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Research Article

The Effects of a Home-Based Intervention for Young Children with Developmental Delays in Vietnam: 6-Month Follow-Up Results

Abstract

We assessed the long-term efficacy of a home-based intervention program for young children (n = 46, ages ranging from 3 to 6 years) with developmental delays in Vietnam. The current paper reports on the six-month follow-up evaluation of the children after their six-month intervention ended. At the same time, the children who were in a wait-list control group during the initial intervention program obtained the same intervention for these six months and their outcomes are reported in this paper. It was hypothesized that after completing the intervention program, the children would retain their adaptive functioning during the six-month follow-up period. It was also expected that the children who had previously served as controls would see similar gains after they received the intervention to those seen in our initial intervention group. The intervention follow-up group (n= 21) was assessed at 6 (the end of their intervention), 9 and 12 months, following their initial assessment at 0 and 3 months during the intervention. The children who received the delayed intervention (n = 25) were assessed at 6, 9 and 12 months during the intervention, following their initial assessment at 0 and 3 months as controls. The Vineland Adaptive Behavior Scale – II (VABS-II) was administered to identify the children as developmentally delayed and to assess the outcomes throughout the intervention and follow-up periods. The initial intervention group showed maintenance of adaptive behaviors in the areas of socialization and communication skills. The delayed intervention group showed improved socialization and communication skills after receiving the intervention. While validating the positive outcomes from the initial intervention program, the study showed that those skills could be maintained at least for six months, probably due to the ability of the caregivers to continue to apply their skills in training and educating their children and/or their increased ability to identify and use resources in the schools and communities. The results are promising in that the children showed improvement in a relatively short period of time by working with college students with limited teaching experience and were able to maintain the gains acquired during the intervention program.

Introduction

Human development occurs across various domains, including but not limited to communication, daily living, social and motor skills. Individuals are said to have developmental disabilities/delays when they do not meet the expectations for developmental milestones for their age. Developmental disability that involves sensory or cognitive disabilities may result from genetic factors, early environmental influences, or an interaction between the two. Some developmental disabilities can be attributed to the known Neurodevelopmental Disorders (ND), including Intellectual Disabilities (ID), Motor Disorders, Autism Spectrum Disorder (ASD), Attention-Deficit Hyperactivity Disorder (ADHD), and Specific Learning Disorder (SLD) [1]. Recent estimates for the United States show that about 15% of, or nearly 1 in 6, children aged 3 through 17 years have one or more developmental disabilities [2]. The American Association on Intellectual and Developmental Disabilities reported expenses totaling $2,995,070 for products and services and for education and training alone for the year 2016 [3]. Estimates of developmental disorders internationally have shown increases in the diagnosis of these disorders, especially ADHD, ASD and SLD [4,5]. There is an increased need for early childhood interventions for these and similar developmental disorders in low and middle-income countries (LMICs), and the structures necessary to meet the need are not in place [5,6].

Developmental disabilities significantly impact the population of Vietnam, and resources to aid individuals are sparse. Vietnam has a population of approximately 92.7 million, and it is a relatively poor country with a GDP of US $2186 per capita [7]. Approximately 7.8% of the Vietnamese

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population is considered disabled, with intellectual disabilities accounting for 13.6% of disabled persons - approximately 826,140 individuals [8]. Furthermore, mental disability and multiple disabilities account for another 33.8% of the disabled population [8]. According to the Early Development Instrument (EDI) survey, 25% of Vietnam's 5-year-olds are vulnerable and 50% are at risk of vulnerability in at least one of the developmental domains (these include physical health and wellbeing, social competence, emotional maturity, language and cognitive development, and communication skills and general knowledge) [9].

Intellectual disability represents a major component of the total disabilities affecting the population of children in Vietnam growing up with developmental disabilities. In a meta-analysis of population-based studies on the prevalence of intellectual disabilities, the highest prevalence was seen in low-income countries, where the prevalence/1000 population was 16.41 (95% CI 11.14–21.68) [10,11]. In this same analysis, it is noted that when studies were analyzed by setting, mixed urban-rural settings showed the highest prevalence (21.23/1000); when analyzed by age group, studies focusing on children and adolescents showed the highest prevalence (18.23 /1000) [10,11].

