Journal of Educational and Developmental Psychology; Vol. 7, No. 1; 2017
ISSN 1927-0526 E-ISSN 1927-0534
Published by Canadian Center of Science and Education

Efficacy Trial of Contrasting Approaches to the Response-Contingent Learning of Young Children with Significant Developmental Delays and Multiple Disabilities

Melinda Raab[1], Carl J. Dunst[1] & Deborah W. Hamby[1]

[1] Orelena Hawks Puckett Institute, Morganton, North Carolina, USA

Correspondence: Carl J. Dunst, Orelena Hawks Puckett Institute, 128 S. Sterling St., Morganton, NC, 28655, USA. Tel: 1-828-432-0065. E-mail: cdunst@puckett.org

Received: September 20, 2016 Accepted: October 30, 2016 Online Published: November 29, 2016

doi:10.5539/jedp.v7n1p12 URL: http://dx.doi.org/10.5539/jedp.v7n1p12

Abstract

Findings from a randomized control design efficacy trial of an asset-based vs. needs-based approach to the response-contingent learning of infants and toddlers with significant developmental delays and disabilities who did not use instrumental behavior to produce or elicit reinforcing consequences are reported. The investigation included 71 children randomly assigned to the two contrasting types of interventions. The asset-based intervention and needs-based intervention differed in terms of how child behavior were identified and used to elicit reinforcing consequences as part of response-contingent learning games implemented by the children's parents or other primary caregivers. Children in the asset-based group were provided more learning opportunities, acquired more response-contingent behavior, and demonstrated more efficient learning compared to children in the needs-based group. Implications for improving practices for very young children with significant developmental delays and multiple disabilities are described.

Keywords: asset-based, strengths, needs-based, deficits, child operant learning, learning games, response-contingent behavior

1. Introduction

Four decades ago, Maier (1978) defined intervention as "A series of socially engineered … activities in which a practitioner deliberately introduces specifically structured events into the experience of an individual or group of individuals … in order to facilitate ordinary developmental processes" (p. 195). A year later, Garwood (1979) defined early childhood intervention as the "provision of meaningful and appropriate educational experiences to preschool children to maximize educational benefits" (p. 3). Whether stated explicitly or implicitly, all interventions are developed from different paradigms where different worldviews include different beliefs and presuppositions about the experiences hypothesized to be related to outcomes of interest (Reese & Overton, 1980). These beliefs and presuppositions in turn influence decisions about both research and practice (Hartung, 2015; Turner & Reese, 1980). Woodhead (2006) noted that historically different early childhood intervention paradigms have influenced policy and practice in discernibly different ways.

1.1 Intervention Paradigms

Two contrasting paradigms have most often been used to conceptualize and operationalize early intervention practices with infants and toddlers with developmental delays and disabilities. One approach focuses on identifying delayed or missing skills and then intervening to teach or facilitate children's acquisition of those skills (Allen & Cowdery, 2015; New & Cochran, 2007). The other approach uses existing child behavior as the building blocks for promoting acquisition of instrumental and functional behavior (Leffert, Benson, & Roehlkepartain, 1997; Wilson, Mott, & Batman, 2004). Eloff and Ebersohn (2001) described these contrasting approaches to early intervention as needs-based and asset-based approaches respectively.

The two approaches differ in terms of their assumptions about the purpose of intervention. Asset-based intervention is premised on the belief that human growth and development is best facilitated when existing behavioral competencies are changed or modified as a result of new or challenging learning opportunities. In contrast, needs-based intervention is premised on the belief that foundational behavior not in a person's repertoire need to be targeted and taught using practices intended to promote acquisition of those behavior. Asset-based approaches to intervention focus on building on child strengths, interests, preferences, and other skills to enhance learning (e.g., Dunst, Herter, & Shields, 2000; Eloff & de Wet, 2009; Lancioni, Singh, O'Reilly, Oliva, & Groeneweg, 2005), whereas needs-based approaches to intervention focus on the identification of child weaknesses, deficits, or missing skills and the amelioration of these deficiencies (see Dunst & Trivette, 2009; and Panitch, 1993; for descriptions of the features of this approach to early intervention).

1.2 Purpose of the Study

The purpose of the study described in this paper was to compare an asset-based versus needs-based approach to response-contingent learning of infants and toddlers with significant developmental delays and multiple disabilities to determine if the two approaches differed in terms of their consequences operationally defined in terms of a number of different child learning measures. Response-contingent learning refers to a child's ability to use a behavior to produce or elicit reinforcing environmental consequences (Gunnar, 1980; Williams, 2001). This type of instrumental learning was described by Watson and Ramey (1972) as response-contingent stimulation because an environmental effect (stimulation) is contingent upon a child's behavioral response, whereas Piaget (1952) described this type of learning as secondary circular reactions where a child's repeated actions on the social and nonsocial environment result in interesting consequences. According to both Gunnar (1980) and Tarabulsy et al. (1996), this type of learning is important because contingency experiences provide infants opportunities to learn to control environmental events and to recognize that they are the agents of environmental effects (i.e., contingency awareness).

1.3 Previous Research

More than 60 years of research indicates that infants without delays or disabilities as young as 2 to 4 months of age acquire the ability to use vocalizations, smiling, visual attention, arm and leg movements, head turns, sucking movements, and other behavior to produce or elicit environmental consequences (see Dunst, Gorman, & Hamby, 2010; Dunst, Storck, Hutto, & Snyder, 2007; Hulsebus, 1973; Lipsitt, 1969; Rovee-Collier & Gekoski, 1979; for reviews). Infants and toddlers with disabilities or delays often take longer to learn these same types of response-contingent behavior and as a result often demonstrate a latency to learn (Hutto, 2007). The extent to which a latency to learn response-contingent behavior among infants and toddlers with delays or disabilities is related to different types of experiences or interventions has not been directly examined nor have the differences in rates of learning been explicitly determined (see e.g., Dunst, Gorman et al., 2010; Dunst, Storck et al., 2007).

Close inspection of response-contingent learning studies with infants and toddlers with significant delays and multiple disabilities suggest that the characteristics of different interventions have differential consequences in terms of child learning. For example, Dunst, Cushing, and Vance (1985) used a needs-based approach to contingency learning where behavior that children did not yet exhibit were targeted to be learned and found a latency to learn for half of the children in their study. In contrast, Lancioni et al. (2005) used an existing child behavior and favorite stimuli to facilitate a young girl's use of vocalizations to produce a preferred environmental consequence. Dunst et al. (2007) reported similar results using an asset-based approach to response-contingent child learning with young children with delays and disabilities. The differences between the two approaches to child learning were the basis for hypothesizing that an asset-based intervention would be more effective than a needs-based intervention for promoting the response-contingent learning of young children with significant delays and multiple disabilities.

