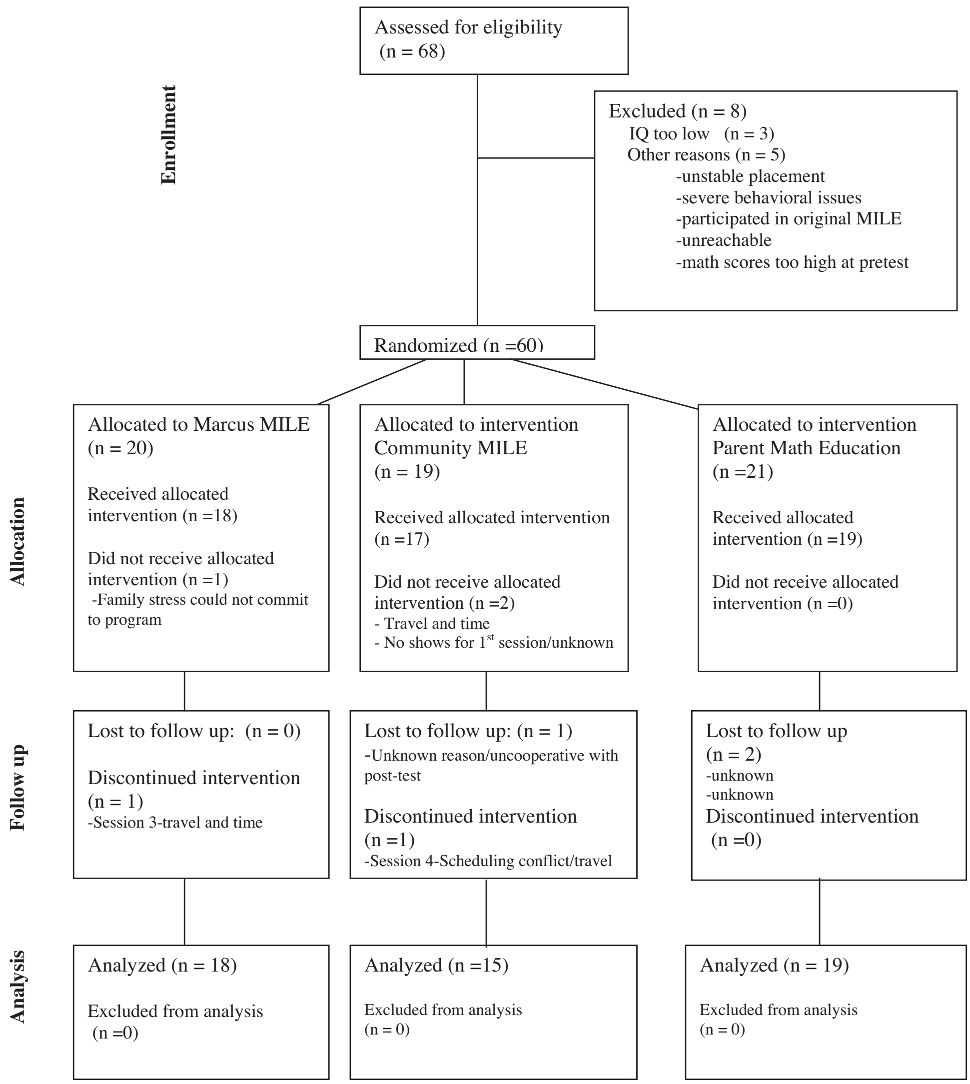

Fig. 2. The flow of participants through each stage of the randomized MILE community effectiveness trial is depicted.

percentage who completed the program within one academic year, defined as a 10-month interval, ($\chi = 7.9$, $p < .019$). The Community MILE group had significantly fewer participants (46.7%) who completed the intervention in an academic year as compared to Parent Instruction (78.9%) or Center MILE (88.9) participants.