There are not enough resources in Vietnam to aid the population of children growing up with developmental disabilities. According to the World Health Organization, there are 0.1 mental health workers per 100,000 persons in Vietnam - the ratio of individuals to psychologists is more than 1,000,000:1, and there are even fewer social workers [12]. In Vietnam, the Law on Education legally entitles people with disabilities to equal access to education. In 2010, the Prime Minister of Vietnam enacted the "Framework on Universal Preschool Education for Children Age Five Years" for the 2010-2015 period [13]. The Vietnamese government is currently working on preschool service proliferation to reach 80% of all three-to-five-year-olds throughout the country [14]. In their recent pilot study, Lenaerts et al. [15], discuss the need for further work training teachers in Vietnam how to tailor curriculum and education practices in order to achieve the best outcomes for children with developmental disabilities.

Currently, only 3-5% of Vietnamese children with special needs receive services. The main barrier to these services is a lack of teacher training [16,17], furthermore, special education teacher training programs are rare in Vietnam. As a result, teachers working with children with disabilities do not possess adequate awareness, knowledge, or skills to meet the needs of the underserved population. In addition, inadequate infrastructure, educational programs and classroom conditions and availability do not meet the demand for special education services [18]. In low-income countries such as Vietnam, with mixed urban-rural settings, children may be most at risk of developmental disabilities, and the resources needed to properly assess and support these children are often lacking [19–22].

Developmental disabilities present many secondary and tertiary effects on children in Vietnam. Disability is associated with poverty in Vietnam, and the combination of disability and poverty is also associated with lower educational attainment [23]. Attempts have been made to estimate the true cost of disability on individual households in Vietnam, and to assess the resources that families currently have access to as they attempt to adapt and cope with additional socioeconomic struggles associated with disability. In qualitative research performed by Palmer et al. [24], families of children with autism spectrum disorder and intellectual disabilities reported that their children were not allowed to attend public schools, and that the family was responsible for the costs of private tutors and in-home assistance. Developmental disabilities have been associated with increased aggressive behavior and lower school achievement [25]. This effect may be partially explained by a lack of adequate understanding of an individual's needs and a mismatch between academic expectations and an individual's adaptive functioning, as well as a lack of adequate resources aimed at early intervention. Furthermore, families with a delayed child reported difficulties in functioning because they often needed to miss work to take care of their children. Traditionally, the responsibility of educating and caring for children with disabilities is maintained by the family unit, and the family unit is often met with shame and pity as a result [16,26]. A community-based intervention that targets adaptive functioning is likely to have long-term effects on the lives of individuals with developmental disabilities and their families.

In fostering development, the participation of parents is essential. Through parenting skills and improved parent-child interaction, children's social and cognitive competence can increase. Past findings have shown that parent-child relationship-based interventions improve child outcomes [27], that these interventions can be applied to children with developmental disabilities specifically [28,29] and that effects of these interventions may last over the course of several months to several years [30]. The addition of home-based intervention to institution-based intervention has been shown to significantly improve outcomes in children with undefined developmental delays [31]. Incorporation of parent training and engaging parents in treatment planning have been shown to reduce challenging behaviors from children with developmental disabilities in treatment, to increase treatment fidelity, and to lead to targeted improvement in the child's direct behavior [32,33]. A synthesis of meta-analyses for the effects of parent involvement in early intensive behavioral interventions for children with autism spectrum disorder found that parent involvement improves functional outcomes [34].

Early interventions for children with developmental disabilities or at risk for developmental delays have shown mixed results for functional improvement in adaptive behavior at the 6-month follow-up period. Various forms of brief, targeted early intervention have been shown to improve aspects of children's adaptive functioning, with improvements lasting up to six months and beyond [35]. Several community-based parent-mediated educational interventions for children with developmental disabilities show maintained change in particular developmental skills at three and six months [36–38]. Furthermore, interventions that incorporate learning strategies into home routines may continue to benefit such

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children's social functioning and growth up to the 6-month follow-up [39]. Still, other studies that utilized didactic and hands-on parent skills training to effect early childhood improvement show no significant results 6-months post-treatment [40] or more complex patterns of change, with some prosocial behaviors continuing to improve post-intervention while others stayed the same [41].