1.4 Study Hypotheses

The study described in this paper was a randomized controlled efficacy trial that included different measures of child learning opportunities, child response-contingent learning, and child learning efficiency. The four hypotheses of the study were:

H_1: Children in the asset-based group will be afforded more learning opportunities (number of learning trials per game) compared to the children in the needs-based group.

H_2: Children in the asset-based group will demonstrate acquisition of more response-contingent behavior (total number of contingency responses and average number of contingency responses per learning game) compared to the children in the needs-based group.

H_3: The response-contingent learning opportunities afforded the children in the asset-based group will result in more efficient learning (percent of trials associated with response-contingent behavior and average number of response-contingent behavior per minute) compared to the children in the needs-based group.

H_4: The rates of change on the different child learning measures will increase more rapidly among the children in the asset-based group compared to those for the children in the needs-based group.

The study is part of a line of research and practice investigating the use of response-contingent learning opportunities with children with significant developmental delays or multiple disabilities to enhance their abilities to interact with their social and nonsocial environments in ways having reinforcing consequences (e.g., Dunst et al., 1985; Dunst, Raab, Trivette, Parkey et al., 2007; Dunst, Raab et al., 2010; Dunst, Raab, Wilson et al., 2007; Raab, Dunst, Wilson, & Parkey, 2009). Preliminary analyses of data from the study yielded encouraging findings about the differences in the two approaches to response-contingent learning (Raab, Dunst, & Hamby, 2016). The study described in this paper included a larger sample of children and different types of data analysis procedures to evaluate whether the two approaches to response-contingent learning had differential effects. Hierarchical linear growth curve modeling was used to examine intraindividual changes in the children's learning and the extent to which those changes were differentially related to the contrasting types of interventions. The study results were also examined in terms of the relative effectiveness of the asset-based intervention beyond that associated with the needs-based intervention. Findings were expected to either support or refute the contention that the two approaches to response-contingent learning had different characteristics and consequences.

2. Method

2.1 Institutional Review and Approval

The study described in this paper was reviewed and approved by the investigators' Research Institute Institutional Review Board. This included, but was not limited to, the approval of the intervention procedures, the procedures for obtaining participant informed consent, and the procedural safeguards for protecting the study participants.

2.2 Recruitment

The children were recruited from early intervention programs, preschool special education programs, hospitals, specialty clinics, physician practices, and parent and disability organizations in three states in the southeastern United States. Children were eligible for participation in the study if they had multiple disabilities (e.g., cerebral palsy and sensory impairments), identified disabilities associated with significant developmental delays (e.g., congenital anomalies or genetic disorders), significant developmental delays without known causes, neurologic diseases or central nervous system disorders (e.g., lissencephaly, Ohtahara syndrome), or birth-related conditions associated with poor developmental outcomes (e.g., extreme low birth weight and grade 3 or 4 intraventricular hemorrhaging); were functioning at or below a 4 to 5 month age level of development; and not yet demonstrating intentional use of behavior to produce or elicit reinforcing social or nonsocial environmental consequences.

One hundred and twenty children were referred to the study and screened for eligibility. Eighty-one children were determined to be eligible for participation. Children who met the eligibility criteria were randomly assigned to either the asset-based (N = 42) or needs-based (N = 39) intervention groups. Four children were lost to attrition in the asset-based group (10%) and six children were lost to attrition in the needs-based group (15%). Two parents in each group never gave oral or written consent to participate, and the investigators lost contact with the other six families. Both overall attrition (10%) and differential attrition (5%) were small enough to establish a low level of bias (What Works Clearinghouse, 2014, n.d.-a). The final sample sizes were 38 and 33 respectively in the asset-based and needs-based intervention groups.

2.3 Participants

The participants were 71 children (37 boys and 34 girls) birth to six years of age and their parents (65 mothers, 2 fathers) and other primary caregivers (2 foster parents, 2 parent guardians). There were no differences in the proportion of males and females in the two intervention groups, $\chi^2 = 0.74$, $df = 1$, $p = .390$, $d = .21$, nor was there a difference in the proportion of mothers in the two intervention groups, $\chi^2 = 1.39$, $df = 1$, $p = .239$, $d = .28$. These findings indicate that the two samples were more similar than different on those participant characteristics.

The Mullen (1995) *Scales of Early Learning* were administered to each child at entry into the study. The children were, on average, 17 months of age (SD = 10) but functioning developmentally, on average, at only 4 months of age (SD = 3). Fifty-six percent of the children had Mullen Composite Standard Scores of 49 which is the lowest score attainable. A score of 49 or less is three or more standard deviations below a mean of 100 where 90 percent of the children had standard scores that indicated very low functioning levels (Mullen, 1995).

Because the majority of the children had Mullen Composite Standard Scores at or below 49, the children's Developmental Quotients (DQ) were estimated by dividing each child's composite developmental age on the Mullen scales by his or her chronological age and multiplying the result by 100. The children's average DQ was 34 (SD = 25). Seventy-five percent of the children had DQs three or more standard deviations below a mean of 100, 60% had DQs four or more standard deviations below the mean, and 50% of the children had DQs five or more standard deviations below the mean.

Table 1 shows the developmental characteristics of the children and the background characteristics of the parents in the two intervention groups at entry into the study. The children's chronological ages, developmental ages, and DQs were very much alike in both groups as evidenced by no statistically significant between group differences. There were also no statistically significant between group differences in the parents' ages, years of formal education, or family socioeconomic status (Hollingshead, 1975). The results are an indication that randomization resulted in the children and parents in the two intervention groups being more similar than different. There was, however, nonbaseline equivalence for child DQs and parent education as evidenced by mean difference effect sizes of $d = .31$ and $d = .36$, respectively (What Works Clearinghouse, 2014, n.d.-b). Both variables were used as covariates in all of the analyses described below.

Table 1. Characteristics of the children and parents at entry into the study

	Asset Group		Needs Group				
Background Characteristics	Mean	SD	Mean	SD	*t*-test	*p*-value	Cohen's *d* Effect Size
Child Characteristics							
Chronological Age (months)	17.61	12.57	17.36	8.70	0.95	.924	.02
Developmental Age (months)	4.56	2.99	4.41	2.46	0.23	.817	.06
Developmental Quotient[a]	36.33	26.23	30.48	18.69	1.09	.282	.31
Parent Characteristics							
Age (years)	32.18	7.57	31.78	8.40	0.21	.835	.05
Years of School Completed	14.05	1.71	13.48	1.46	1.49	.140	.36
Family SES[b]	36.16	15.01	33.85	9.13	0.79	.436	.19

Computed as child developmental age divided by child chronological age x 100.[b] Hollingshead (1975) four factor index of socioeconomic status.