The extensive range in days to completion represented a challenge to assessing math change using raw scores, which are vulnerable to maturation effects, so time lapse was included as a covariate. Preliminary examination of the effect of impact of the time lapse on math outcomes within treatment group, however, revealed a differential effect of time. Those in the Parent Instruction group showed a significant positive relationship between time lapse and math change as would be expected from maturational effects but those in the intervention groups had a non-significant negative relationship between time lapse and change in math skills. For those in the intervention groups, time lapse is dependent on compliance with appointment keeping whereas in the Parent Instruction group time lapse is dependent on being yoked to one of the participants in the intervention groups, suggesting that time lapse is also indexing a compliance component in the intervention groups. To control for this group difference in meaning of time lapse, an interaction term yes/no completed within one academic year and group status were used as covariates in assessing relative differences in treatment outcomes.

3.2. Characteristics of children in treatment groups

Table 1 provides sample characteristics by group status. Comparisons of demographic and family characteristics, birth weight, and intellectual skills of the participants, yielded no significant group differences with the exception of the percentage who were adopted or being raised by non-relative parents. Those in the Parent Instruction group were significantly more likely to be raised by a non-relative than were either of the intervention groups ($\chi = 6.33$, $p < .042$) but this status was not related to the outcome variables. In contrast, number of home placements, having another caregiver, the number of adults in the home, and combined household income were related to changes in math functioning from pretest to post-test. A step-wise regression procedure was done to reduce collinearity among these variables in predicting math outcome. Only the number of adults in the home was retained in the model ($F(1, 48) = 5.10$, $p < .028$) and used subsequently as a covariate for assessing treatment outcome.

3.3. Analytic plan

To compare group effects on knowledge gains as a result of training, an analysis of variance (ANOVA) was used to compare those trained in the center, those training in the community, and center-staff that were not trained in the MILE teaching methodology. Mean fidelity ratings were computed and compared across sites using ANOVA. Repeated measures ANOVA was done to assess learning effects associated with on-going supervision during the intervention and compared by location (center vs. community). Pearson correlations were computed between fidelity and session number and between mean site fidelity ratings and the math outcome measures. To compare group effects on math outcomes, a repeated measures analysis of covariance was carried out on the sum of the raw scores from the Bracken, TEMA, and Handwriting measure as all participants received these measures at pretest and post-test. Covariates included age of the child, time lapse between pretest and post-test, an interaction term with timely completion and group status, overall level of intellectual functioning,

Table 1
Characteristics of sample.

Variable	Groups		
	Center MILE ($n = 18$)	Community MILE ($n = 15$)	Parent Instruction ($n = 19$)
% Male	44.4	53.3	52.6
Child age at pretest	6.5 (2.2)	7.0 (1.4)	6.1 (1.7)
% African American	58.8%	50.0%	35.3%
% Caucasian	35.3%	25.0%	52.9%
% Mixed race	5.9%	25.0%	11.8%
% Adopted or legal guardian-non relative	50.0%	56.3%	88.2*
% With two caregivers	83.3%	81.3%	76.5%
Number of lifetime placements	2.7 (1.8)	2.5 (1.8)	2.3 (1.6)
Number of adults in home	1.8 (0.4)	2.1 (0.7)	2.0 (0.8)
Number of children in home	1.4 (1.2)	1.6 (1.4)	2.4 (1.9)
Rank of gross household income (6 = 35,000–49,999)	6.1 (2.5)	6.9 (2.2)	6.6 (2.2)
Pedscore[a] (total dysmorphia)	19.8 (6.0)	16.2 (5.2)	16.0 (4.9)
Birthweight (grams)	2432.5 (831.7)	2513.7 (590.3)	2898.1 (990.3)
DAS-2[b] general cognitive ability	84.1 (16.6)	86.6 (11.8)	84.8 (10.6)

* $p < .05$.

[a] The Pedscore is the sum of the 30 weighted items on a standard pediatric dysmorphia checklist (Coles, Fernhoff, Lynch, Falek, & Dellis, 1997) used to identify alcohol-related dysmorphic features. This Checklist is a modification of the usual "genetics" checklist where characteristics associated with the disorder are listed and weighted based on their saliency for the diagnosis (e.g., hypoplastic philtrum is a "3"). Scores greater than 10 are assumed to indicate alcohol-related dysmorphology.