While few early intervention models have been widely tested in developing countries, the Portage model CESA 5 [42], has shown promise in applying home-based services to address the needs of families with one or more children with developmental delays. Recent research suggests that with some adaptation, the Portage model may benefit families in low and middle-income countries [43]. The Portage model was originally designed as a home-based intervention for rural communities in the USA. It has been translated into over 36 languages and adopted internationally as an effective program for training parents to educate and mentor their children where few-to-no professional resources or physical structures for center-based programs exist [44]. Its ease of accessibility is evident in the ready-made curriculum, assessment materials, and instruction manual that can be utilized by paraprofessionals in diverse settings. The full program covers five core developmental modules, including communication/language/literacy, exploration and approaches to learning (problem solving and reasoning, memory), purposeful motor activity (coordination of large and small muscle movements), sensory organization, and social and emotional development [42]. Age-appropriate activities, interactions, tasks and routines are also encouraged, with explanations of why these particular activities are essential in promoting a child's development. The structure of module content lends itself to facilitators educating parents about child development and parenting skills. Content is written to suggest integration of these parenting skills into activities of daily living to meet the needs of the natural home and community environment [42].

Critical evaluation of intervention for Vietnamese children with intellectual delays and their families is called for. According to *The Efficacy of Community-Based Rehabilitation (CBR) for Children with or at Significant Risk of Intellectual Disabilities in Low and Middle Income Countries: A Review* [45], "CBR has not been the subject of a significant amount of rigorous evaluation in low and middle income countries, and children and adolescents with intellectual disabilities in these countries have not been the recipients of significant amounts of CBR" [12]. Finally, behavioral measures need to be instituted in order to critically evaluate the effects of those interventions that have been implemented [45]. The current study aims to critically evaluate the longer-term efficacy of an application of Portage program in Vietnam.

The initial intervention [46] was conducted in the city of Hanoi, Vietnam. When this study was initiated in 2011-2012, there were twelve disability centers that provided early intervention for children with developmental disabilities (unpublished information). There was one college that trained special education teachers, but there was no education or training available for early interventionists at the university level in Hanoi. Our goal was to explore the possibility of establishing pragmatic, *lasting* intervention programs with a limited need for sustained professional resources.

The purpose of the research project was to assess the long-term efficacy of a home-based intervention program for children between the ages of three and six years with identified intellectual delays after a 6-month span post-intervention. The immediate outcome of the initial intervention study, in which children who were enrolled in a six-month intervention program were compared to those on a wait-list for six months, is reported in our previous publication [46]. This current paper reports on the 6-month follow-up evaluation of this intervention. In the current study, we assess the efficacy of the maintenance program by comparing the children's outcomes immediately after the intervention with a re-assessment of these same outcome measures six months after the intervention had concluded. We used the Vineland Adaptive Behavior Scales (VABS) [47,48] as an indicator of adaptive behavior and developmental competence. We administered it before the initiation of the program, at 6 months into the program, at the end of the program, and then again at a 6-month follow-up point for each individual. It was hypothesized that after completing the intervention program, the children would retain their adaptive functioning during the six-month follow-up period. It was also hypothesized that the children who had previously served as a control group (the delayed intervention group) would show significant improvement in their adaptive functioning during the six-months in which they obtained the services. We expected that the delayed intervention group would see similar gains after intervention to those seen in our initial intervention group.

Methods

Participants

The IRB approvals to carry out the early intervention project were obtained from Hofstra University in the US and the Institute of Population, Health and Development in Hanoi, Vietnam. We recruited children and their parents in Vietnam who met the criteria used by the U.S. for intervention programs for young children with developmental delays: The children performed at 2 standard deviations (SD) below the mean in one of the subdomain areas and/or 1.5 SD below the mean in 2 or more domain areas [49], of the Vineland Scale. Among 64 children

Who completed the intervention program for six months (this includes both children who were assigned to the initial intervention and those who were assigned to the delayed intervention), 46 children completed this follow-up study. The demographic information for the children and their families is presented in table 1. Of the 32 children who had received the initial intervention services (intervention follow-up group), 21 participated in the 9- and 12-month follow-up studies; at the same time 25 of the 32 children who were in the wait-list control group (delayed intervention group) received weekly home-visit services for six months, exactly the same services the children in the initial intervention group had obtained.