Inasmuch as the study participants were also receiving special instruction/special education, and therapy services from other programs, agencies, and providers, we ascertained the similarity of the two groups of children on early childhood intervention services. The percent of children receiving the four services that "make up" the bulk of early childhood intervention in the U.S. (Hebbeler et al., 2007) are shown in Table 2. There were no between group differences for any of the four comparisons. There were also no differences in the total number of the four kinds of services for the children in the asset-based (M = 2.55, SD = 1.41) vs. needs-based (M = 2.39, SD = 1.09) intervention groups, $t = 0.54$, $df = 69$, $p = .593$, $d = .13$.

Table 2. Percent of children receiving early childhood intervention services

Child Services	Asset Group	Needs Group	χ^2	*p*-value	Cohen's *d* Effect Size
Special Instruction/Education	50.0	46.7	0.08	.785	.07
Speech and Language Therapy	60.5	54.8	0.23	.634	.12
Occupational Therapy	65.8	54.8	0.86	.354	.23
Physical Therapy	78.9	83.9	0.27	.603	.13

2.4 Procedure

Three early childhood practitioners were assigned to implement the asset-based intervention and three early childhood practitioners were assigned to implement the needs-based intervention. The asset-based approach used existing behavior in the children's repertoire as target behavior as part of response-contingent learning opportunities, whereas the needs-based approach used adult-selected behavior for the children to learn as target behavior. The practitioners in the two groups were kept unaware of the fact that there was a contrasting intervention group, and the staff assigned to the two different intervention groups never interacted with one another throughout the course of the study.

The children in both groups were first assessed to identify behavior that the children would use to produce or elicit environmental consequences as part of response-contingent learning opportunities (described to the parents as learning games). The two interventions differed only in the procedures used to identify and select target behavior. Lancioni et al. (2001) described the differences between the contrasting interventions in terms of asset-based practices "not requiring excessive effort" (p. 271) to control environmental consequences and needs-based practices as requiring "excessively high levels of effort" (p. 271) to control environmental consequences.

The children in the asset-based group were observed in everyday activities in their homes and their parents queried to identify behavior in the children's repertoires but not used intentionally to produce or elicit reinforcing environmental effects. An investigator-developed checklist was used to record the occurrence and frequency of different child behavior, including, but not limited to, head, body, arm, leg, fist, and hand movements; vocalizations; and directed gaze and visual fixation. Behavior that a child produced frequently or for considerable durations of time were selected as target behavior to be used as part of providing the children response-contingent learning opportunities.

The children in the needs-based group were administered the birth to three-year-old *Assessment*, *Evaluation*, *and Programming Systems* (AEPS) (Bricker, Capt, & Pretti-Frontczak, 2002) scales to identify missing skills operationalized as behavior at or just above the ceiling level in six scale domains (fine motor, gross motor, adaptive, cognitive, social-communication, and social). Results were used to select child behavior as the intervention targets where response-contingent learning games were used to facilitate acquisition of those behavior targets. The AEPS was not used as intended by assessment system developers but rather to simply identify intervention targets for response-contingent learning opportunities.

As part of the assessments administered to both groups of children, child-specific reinforcers were identified through observations and parent interviews to determine the people, materials, activities, events, and so forth that elicited or maintained the children's attention. This was done in a manner similar to how Dunst, Raab, Trivette, Wilson et al. (2007) identified reinforcing consequences in their research with children with significant developmental delays and multiple disabilities. Fisher, Piazza, Bowman, and Amari (1996) noted that this is a more effective approach to identify reinforcers compared to using a predetermined list of potential reinforcers.

The same types of response-contingent learning games for children in both intervention groups were used to promote the children's use of targeted behavior to produce or elicit reinforcing consequences. Learning games included targeted operant behavior that either resulted in reinforcing consequences (e.g., swiping at a mobile producing movement or sound) or were reinforced by a caregiver (e.g., an adult talking to a child each time he or she looked at the adult's face). All of the learning games were characterized by behavior-based contingencies where the availability of a reinforcement or the production of an interesting consequence was dependent on the children's production of the targeted behavior (Tarabulsy et al., 1996).

2.5 Implementation

Early childhood staff were taught the intervention practices in the contrasting approaches over a two-month period of time prior to their work with children and their families using an evidence-based adult learning procedure (Dunst, Trivette, & Hamby, 2010). These early childhood staff, in turn, taught parents to use the practices in the families' homes using a modified version of the adult learning procedures (Raab, Dunst, & Trivette, 2013).

The adult learning procedure involved staff's active participation in four phases for learning either of the two interventions: (1) acquiring information about and examples of the intervention practices; (2) authentic use of the interventions and evaluating the characteristics and outcomes of the practices; (3) reflecting on their overall understanding and mastery of the practices; and (4) identifying and participating in additional opportunities to learn to use their particular approach to intervention. Staff were trained using procedural manuals that were identical for the two intervention groups except for the methods used to identify target behaviors. Video examples of response-contingent learning opportunities were used both to illustrate the practices to the practitioners and to provide staff opportunities to use and understand how the interventions were implemented. Role-playing, in-vivo training, and investigator feedback were employed to provide staff opportunities to use the interventions in a manner consistent with the study procedures.

The practitioners and the children's parents developed four to six learning games so that targeted behavior were associated with child-specific reinforcers to facilitate the children's acquisition of contingency responses. Both social and nonsocial games were developed for each child. Social learning games involved a child's use of a target behavior to elicit a social response from the parent (e.g., a parent kissing the child on the neck each time she turned her head from side to midline while in a supine position). Nonsocial learning games involved a child's use of a target behavior to elicit a nonsocial environmental consequence (e.g., a child producing movement of a mobile by leg or hand movements).

Parents were taught to implement the learning games by the practitioners using the same adult learning procedure used to train the staff (Dunst et al., 2010). For each game that was developed, staff engaged a parent in completing an investigator-developed *Learning Games Intervention Form* that included the target behavior and reinforcing consequence used in a game, procedures to prepare and set up a game (e.g., materials needed, positioning of the child, etc.), strategies for implementing the game to ensure delivery of the reinforcing consequence when the child produced a target behavior, and any special child-specific considerations (e.g., wait time, adaptations, etc.). Staff described the key characteristics of a game, demonstrated the use of the game, and then had the parent practice each game with her child. Supportive feedback and guidance were provided as necessary to ensure the parents understood how to implement the learning games in the ways intended.