[b] DAS refers to the Differential Ability Scales, 2nd edition (Elliot, 2007). Performance is measured using standard score that has a mean of 100 and a standard deviation of 15 points.

and number of adults in the household. To compare group effects on parental satisfaction with their treatment experiences, ANOVAs were conducted on each of the satisfaction items.

3.4. Instructor satisfaction, knowledge, and fidelity

Instructors reported a high degree of satisfaction with the overall training experience and were willing to recommend the program to others. Specific details regarding the mean level of satisfaction by item and percentage of instructors who agreed or strongly agreed with each item are presented in Table 2. A significant group effect was obtained on the knowledge scores ($F(2, 48) = 8.21$, $p < .001$, partial eta-squared = 0.255) with center-based employees who were not trained in the MILE program receiving lower scores ($X = 8.00$, STD = 1.92) than both instructors trained at the center ($X = 9.83$, STD = 0.76) or in the community ($X = 9.39$, STD = 0.41). There were no significant differences between instructors trained at the center or in the community sites. Fidelity to training was measured using the scale shown in Fig. 1. The mean fidelity ratings for adherence to the teaching methodology were as follows: Center – 23.7 (5.8); and for the five, community sites: Community1 – 20.7 (5.7), Community2 – 23.0 (3.2), Community3 – 16.0 (2.8), Community4 – 22.7 (5.0), and Community5 – 26.3 (1.9). All but one of the community sites had means that fell within one standard deviation of the mean fidelity ratings of the center-based instructors but there was not a significant site effect when assessing across the various sites. Fig. 3 displays the mean fidelity ratings aggregated across 3 blocks of 5 sessions for those trained at the center and in the community. The session number was positively related to the fidelity score ($r = 0.36$, p .005), suggesting that instructors were improving over the course of sessions. A repeated measures analysis of variance was done on the fidelity ratings by site across blocks. A significant effect was found for block ($F(2, 52) = 4.26$, $p < .019$) but was not found for site. Higher ratings of fidelity were obtained in the final block of five sessions relative to the initial block of sessions.

3.5. Math outcomes and relationship to treatment adherence

Table 3 displays the least squares mean for each of the math measures by treatment group at pretest and post-test for each math outcome measure. There was no significant group by time effects on the individual tests; however using the math summary score derived from summing the raw scores from the Bracken, TEMA, and Handwriting measure, a significant time by treatment group effect was found ($F(2, 41) = 3.4$, $p < .04$, partial eta-squared = 0.139) with those in the MILE intervention groups demonstrating more positive gains in math skills than those in the Parent Instruction group. See Fig. 4 for details.

To explore the impact of fidelity on math outcomes, correlations between the mean site fidelity ratings and the math outcomes were computed. Within the MILE instruction groups, mean site fidelity ratings were positively correlated with change on the total score of the KeyMath (standard score Δ: $r = 0.48$, $p < .02$) and the TEMA (raw score Δ: $r = 0.35$, $p < .04$; standard score Δ: $r = 0.45$, $p < .04$) but were not related to changes in the raw score of the KeyMath, the number writing scores, or the total scores from the Bracken.

Table 2
Satisfaction with instructor training program.

Item	Mean rating[a]	% Agree or strongly agree
Instructor items		
Friendly and helpful	3.92 (.28)	100%
Knowledgeable	3.97 (.16)	100%
Encouraged questions	3.92 (.28)	100%
Gave easy to follow examples	3.78 (.42)	100%
Spoke clearly and plainly	3.84 (.37)	100%
Clarified questions from self-study	3.69 (.47)	100%
Material/content items		
Useful/helpful	3.81 (.40)	100%
Easy to understand	3.62 (.49)	100%
Good pace/speed	3.72 (.45)	100%
Right amount of information	3.59 (.55)	97%
Clear and easy to follow	3.68 (.53)	97%
Combination of workshop/self-study useful	3.69 (.47)	100%
Online training clear and easy to follow	3.66 (.48)	100%
Online training useful for understanding MILE	3.60 (.50)	100%
Online training useful for understanding FAS	3.49 (.56)	97%
Feel confident to start teaching MILE	3.36 (.54)	97%
Overall impression items		
Overall training experience helpful	3.89 (.32)	100%
Would recommend this experience to others	3.80 (.41)	100%

[a] Responses are based on a 4 point Likert scale with 0 = strongly disagree and 4 = strongly agree.