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Table 1: Characteristics of Children and Families.

Variables	Intervention Group (n=21)		Wait List Control Group (n=25)		T
	Mean	SD	Mean	SD	
Children					
Age (years)	3.86	0.91	3.84	0.80	0.07
Gender (%)					0.99
Boys (1)	17(81.0)		17 (68.0)		
Girls (0)	4 (19.0)		8 (32.0)		
Mothers					
Age (years)	33.77	5.13	32.68	5.26	0.70
Education* (%)					7.51
Primary School (1)	1 (4.8)		0 (0)		
Secondary School (2)	2 (9.5)		1 (4.0)		
High School (3)	3 (14.3)		4 (16.0)		
Junior College (4)	3 (14.3)		3 (12.0)		
College (5)	12 (57.1)		13 (52.0)		
Post graduate	0		4 (16.0)		
SES (%)					
Very Poor (1)	2 (9.5)		0 (0)		
Poor (2)	3 (14.3)		2 (8.0)		
Average (3)	16 (76.2)		23 (92.0)		
Rich (4)	0 (0)		0 (0)		

There were 4 females and 17 males in the intervention follow-up group and 8 females and 17 males in the delayed intervention group. Regarding socioeconomic status in the intervention follow-up group, 2 families were rated "very poor," 3 were "poor," and 16 were "average" by the mothers. In the delayed intervention group, 2 families were rated "poor" and 23 "average." As for parent involvement in the intervention follow-up group, 2 indicated that they were "not involved," 7 "sometimes" involved, and 12 demonstrated "active involvement." In the delayed intervention group, 1 parent indicated "not involved," 10 "sometimes" involved, and 14 demonstrated "active involvement." There were no statistically significant differences between the groups for these demographic variables, as tested by χ^2-analyses (p = .319 for gender, p = 137 for SES, and p = .938 for parental involvement).

Measures

The VABS II- Survey Interview Form [50] was used to assess the children's development over the 6-month intervention period. The scale provides a measure of adaptive behavior obtained through interviews with the parents. The survey form consists of items that provide information about the children's functioning in the domains of communication, socialization, motor skills and daily living. The Vineland Scale is the most widely used instrument in the U.S. for assessing the adaptive behavior of children with developmental disabilities and has been widely used internationally. The scale was translated into Vietnamese and was evaluated for content (cultural relevance) and semantic equivalence (the same meaning as the English version) by three bilingual Vietnamese. The psychometric properties of the scale have been reported in separate publications [46,48].

Procedures

Twenty student teachers recruited from the Department of Psychology and Pedagogy of Hanoi National University of Education participated as teachers. We asked the students in junior and senior classes of the department to participate in the project if they were interested in working with young children with developmental delays. Although they were interested in working with children with delays, none of the students had prior knowledge or experience of working with this population. Before they began the program, they received 3 months of weekly training conducted by the second author, who was one of the lead investigators and a psychologist, in early childhood development, developmental/intellectual disabilities, the Portage project and developing teaching objectives and task analyses. An experienced clinical supervisor provided necessary training and clinical supervision of the teachers throughout the project period by attending the supervision meetings or by being available to speak with them by phone or to meet with them individually.

Twenty student evaluators were recruited separately from the same department and trained in administering the Vineland Scales. They conducted the evaluation of the children without knowledge of whether the children were in the intervention or control group. They evaluated the children at 0, 3, 6, 9 and 12 months.

Results

Descriptive analyses

Table 2 shows the means and standard deviations for domain scores of the Vineland Adaptive Behavior Scale-II (VABS-II) for both groups over time. The standard scores for the VABS-II were used. From table 2, it can be seen that at pretreatment (0 month), the scores for the adaptive behavior scales (Communication, Daily Living Skills, Social Skills, and Motor Skills) are quite similar for both groups.