The practitioners visited the children and parents weekly or every other week and observed and recorded the types of games played with the children, the length of time each game was played, the child behavior that was targeted to elicit or produce reinforcing consequences for each game, and the number of child behavior that had and did not have reinforcing consequences. The home visits were also used to change or modify the learning games, develop new learning games, and to coach the parents in how to engage their children in the learning games.

2.6 Procedural Fidelity

The parents maintained weekly logs, which were used to determine procedural fidelity in terms of the number of games developed for a child compared to the number of games implemented by a parent with the child, and the frequency of child participation in the games per week. There were, on average, 2.92 (SD = .79) different games planned and 2.72 (SD = .87) games implemented for each child per week, t = .61, df = 69, p = .545, d = .15. The games were played, on average, 4.30 days per week (SD = 1.38). There was no statistically significant difference in the number of days per week that the children participated in the games in the two intervention groups, t = .08, df = 69, p = .933, d = .02. These results indicated that the groups did not differ in terms of the number of planned compared to the number of implemented games or how often the parents implemented the games with the children in the two intervention groups.

2.7 Dependent Measures

Investigator-developed recording forms were used to code different information about the learning games during the home visits by the staff with the children and their parents. Each recording form included space for recording the number of trials per game. A trial was defined as the availability of a child-specific reinforcement where a targeted behavior for a game (either prompted or non-prompted) did or did not result in the reinforcing consequence. The recording form included codes for non-prompted targeted behavior that produced or elicited a reinforcing consequence, physically and verbally prompted child contingency behavior, and child behavior that had no environmental effects per learning opportunity trial. A trial lasted up to six seconds at which time the child's responses were coded. A learning game was defined as a series of learning trials that involved use of a targeted behavior to produce or elicit a child-specific reinforcing consequence where a game lasted until a child ceased attempts to elicit a reinforcing consequence, or lost interest in a game. Each child had an average of five data collection sessions during the eight weeks of intervention. Three games on average were played with each child per session where each game lasted an average of six minutes.

The information on the recording forms was used to compute two child learning opportunity measures, two child response-contingent behavior measures, and two child learning efficiency measures. The child learning opportunity measures included the number of learning games used with a child and the number of learning opportunities (trials) per game. The child response-contingent behavior measures included the total number of non-prompted response-contingent behavior that resulted in a reinforcing consequence and the average number of non-prompted child response-contingent behavior per learning game. A non-prompted response-contingent behavior was defined as a child's use of a targeted behavior to produce or elicit a reinforcing consequence that was not prompted by either a parents' or a practitioners' verbal or nonverbal behavior. The child learning efficiency measures included the percent of learning opportunities (trials) associated with non-prompted child behavior having reinforcing consequences and the average number of non-prompted child behavior having reinforcing consequences per game minute. The six learning measures were first computed for each game and then averaged across games per session.

2.8 Interrater Agreement

The early childhood practitioners made a total of 355 home visits during the course of the study where 1,010 learning games were played during the home visits. Research assistants (one for each intervention group) made joint visits with the practitioners in their respective intervention groups on 95 occasions (27% of the total number of home visits) where 272 learning games (27% of the total number of learning games) were played during the home visits. The research assistants used the same recording form as the practitioners where the two sets of codes were used to compute interrater agreement for (1) the number of games played during the home visits, (2) the length of the games in minutes, (3) the number of learning trials per game, and (4) the number of non-prompted response-contingent child behavior. Interrater agreement was computed as the number of agreements divided by the number of agreements plus non-agreements multiplied by 100. There was 100% agreement on both the number of games played during the home visits and the number of minutes each game was played. There was 92% agreement on the number of trials for the learning games (range = 89 to 93), and 91% agreement on the number of non-prompted child response-contingent behavior (range = 85 to 95).

2.9 Data Analysis

Hierarchical linear growth curve modeling (Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2011) was used to evaluate the effects of the two contrasting approaches to interventions on the six child learning measures. Each analysis included tests for linear increases in the slopes of the learning measures (Level-1) and between intervention group differences in the slopes controlling for the non-time varying covariates (Level-2). The between group comparisons are analogous to between group x measurement occasion tests for interactions between the independent and dependent measures. The growth curves were modeled with each child's baseline learning measure equal to zero inasmuch as none of the children demonstrated instrumental response-contingent behavior at the beginning of the study. The main analyses were supplemented by additional analyses as indicated to clarify the nature of the relationships between the two contrasting interventions and the child learning measures.

In addition to statistical significance testing, we also computed Cohen's *d* effect sizes for the differences in the slopes for the two intervention groups. The effect sizes were computed using the formula $d = b/\sqrt{tau}$, where b is the regression coefficient for the between slope differences and tau is the random effects variance component for the measurement occasion slopes (Feingold, 2009). We also computed the improvement indices for the between group slope differences for evaluating the practical importance of the intervention effects (What Works Clearinghouse, 2014). This is a measure of the relative effectiveness of the asset-based intervention beyond that associated with the needs-based intervention (Lipsey et al., 2012). An improvement index can take on values between -50 and +50, where positive indices show favorable results for the particular intervention hypothesized to be more effective. It is interpreted as the percentage of slope indices in the asset-based group that exceeded those in the needs-based group. *ZCalc* was used to compute the improvement indices (Neill, 2006).

3. Results

Table 3 shows the results for the linear growth curve analyses for each of the six dependent measures with the effects of the non-time varying covariates (parent education and child DQ) partialled from the between group differences. Parent education was not related to any of the between group slope differences, and child DQ was related to only the between group slope differences for the total number of nonprompted response-contingent behavior, $t = 2.04$, $df = 67$, $p = .045$, $d = .50$, and average number of response-contingent behavior per game, $t = 2.22$, $df = 67$, $p = .030$, $d = .54$.

Results indicated that there were statistically significant between group slope differences in the rates of change for 4 of the 6 learning measures, but large to very large effect sizes for the between group slope differences for all six learning measures. All of the sizes of effect favored the asset-based group except for the number of learning games played with the children. The findings showed that the progressive increases in the slopes on the dependent measures (except the number of learning games) were greater for the asset-based intervention compared to the needs-based intervention.

Table 3. Fixed effects estimates for the differences in the linear growth curves (slopes) for the asset-based vs. needs-based intervention groups

Child Learning Measures	Between Group Coefficient	Standard Error	*t*-ratio	*p*-value	*d*
Child Learning Opportunities					
Number of Learning Games	-0.06	0.03	-1.85	.069	0.81
Number of Learning Trials Per Game	0.90	0.24	3.68	.000	1.13
Child Response-Contingent (RC) Behavior					
Number of RC Behavior	3.67	0.72	5.14	.000	1.45
Number of RC Behavior Per Game	1.08	0.21	5.26	.000	1.48
Child Learning Efficiency					
Percent of Trials with RC Behavior	1.34	0.73	1.83	.072	0.86
Average RC Behavior Per Minute	0.16	0.03	4.79	.000	4.87

Notes. Results are adjusted for baseline differences in child DQs and parent education. *d* = Cohen's *d* effect size.