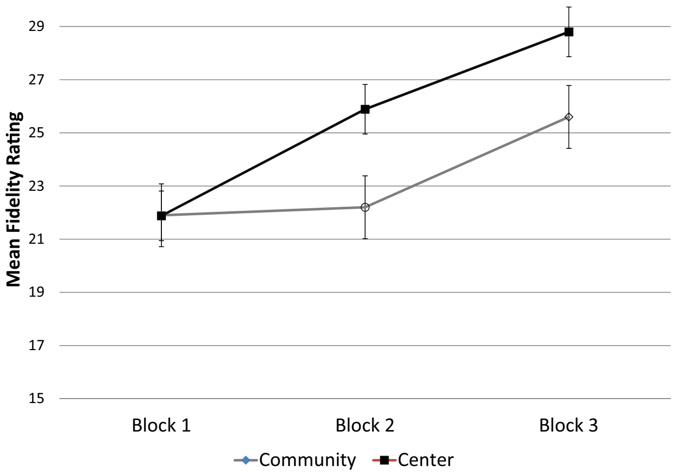

Fig. 3. The mean fidelity ratings by site across blocks of five sessions are displayed in this figure. The error bars reflect the standard error of each block.

Table 3
Least square means[a] and standard error of math pretest and post-test scores by treatment group.

Variable	Groups					
	Center MILE ($n = 18$)		Community MILE ($n = 15$)		Parent Instruction ($n = 19$)	
	Pretest	Post-test	Pretest	Post-test	Pretest	Post-test
Total Bracken raw score	54.1 (8.7)	81.3 (8.0)	69.9 (3.0)	77.1 (2.8)	80.9 (9.4)	69.6 (8.6)
Total KeyMath raw score[b]	40.3 (11.6)	56.9 (16.4)	34.6 (3.1)	47.0 (4.5)	32.7 (11.6)	40.9 (16.4)
TEMA raw score	25.0 (5.6)	39.6 (5.4)	23.0 (2.0)	31.8 (1.9)	26.9 (6.1)	25.4 (5.8)
Total quality of handwriting	15.9 (4.3)	22.8 (4.2)	22.8 (1.5)	26.8 (1.5)	27.4 (4.6)	26.4 (4.6)
KeyMath standard score[b]	98.8 (7.3)	97.5 (7.9)	92.9 (2.0)	90.5 (2.1)	82.6 (7.3)	81.9 (7.9)
TEMA standard score	76.8 (9.5)	96.8 (10.6)	81.3 (3.1)	85.0 (3.5)	84.6 (8.1)	75.8 (9.1)

[a] Least square means after adjusting for age of the child, time lapse between pretest and post-test, an interaction term with yes/no completed study within an academic year and group status, overall level of intellectual functioning, and number of adults in the household.
[b] KeyMath is administered to only children who are 5 years old and older. N's are as follows: Center = 9; Community = 14; Parent Instruction = 12.

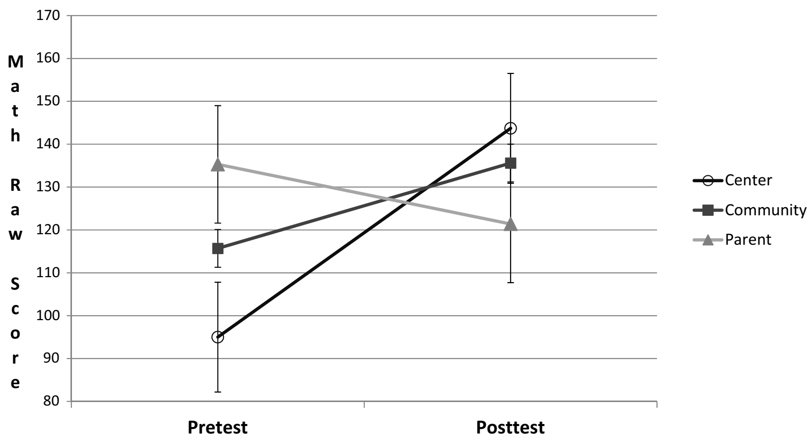

Fig. 4. The mean changes in math skills as a function of treatment group are represented in this figure. Error bars represent the standard error for each group.