During Phase 1, which lasted for six months with assessments at three and six months, the home-based intervention was administered to the intervention follow-up group. During this phase, the means for Communication, Daily Living Skills, and Social skills all showed improvement, starting at 3 months and continuing through 6 months. This improvement was not as strong for Daily Living Skills (Table 2). For Motor Skills, the improvement did not start at 3 but 6 months. During Phase 2, which lasted for six months with assessments at 9 and 12 months, the improvement for the intervention follow-up group leveled off at 9 and 12 months. This leveling off was evident for all four domain scales.

The delayed intervention group, which did not receive any treatment during Phase 1, had a slight trending of improvement on the Communication and Social Skills scales at 3 and 6 months. There was a decrease in Daily Living Skills and Motor Skills from 3 to 6 months. During Phase 2, the delayed intervention group showed a marked improvement for all four adaptive behavior scales when they were administered the intervention at 9 months. The improvement evidenced at 9 months remained level at 12 months.

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Table 2: Vineland Scale Scores by Condition and Time.

	Intervention[b] (n = 21)					Wait List Control[a] (n = 25)				
	0 month	3 months	6 months	9 months	12 months	0 month	3 months	6 months	9 months	12 months
Domains	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Communication	72.05	80.86	82.38	82.62	84.57	73.04	76.00	78.68	83.92	85.32
	13.04	17.87	16.06	17.80	16.00	10.02	10.21	10.02	12.85	13.39
Daily Living Skills	82.91	85.61	85.43	84.05	87.43	84.32	84.68	81.84	84.12	86.60
	14.65	15.24	13.69	14.76	13.45	10.23	10.87	7.23	9.55	9.66
Social Skills	72.67	77.86	80.81	79.10	79.29	72.28	72.32	75.48	78.40	78.72
	9.80	9.90	11.69	10.56	10.27	9.05	7.80	6.39	8.07	7.61
Motor Skills	85.29	85.76	91.95	92.43	92.57	85.08	89.32	84.56	91.44	89.72
	12.91	17.13	14.60	16.39	24.48	12.21	10.73	11.78	10.67	12.06

Notes: Standard scores are used for domain scores. Higher scores indicate higher levels of adaptive behavior.
a: No treatment at 0,3, and 6 months; home-based intervention at 9 and 12 months. **b:** No treatment at 0 month; home-based intervention at 3 and 6 months.

It can be seen from table 2 that the intervention follow-up group tended to have more within-group variability than the delayed-intervention group for Communication, Daily Living Skills, Social Skills, and Motor Skills. Exploratory data analyses (boxplots) revealed that there was an extreme outlier in the intervention follow-up group. This child was male, average level of SES, and diagnosed autistic. His mother had a university education and his parents were married and actively involved in the home-based intervention for their son. The outlier occurred for the clear majority of the variables over time (13 times out of 20 for four composite scores over five time intervals). It was always the case that the direction of the extreme outlier was on the low end or maladaptive end of the composite scale. This pattern for this extreme outlying client continued until the end of the program. For example, for months 9 and 12 this child had five outlying scores out of eight possible outcomes. This score was not deleted for any of the analyses. The impact of this score led to increase within-group variability (error variance) and lowered the overall mean on the adaptive behavior scale scores for the intervention follow-up group.

Intercorrelations of the adaptive behavior composite scores at pretreatment (0 month). The zero-order correlations among the Communication, Daily Living Skills, Social Skills, and Motor Skills domain scales are given in table 3. As can been seen from that table, all of the correlations were positive. The correlation between Communication and Motor Skills was not statistically significant (p = .06). Given the high positive magnitude of almost all of these correlations, a decision was made to conduct multivariate analyses when comparing the intervention follow-up and delayed intervention groups.