3.1 Child Learning Opportunities

There were linear increases in the number of learning games played with the children across measurement occasions for all the children taken together, b = .39, *t* = 20.46, *p* = .000, *d* = 4.76, where the linear growth curve slopes were greater for the needs-based intervention compared to the asset-based intervention (Table 3). There were also linear increases in the number of learning opportunities (trials) afforded the children, b = 1.54, *t* = 9.101, *p* = .000, *d* = 1.56, where the linear increases were much more pronounced for the asset-based compared to the needs-based intervention.

The average slopes for both child learning opportunity measures are shown in Table 4. The average slope for the number of learning games was b = .46 for the needs-based group compared to b = .33 for the asset-based group. This finding, however, is somewhat misleading because of the small standard error associated with the between slope differences. This is the case as shown in Figure 1 where the slopes for the two contrasting interventions are very much alike. The average number of games played at Week 1 was 1.67 (SD = .15) for the asset-based group and 1.46 (SD = .11) for the needs-based group, and at Week 8 was 3.78 (SD = .32) for the asset-based group and 3.91 (SD = .26) for the needs-based group.

Although the number of learning games played per week with the children in both intervention groups were more similar than different, the rates of increase in the number of learning opportunities (trials) afforded the children per game in the asset-based group (b = 1.94) was nearly twice as large as that for the needs-based group (*b* = 1.09). The between slope difference shown in Table 4 was associated with a very large effect size (*d* = 1.13). The difference in the slopes is shown in Figure 2 where the average number of trials per game at the end of the study was 20.96 (SD = 2.41) for the asset-based group compared to 10.63 (SD = 1.75) for the needs-based group, *t* = 20.37, *df* = 69, *p* = .000, *d* = 4.90. The between group difference in the slopes for number of child learning opportunities had an improvement index of 37. This indicates that if the children in the needs-based group had received the asset-based intervention they would have experienced 37% more learning opportunities (trials) per game.

Table 4. Linear growth curve average rates of change for the contrasting types of interventions

	Asset Group		Needs Group			
Child Learning Measures	Average Slope	SE	Average Slope	SE	*d*	Improvement Index
Child Learning Opportunities						
Number of Learning Games	0.33	0.04	0.46	0.05	0.81	29
Number of Learning Trials Per Game	1.94	0.23	1.09	0.25	1.13	37
Child Response-Contingent (RC) Behavior						
Number of RC Behavior	5.60	0.53	1.67	0.57	1.45	43
Number of RC Behavior Per Game	1.73	0.20	0.49	0.21	1.48	43
Child Learning Efficiency						
Percent of Trials with RC Behavior	8.70	0.93	4.99	1.00	0.86	31
Average RC Behavior Per Minute	0.34	0.08	0.06	0.08	4.87	50

Notes. The average slopes are adjusted for the two non-time varying covariates (child DQ and parent education). The Cohen's *d* effect sizes for the Table 3 contrasts were used to compute the improvement indices (Neill, 2006).

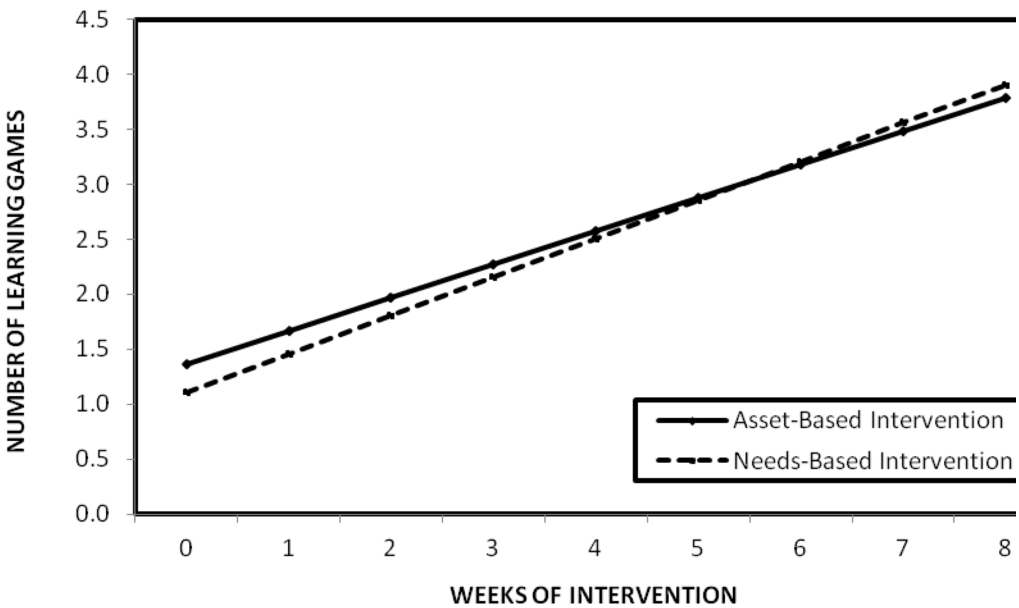

Figure 1. Average number of learning games implemented during each week of intervention

3.2 Child Response-Contingent Behavior

The between intervention group linear trend comparisons for the total number of non-prompted response-contingent behavior and average number of non-prompted response-contingent behavior per game were both associated with statistically significant differences and very large effect sizes (Table 3). In both analyses, the asset-based group demonstrated faster rates of learning compared to the needs-based group (Table 4). The rates of change for both the total number of response-contingent behavior and the average number of response-contingent behavior per game were more than three times greater for the asset-based intervention compared to the needs-based intervention. Both differences were associated with very large between slope differences effect sizes.