3.6. Parent satisfaction

As might be predicted, parents in the Parent Instruction group reported less agreement that their child had improved in their math skills and felt their ability to help their child study had improved less as compared to both other treatment groups.

Parents assigned to the Center MILE group reported more favorable ratings than did those assigned to the Parent Instruction group on the following items regarding the program: informative, helpful, improved understanding of FAS/pFAS, and helped their child's study habits. The parents assigned to the Community MILE did not differ from those in the Center MILE or the Parent Instruction groups on the latter variables. Table 4 displays the mean values by treatment group.

4. Discussion

To evaluate the community translation of the previously validated MILE intervention, this study compared the outcomes of those who received the MILE math instruction from a community instructor to those who received the instruction at a specialty care center and to a minimal intervention control group who received only Parent Instruction. Parental satisfaction with their treatment experiences was also compared across groups. Finally, the MILE instructor training process was evaluated by assessing their knowledge gains, satisfaction with the training experiences and the impact of adhering to the treatment methodology on changes in math scores. The results indicated that participants assigned to one of the MILE instructional groups demonstrated greater positive gains in their math skills relative to those who did not receive the MILE instruction and there was no significant difference in gains between participants who received the instruction in different environments. Parents of children who did not receive the MILE intervention were less satisfied with their child's math development and their ability to help their child then those assigned to the Center MILE group but satisfaction ratings did not differ between those in the MILE intervention groups. The results also suggested that the MILE instructor training program, developed in the community translation process, was well-received and effective in producing positive treatment outcomes in that adherence to the teaching methodology predicted improvements in math skills. Instructors reported a high degree of satisfaction with the overall training and were able to effectively implement the teaching methodology as all but one of the community sites had fidelity ratings that fell within one standard deviation of the mean fidelity ratings of the center-based instructors.

Community instructors achieved comparable knowledge to those in the center-based intervention and had mean site fidelity ratings that were sometimes even higher than the center-based instructors. The improvement observed across blocks of sessions suggests that the on-going feedback helped with the learning process and should be incorporated into the training experience directly. The effectiveness of the community implementation of the MILE program was not uniform across all sites. There was variability within the sites with respect to their ability to maintain adherence to the teaching methodology and this variability was related to math outcomes in the participants. Within the community site that struggled with adherence, the instructor identified to participate in the program developed a serious medical health problem and another instructor who had attended the training stepped in to assist with completing the remaining sessions for participants enrolled in their site. In translating this program into community sites, such difficulties are probably to be expected over time, suggesting that on-going adherence to the teaching methodology should be monitored to insure that participants are receiving appropriate treatment.

Those in the intervention groups demonstrated more positive gains in math skills than those who only received Parent Instruction of math development in children with FASD but the comparison of the outcomes in this study across treatment groups may be limited by the small number of participants in each group and the large variability in the interval with which it took to complete the program. Although the overall sample size was comparable to that of the original MILE studies, there were only two groups being compared as opposed to three in this study. It is possible with a larger sample size that additional group differences may have been detected.

The change from the 6 weeks program implemented in the original clinical trials to the 15 weeks community translation did not result in an improvement in the effectiveness of the intervention as was expected. The extension to 15 weeks may have resulted in less focused effort or concentration to complete the treatment goals. The extension also created difficulties in the assessment of the treatment-related changes in math skills for which we did not appropriately plan.

Table 4
Parent satisfaction ratings by treatment group.