Multivariate analyses

Pretreatment (0 month). The four Vineland adaptive behavior domain scores (Communication, Daily Living Skills, Socialization Skills, and Motor Skills) were the dependent variables for this analysis. The discriminant analysis [Wilks' Λ = .989, using Bartlett's conversion to a chi-square with $\chi^2(4)$ = .46, p = .977, canonical R^2 = .011] was *nonsignificant*. As seen from table 1, the means for the intervention follow-up and delayed intervention groups were similar at the pretest and there is no evidence that the conditions differed at pretreatment.

The intervention follow-up group received home-based intervention (Phase 1). During this phase only the intervention follow-up group received treatment. This home-based intervention occurred over six months with the assessments at 3 and 6 months. Data on the four domain scores were collected at those two observation points and were used in the discriminant analysis. This analysis was statistically significant [Wilks' Λ = .663, $\chi^2(8)$ = 16.44, p = .037]. Approximately 33.6% (canonical R^2) of the variance of the adaptive behavior composites at 3 and 6 months can be attributed to treatment. To better understand the nature of this group discriminating dimension, descriptive discriminant analyses were done (See table 4).

Discriminant dimension. Standardized discriminant function coefficients are given in table 4. These weights are derived to maximize group separation on the discriminating dimension and represent the unique or relative contribution of each of the variates. At 3 months, Motor Skills and Daily Living Skills exhibit negative weights, indicating that the delayed intervention group scored higher on those two variates. For Socialization Skills, the positive weight illustrates that the intervention group scored higher at 3 months. By 6 months, all four variates (Communication, Daily Living Skills, Socialization Skills, and Motor Skills) exhibited positive weights, indicating that the intervention group scored higher on these variates (Tables 2,4). Overall, Socialization Skills and Motor Skills consistently contributed to group separation at 3 and 6 months, while Daily Living Skills was a contributor only at 3 months and Communication only at 6 months (Table 4).

Structure correlations are also presented in table 4. These are useful for interpreting the substantive nature of the discriminating dimension. They are akin to factor loadings. All of these loadings are .20 or greater, except for Daily Living Skills at 3 months. Given this pattern the overall dimension is a "*general adaptive behavior*" factor. Centroids are used to illustrate each group's mean on the discriminating dimension. These centroids showed that the intervention group scored higher than the delayed intervention group on the *general*

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Table 3: Intercorrelations of the Vineland Scale Adaptive Behavior Composite Score and Subdomain Scores at Pre-Treatment.

Vineland Scores	1	2	3	4
1. Communication	----			
2. Daily Living Skills	.59*	----		
3. Socialization Skills	.46*	.64*	----	
4. Motor Skills	0.28	.53*	.41*	----

Note: N=46. Standard scores are used for the domain scores.
* p <.01

Table 4: Summary of the Linear Discriminant Function at the First Intervention Phase (Months Three and Six).

	Standardized Discriminant Function Coefficient [a]		Structure Correlation [b]	
	Month		Month	
Adaptive Behavior Domains	3	6	3	6
Communication	0.03	0.17	0.24	0.2
Daily Living Skills	-0.68	0.03	-0.01	0.24
Social Skills	0.85	0.23	0.45	0.41
Motor Skills	-1.02	0.71	-0.18	0.4

Notes: n = 25 for delayed intervention group. n = 21 for intervention follow-up group. During the first intervention phrase only the intervention follow-up group received the home-based treatment at months three and six.
[a] Weights are the coefficients used to maximize group separation. Weights represent the relative /unique contribution of each variate, given the other variates, to the discriminant function.
[b] Also called canonical variate correlations. They are pooled within-groups correlation between the variates and the discriminant function. They are akin to factor loadings.

adaptive behavior dimension, .761 and -.639, respectively. *In toto*, the multivariate analyses support the idea that the home-based intervention did statistically significantly improve the adaptive behavior of the intervention group in comparison to the delayed intervention group during Phase 1.

Phase 2: The intervention group was followed up without the intervention and the delayed intervention group received home-based intervention. During this phase, the adaptive behavior domain scores at 9 and 12 months served as the variates for both groups. This discriminant analysis was *non-significant* [Wilks' Λ = .969, $\chi^2(8)$ = 1.25, p = .996, canonical R^2 = .031]. The differences found between the delayed intervention group and intervention group during Phase 1 were no longer evident when the delayed intervention group also received treatment.