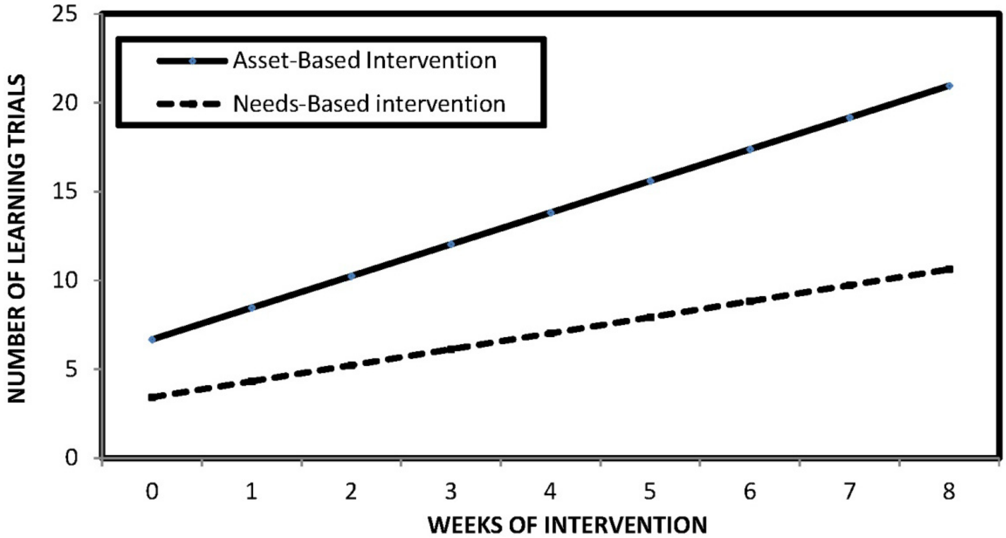

Figure 2. Average number of trials (learning opportunities) afforded the children per game across the eight weeks of intervention

Figure 3 shows the rates of learning for the average number of response-contingent behavior per game for the contrasting intervention approaches. The results show that the asset-based intervention was associated with considerably more rapid child learning compared to the needs-based intervention. Whereas the average number of response contingent behavior per game was 18.31 (SD = 3.33) for the ability-based intervention at the end of the study, the average number of response-contingent behavior was only 4.76 (SD = 2.44) for the needs-based intervention, $t = 19.30$, $df = 69$, $p = .000$, $d = 4.64$.

The between group differences for both learning measures were associated with improvement indices of 43 (Table 4). These indices show the relative effectiveness of the asset-based intervention beyond that associated with the needs-based intervention. The results indicate that the children in the needs-based group would have shown 43% improvement in their rates of learning had they experienced the assed-based rather than the needs-based intervention.

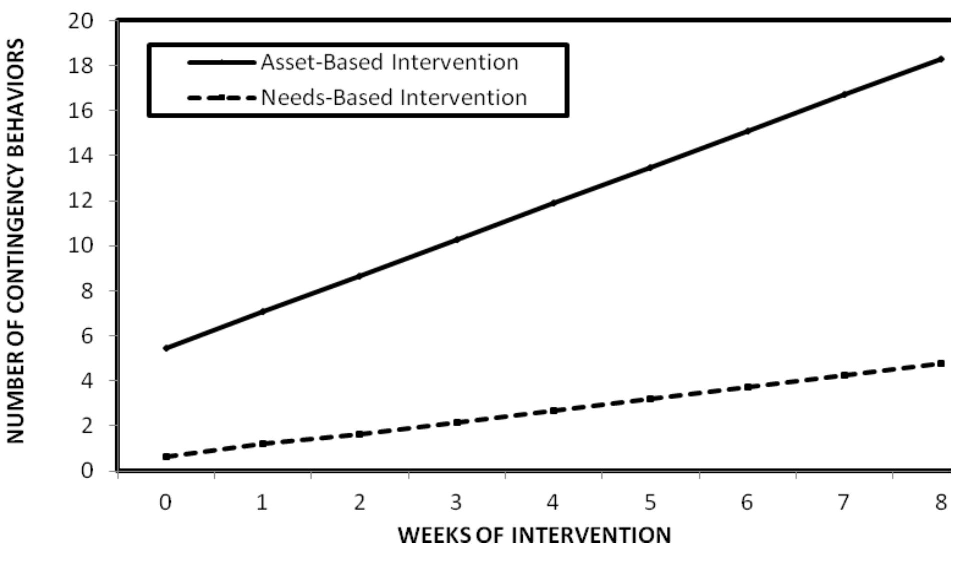

Figure 3. Average number of child response-contingent behavior per game across the eight weeks of intervention

3.3 Child Learning Efficiency

Results showed that the between group differences in the slopes for the percent of response-contingent behavior per number of trials was associated with a large effect size (*d* = .86) and the differences in the average number of response-contingent behavior per minute was also associated with a very large effect size (*d* = 4.87). Both sets of analyses showed that learning efficiency improved more rapidly for the asset-based intervention group compared to the needs-based intervention group (Table 4). At the end of the eight weeks of the intervention, the average percent of trials associated with nonprompted response-contingent behavior was 99.99 (SD = 6.42) for the asset-based intervention compared to 52.36 (SD = 4.78) for the needs-based intervention, $t = 35.03$, $df = 69$, $p = .000$, $d = 8.42$.

Closer inspection of the findings showed a curvilinear rather than a linear relationship for the changes in the percent of trials associated with nonprompted response-contingent behavior and a between slope difference in the rates of change between the contrasting interventions, b = 2.02, $t = 6.85$, $p = .000$, $d = 4.12$. Figure 4 shows the differences in the curvilinear rates of change for the two contrasting interventions. As hypothesized, child response-contingent learning was considerably more efficient for the asset-based intervention compared to the needs-based intervention as evidenced by a more rapid increase in the percent of trials associated with response-contingent behavior during the first three weeks of intervention and a larger and more stable ratio of response-contingent behavior to learning trials during the last three weeks of intervention.

Both learning efficiency measures had improvement indices favoring the asset-based intervention (Table 4). These indices show the relative efficiency of asset-based contingency learning practices beyond those associated with needs-based contingency learning practices. The results, and especially those for the percent of response-contingent behavior per number of learning trials (Figure 4), illustrate the value-added effects of an asset-based approach to early intervention.

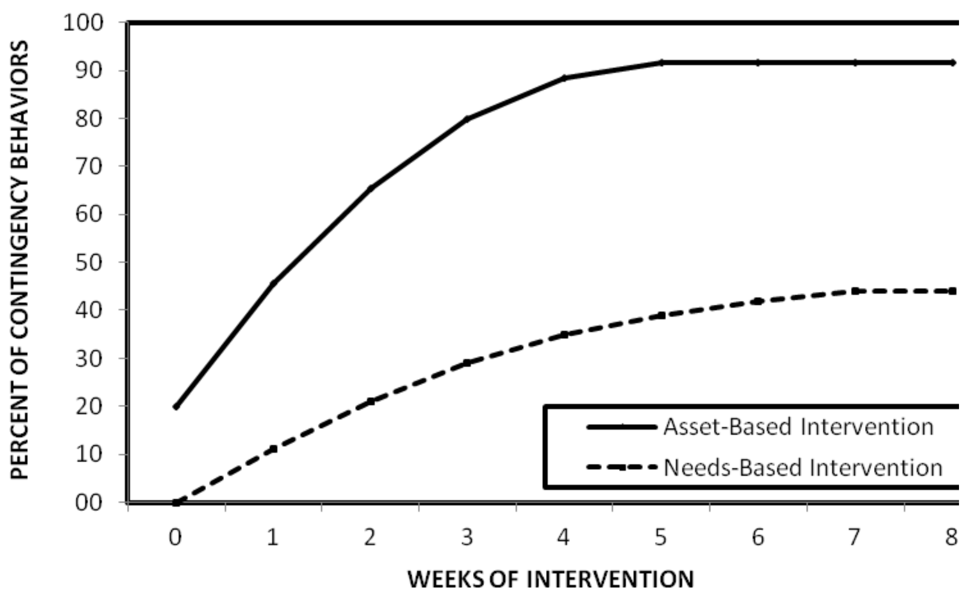

Figure 4. Average percentage of child response-contingent behavior per number of learning trials across the eight weeks of intervention