Item	Mean satisfaction ratings[a]		
	Center	Community	Parent Instruction
Informative	3.18 (1.43)	2.53 (1.51)	2.00 (1.24)*
Helpful	3.18 (1.43)	2.67 (1.59)	1.89 (1.02)*
Improved my understanding of FAS/pFAS	3.12 (1.11)	2.40 (1.24)	1.89 (1.13)**
Increased knowledge of resources	2.76 (.97)	2.33 (1.18)	2.00 (1.19)
Feel more comfortable asking for services	2.82 (1.02)	2.27 (1.18)	2.12 (1.22)
Improved my ability to help my child study	3.18 (1.02)	2.80 (1.01)	1.94 (1.16)**
Helped my child's study habits/routine	2.82 (1.07)	2.40 (1.18)	1.83 (.92)*
Improved my child's math skills	3.18 (1.02)	2.60 (1.18)	1.72 (.83)***
Would recommend this program to others	3.14 (1.23)	2.69 (1.44)	2.24 (.90)

* $p < .05$.
** $p < .01$.
*** $p < .001$.
[a] Responses are based on a 4 point Likert scale with 0 = strongly disagree and 4 = strongly agree.

The lengthy duration and variability in duration to complete the 15-week program presented challenges that were not present in the original MILE studies. The math outcomes used in this study included both raw and standardized scores. Raw scores of math performance are vulnerable to maturation effects requiring time elapsed and age to be controlled to assess treatment outcome. Although standardized scores theoretically control for age of the participant and its associated maturation effects, the broad age span of the participants creates problems as often standardized tests of achievement have floor effects with younger children. This results in a test-based decrease in mean scores as participants' age rather than a true decline in ability. For participants who are at or above the ability level of a test, the ability to detect changes in performance also declines as a result of a limited number of items. This issue is less important when assessing children whose ages fall within the mid-range of ability assessed by a test. As the participants in this study ranged from 3 to 10, the discriminative power of tests used to assess treatment effects or change in ability varied by age. The longer duration between pretest and post-test exacerbated this problem in this study. Although attempts were made to control for these factors statistically by co-varying out age and time elapsed, reducing this elapsed time variability in future investigations of community translations of the MILE program may help in clarifying the relative effectiveness of the program.

Completion of the program within one academic year was less likely for participants who received their instruction in the community. This may be because the staff at the specialty clinic was more motivated to complete the program in a timely manner but other factors may have also contributed to this group difference. Although participants in all groups were given reimbursement for study-related travel as needed, those who received community-based interventions did not have readily available staff that could babysit other children in the family or possibly as much flexibility in scheduling as those who were seen in the center-based program. As interventions for children with FASDs are implemented within their communities, it is important to assist them with overcoming barriers to successful implementation and completion of interventions. Failure to accommodate to these needs may lead to reduced effectiveness in the translation of a program. Unfortunately, these accommodations are often not well-reimbursed by existing payor systems, which may make implementation in community settings more difficult.

Additional translations of the MILE program are on-going. The program was incorporated into a large scale epidemiological study of the prevalence of FASD conducted in a school system in San Diego. Another group of investigators have made modifications in the program by implementing the teaching methodology within a school system in Canada without working with the parents. Initial reports of the outcomes in the Canadian study have indicated that children who received the MILE program made significant gains in mathematics skills compared to children who were enrolled in a social skills group and the results were also maintained over time (Kully-Martens et al., 2013). In both studies, the staff was trained using similar methods outlined in this study.

Teaching math skills to children with FASDs is an important life skill that transcends classroom performance and school grades. The metacognitive learning strategy used to enhance learning has the capacity to influence all of life learning. Improvements in understanding of time, space, quantity, and mathematical operations targeted by this intervention can improve educational attainment, overall quality of life, and ability to function independently.

5. Conclusion

The limited availability of specialty clinics to provide care for children with FASDs suggests that they will not be able to meet the treatment needs of alcohol-affected children and there is need for translation of targeted interventions for children with FASDs into the communities in which they reside.

The community translation of the MILE program and the instructor training process developed and evaluated as part of this study has provided promising evidence of the program's ability to be implemented into the communities to increase the availability of services for these children.

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