Treatment trends over time. Two of the scales, Communication and Socialization Skills, clearly illustrate the impact of treatment over time (Figure 1). At 0 month, both groups scored comparably low on these adaptive behaviors, as evidenced by the *nonsignificant* result of the multivariate analysis. During Phase 1, when only the intervention group had received the home-based intervention, it can be seen that the intervention group showed an increase of adaptive behavior in comparison to the delayed intervention group. This point was supported by the statistically significant multivariate result for this phase. During Phase 2, when the intervention and delayed intervention groups both had received the home-based intervention, both groups were again comparable on adaptive behavior, as evidenced by the *non-significant* multivariate result for that phase.

As can be seen in figure 1, by 12 months, both groups showed an improvement in adaptive behavior as compared with pretreatment. Furthermore, the efficacy of the treatment was demonstrated and replicated for the intervention follow-up and delayed intervention groups, respectively. It can also be seen from figure 1 that while the initial treatment impact on adaptive behavior was demonstrable, this effect leveled off over continued treatment. This pattern was examined via trend analyses and dependent comparisons for the Communication and Socialization Skills domains.

Trend Analyses. There were statistically significant linear [Communication, F (1, 20) = 18.86, p < .001; and Socialization Skills, F (1, 20) = 15.79, p = .001] and quadratic relationships [Communication, F (1, 20) = 4.99, p = .037; Socialization Skills, F (1, 20) = 7.82, p = .011] for the intervention group (Figure 1). The trends showed that there was an improvement in adaptive behavior (linear component) and that this treatment effect leveled off (the quadratic component). Specifically, dependent comparisons of pretreatment *vs.* three months were statistically significant for Communication [dependent t (20) = 2.92, p = .008] and Socialization Skills [dependent t (20) = 2.94, p = .008]. Three additional dependent comparisons were undertaken for both Communication and Socialization Skills. These comparisons supported the point that the treatment effect leveled off. Specifically, for Communication, the comparisons of the initial treatment (month 3) to the succeeding treatment times (months 6, 9, and 12) yielded

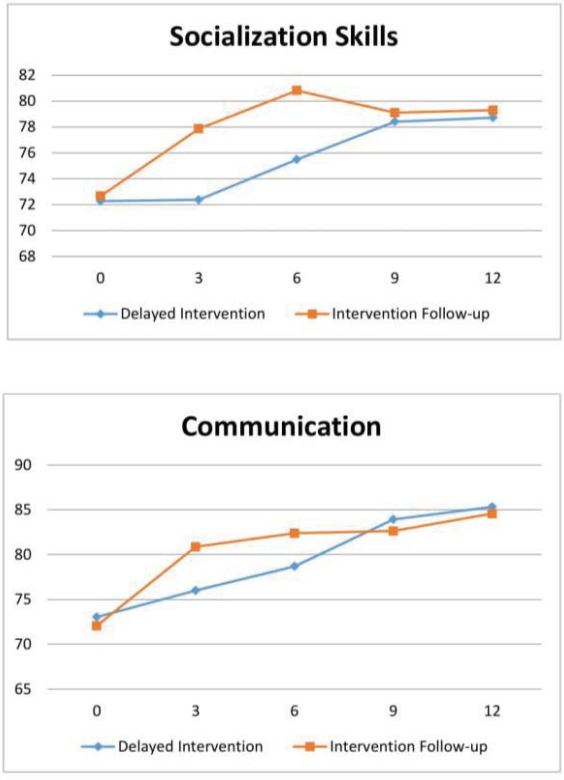

Figure 1: Trends of Adaptive Behavior Scores over Treatment and Time.

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nonsignificant results [dependent *t*-tests: t (20) = .63, p = .537 for three *vs.* six months; t (20) = .69, p = .497 for three *vs.* nine months; and t (20) = 1.11, p = .281 for three *vs.* 12 months]. For Socialization Skills, the results were: three *vs.* six months t (20) = 1.78, p = .090; for three *vs.* nine months t (20) = .82, p = .423; and three *vs.* 12-months t (20) = .93, p = .363.