4. Discussion

Findings showed that the children in the asset-based group were afforded more learning opportunities and demonstrated more response-contingent learning, and the learning games resulted in more efficient child learning, compared to the children in the needs-based group. The results provide support for the four study hypotheses, and highlight the fact that the ways in which child behavior are identified, selected, and used as part of learning games to facilitate acquisition of response-contingent behavior matter a great deal in terms of child learning capacity and efficiency. The results are consistent with Eloff and Ebersohn's (2001) contention that asset-based and needs-based early childhood interventions differ both conceptually and procedurally and in turn differ in their characteristics and consequences.

It is important to note that the effects of the asset-based intervention were considerably more robust than found in earlier studies with children with significant developmental delays or disabilities (e.g., Bailey & Meyerson, 1969; Haskett & Hollar, 1978; O'Brien, Glenn, & Cunningham, 1994; Utley, Duncan, Strain, & Scanlon, 1983) including earlier studies conducted as part of the line of research and practice by the study investigators (e.g., Dunst et al., 1985; Dunst, Raab, Trivette, Parkey et al., 2007; Dunst, Raab et al., 2010; Dunst, Raab, Trivette, Wilson et al., 2007; Raab et al., 2009). We also note that the acquisition and use of response-contingent behavior in the asset-based group was almost immediate and there was no latency to learn as has been the case in other studies of young children with severe developmental delays and multiple disabilities (Hutto, 2007). These findings are most likely the case because the asset-based intervention was conceptualized and implemented from a strengths-based perspective where the children were seen as having existing capabilities as well as the capacity to become more competent. This included the use of existing child behavior as the building blocks for developing their response-contingent capabilities and child-specific reinforcers which was not necessarily the case in previous research where targeted behavior and reinforcers were predominantly investigator or practitioner selected rather than based on existing behavior in a child's repertoire (e.g., Hanson & Hanline, 1985; Sullivan, Laverick, & Lewis, 1995; Watson, Hayes, & Vietze, 1982) including our own research (e.g., Dunst et al., 1985; Laub & Dunst, 1974).

The fact that the children in the needs-based group made some progress deserves comment because the intervention practice used with this group of children was intended to mirror a particular type of early childhood intervention where the results from developmental assessment scales are used to identify behavior for children to learn. This approach to intervention is part of a long standing tradition of using assessment scale results as the source of information for identifying behavior that early childhood intervention is designed to promote or facilitate but which children do not yet use in an intentional or functional manner (see especially Dunst, Snyder, & Mankinen, 1988). As stated by Eloff and Ebersöhn (2001), "Even though many proponents of the needs-based approach ... [include assessment] of strengths and weaknesses, practice serves to emphasize weaknesses" (p. 149).

The learning demonstrated by the children in the needs-based group is typical for the type of intervention that was used with the children in the study described in this paper (Hutto, 2007). In fact, infants and toddlers with significant developmental delays and young children with multiple disabilities often demonstrate at least some learning as a result of any number of early childhood intervention practices (see e.g., Dunst, 1986). In the absence of the findings from the children in the asset-based group, one might conclude that the needs-based intervention was about as effective as would be expected with children with significant delays and disabilities. The results show that the needs-based intervention was not nearly as effective as the asset-based intervention as evidenced by the results reported in the paper.

The practical significance of the asset-based approach to response-contingent learning was demonstrated by the magnitudes of the improvement indices for 5 of the 6 learning measures (Table 4). The magnitudes of the improvement indices are larger than those reported for other types of early childhood interventions (e.g., Feil, Frey, Walker, & Forness, 2015; What Works Clearinghouse, 2006), and illustrate the value-added effects of asset-based compared to needs-based approaches to response-contingent intervention.

The differences between asset-based and needs-based practices perhaps is best illustrated by noting that an asset-based approach is part of a family of early childhood intervention practices that emphasize child and family strengths as the behavior used to promote participation in everyday activities to provide opportunities to interact with people and material in ways that not only strengthen existing capabilities but also provide contexts for acquiring new skills (e.g., Campbell, Milbourne, & Silverman, 2001; Granlund, Wilder, & Almqvist, 2013; Green, McAllister, & Tarte, 2004; Swanson, Raab, & Dunst, 2011). Accordingly, the learning games for the asset-based group were the sources of child learning opportunities, and existing non-instrumental child behavior were the strengths (abilities) used to elicit reinforcing environmental consequences and promote child acquisition of instrumental and functional behavioral capabilities as was found in the study described in this paper.

4.1 Implications for Practice

We conclude by noting the implications for changing and improving early childhood intervention practices. Young children with significant delays and disabilities more often than not are seen as lacking foundational skills that lead to identification of child behavior, which the children do not or cannot easily produce (i.e., missing skills). Results reported in this paper and elsewhere (e.g., Dunst, Raab, Wilson et al., 2007; O'Brien et al., 1994) indicate that intervention practices for young children with significant developmental delays or multiple disabilities could be improved considerably by (1) changing the ways in which target behavior are selected, (2) using assessment procedures for identifying child-specific reinforcers, and (3) arranging learning opportunities (e.g., learning games) to facilitate child use of behavior to produce or elicit reinforcing environmental consequences (see e.g., Dunst, 1981; Lancioni, 1980; Sullivan & Lewis, 1990; Watson et al., 1982; for descriptions of response-contingent learning interventions).

An asset-based approach to child response-contingent learning starts by identifying behavior that children already demonstrate (intentionally or non-intentionally) and using these behavior as the building blocks to promote acquisition of contingency behavior (Eloff & Ebersöhn, 2001; Wilson et al., 2004). Response-contingent learning is more likely to occur if child-specific rather than *a priori* selected reinforcers are used as the consequence of child behavioral responses (Crawford & Schuster, 1993; Piazza, Fisher, Hagopian, Bowman, & Toole, 1996). The experiences (e.g., learning games) afforded children to use behavior to produce or elicit reinforcing consequences need to be ones that have a high probability of occurring as frequently and as often as possible to provide lots of opportunities to be associated with positive effects (Dunst, Raab, Trivette, Wilson et al., 2007; Dunst, Trivette, Raab, & Masiello, 2008). This is the case, in part, because young children with delays or disabilities often take longer to learn contingency detection (Tarabulsy et al., 1996) and awareness (Watson, 1966), and the more children are afforded learning opportunities with developmentally enhancing characteristics, the more likely they will learn that they are the agents of environmental effects.