For the delayed intervention group, there were statistically significant linear trends only for Communication [F (1, 24) = 19.50, p < .001] and for Socialization Skills [F (1, 24) = 10.82, p = .003]. While the delayed intervention group showed a slight improvement during Phase 1, there was a statistically significant result for the dependent comparison six *vs.* nine months for Communication [dependent t (24) = 2.44, p = .022] and less so for Socialization Skills [dependent t (24) = 1.72, p = .099]. These results demonstrate the efficacy of the initial treatment. However, the leveling off effect also occurred for this group. That is, there were *non-significant* results for nine *vs.* 12-months for Communication [dependent t (24) = .90, p = .376] and for Socialization Skills [dependent t (24) = .28, p = .779].

Discussion

In this study, we examined two effects of a home-based intervention for Vietnamese children with developmental delays, based on the Portage model. These two effects represent: first, the long-term follow-up effect of the intervention for our initial treatment group and, second, the effect of the intervention on our delayed intervention (initial control) group. As mentioned above, the initial intervention group had shown significant improvement in adaptive behavior and functioning after the intervention. And now, the initial intervention group showed maintenance of adaptive behavior for six months after the intervention ended. More specifically, the initial intervention group showed maintenance of communication and social skills significantly above their pretreatment levels. Also, our delayed intervention group has shown significantly improved adaptive behavior after receiving the intervention.

There are several factors that might have contributed to maintaining the skills the children obtained from the intervention during the follow-up assessment. Parents are educated and given practice in training their children for their adaptive behaviors, thus the parents' ongoing application of the knowledge might have helped. Children may be maintaining their gains through the learning that occurred during intervention. The children could have applied social skills they obtained from the intervention to other peer and family social interactions, which might have contributed to maintaining the skills. The one-hour per week home-based intervention may have acted as a protective factor against isolation and brought social interactions and enrichment that enhanced the children's communication and social skills. Parents become experienced in identifying and connecting with school and community resources that further educated and enhanced the children's adaptive behaviors.

Because baseline intellectual testing is not common practice in Vietnam, and our teachers were not trained in psychoeducational assessment or achievement testing techniques, our assessment of functioning relied on parent report. The differential improvement for the adaptive behavior domains may help to rule out the subjective perception of increase in adaptive functioning, due to the fact that they received the treatment. If the subjective perception was our only source of change reported, then reports of adaptive functioning would be expected to disregard specific skill sets and affect all areas equally. More objective assessment, however, by trained clinicians who are blind to intervention status, would help eliminate sources of bias in assessing improvement in adaptive functioning.

Compared to the previous report, in which we found the intervention group gaining in communication, social skills and motor skills over a six-month period [46], this follow-up study showed and validated the significant gains in socialization skills and communication skills for both intervention and the delayed intervention groups. In addition, the trend analysis reveals that both groups show upward gains in subdomain areas, further validating the gains the intervention brought for both groups. The maintained results on adaptive skills for the initial intervention group, and the improvement in these skills for the delayed intervention group show that a home-based intervention with limited professional resources continues to be a viable option. The results are promising in that many families presented and maintained improvements in important adaptive behavior skills in a relatively short time. These skills are important for independent functioning, and for relieving the difficulties that developmental delays may place on the individual, the family, and the larger society that is struggling to support special needs.

Our observations, experiences, and data from our time in Vietnam all indicate that an early intervention program for children with developmental delays and their families may be implementable in low-income nations where resources are sparse. The improvements that we report here were all achieved through a limited level of teacher skill (formal college training in special education was not requisite; some had experience working with children with developmental delays), and manualized treatments that are easy to use. In future studies, objective measures of fidelity may allow researchers to better assess how level of expertise of teachers played a role in the effective implementation of the program. While the program may not have met the needs of all individuals due to different levels and types of comorbid presentations, it appears to be broadly applicable for the majority of children with developmental delays in improving their adaptive skills toward a level of independence. This intervention may be a short-term, feasible, resource-light, *lasting* intervention that greatly improves the quality of life and functioning for children with developmental delays and their families in LMICs.

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