Acknowledgment

The research described in this paper was supported, in part, by the U.S. Department of Education, Institute of Education Sciences (Grant # R324A110183). The opinions expressed, however, are those of the authors and do not necessarily represent the opinions or official position of the Department or Institute.

References

Allen, K. E., & Cowdery, G. E. (2015). *Exceptional child: Inclusion in early childhood education* (8th ed.). Stanford, CT: Wadsworth Cengage Learning.

Bailey, J., & Meyerson, L. (1969). Vibration as a reinforcer with a profoundly retarded child. *Journal of Applied Behavior Analysis*, *2*, 135-137. https://dx.doi.org/10.1901/jaba.1969.2-135

Bricker, D., Capt, B., & Pretti-Frontczak, K. (Eds.). (2002). *Assessment, evaluation, and programming system for infants and children: Vol. 2. Test: Birth to three years and three to six years* (2nd ed.). Baltimore, MD: Brookes.

Campbell, P. H., Milbourne, S. A., & Silverman, C. (2001). Strengths-based child portfolios: A professional development activity to alter perspectives of children with special needs. *Topics in Early Childhood Special Education*, *21*, 152-161. https://dx.doi.org/10.1177/027112140102100303

Crawford, M. R., & Schuster, J. W. (1993). Using microswitches to teach toy use. *Journal of Developmental and Physical Disabilities*, *5*, 349-368. https://dx.doi.org/10.1007/BF01046391

Dunst, C. J. (1981). *Infant learning: A cognitive-linguistic intervention strategy*. Allen, TX: DLM.

Dunst, C. J. (1986). Overview of the efficacy of early intervention programs. In L. Bickman, & D. Weatherford (Eds.), *Evaluating early intervention programs for severely handicapped children and their families* (pp. 79-147). Austin, TX: PRO-ED.

Dunst, C. J., & Trivette, C. M. (2009). Capacity-building family systems intervention practices. *Journal of Family Social Work*, *12*(2), 119-143. https://dx.doi.org/10.1080/10522150802713322

Dunst, C. J., Cushing, P. J., & Vance, S. D. (1985). Response-contingent learning in profoundly handicapped infants: A social systems perspective. *Analysis and Intervention in Developmental Disabilities*, *5*, 33-47. https://dx.doi.org/10.1016/S0270-4684(85)80004-5

Dunst, C. J., Gorman, E., & Hamby, D. W. (2010). Effects of adult verbal and vocal contingent responsiveness on increases in infant vocalizations. *CELLreviews*, *3*(1), 1-11.

Dunst, C. J., Herter, S., & Shields, H. (2000). Interest-based natural learning opportunities. In S. Sandall, & M. Ostrosky (Eds.), *Natural environments and inclusion* (pp. 37-48). Longmont, CO: Sopris West.

Dunst, C. J., Raab, M., Trivette, C. M., Parkey, C., Gatens, M., Wilson, L. L., … Hamby, D. W. (2007). Child and adult social-emotional benefits of response-contingent child learning opportunities. *Journal of Early and Intensive Behavior Intervention*, *4*, 379-391. https://dx.doi.org/10.1037/h0100380

Dunst, C. J., Raab, M., Trivette, C. M., Wilson, L. L., Hamby, D. W., & Parkey, C. (2010). Extended child and caregiver benefits of behavior-based child contingency learning games. *Intellectual and Developmental Disabilities*, *48*, 259-270. https://dx.doi.org/10.1352/1934-9556-48.4.259

Dunst, C. J., Raab, M., Trivette, C. M., Wilson, L. L., Hamby, D. W., Parkey, C., … French, J. (2007). Characteristics of operant learning games associated with optimal child and adult social-emotional consequences. *International Journal of Special Education*, *22*(3), 13-24. Retrieved from http://www.internationaljournalofspecialeducation.com/.

Dunst, C. J., Raab, M., Wilson, L. L., & Parkey, C. (2007). Relative efficiency of response-contingent and response-independent stimulation on child learning and concomitant behavior. *Behavior Analyst Today*, *8*, 226-236. https://dx.doi.org/10.1037/h0100615

Dunst, C. J., Snyder, S. W., & Mankinen, M. (1988). Efficacy of early intervention. In M. Wang, H. Walberg, & M. Reynolds (Eds.), *Handbook of special education: Research and practice: Vol. 3. Low incidence conditions* (pp. 259-294). Oxford, England: Pergamon Press.

Dunst, C. J., Storck, A. J., Hutto, M. D., & Snyder, D. (2007). *Relative effectiveness of episodic and conjugate reinforcement on child operant learning*. Asheville, NC: Winterberry Press.

Dunst, C. J., Trivette, C. M., & Hamby, D. W. (2010). Meta-analysis of the effectiveness of four adult learning methods and strategies. *International Journal of Continuing Education and Lifelong Learning*, *3*(1), 91-112.

Dunst, C. J., Trivette, C. M., Raab, M., & Masiello, T. (2008). Early child contingency learning and detection: Research evidence and implications for practice. *Exceptionality*, *16*, 4-17. https://dx.doi.org/10.1080/09362830701796743

Eloff, I., & de Wet, A. (2009). Opting for assets to enrich pre-school learning. *Early Child Development and Care*, *179*(3), 247-257. https://dx.doi.org/10.1080/03004430601156887

Eloff, I., & Ebersöhn, L. (2001). The implications of an asset-based approach to early intervention. *Perspectives in Education*, *19*(3), 147-157.

Feil, E. G., Frey, A. J., Walker, H. M., & Forness, S. R. (2015). The efficacy of a home-school intervention for preschoolers with challenging behaviors: A randomized controlled trial of Preschool First Step to Success. *Journal of Early Intervention*, *36*(3), 1-20.

Feingold, A. (2009). Effect sizes for growth-modeling analysis for controlled clinical trials in the same metric as for classical analysis. *Psychological Methods*, *14*(1), 43-53. https://dx.doi.org/10.1037/a0014699

Fisher, W. W., Piazza, C. C., Bowman, L. G., & Amari, A. (1996). Integrating caregiver report with a systematic choice assessment to enhance reinforcer identification. *American Journal of Mental Retardation*, *101*, 15-25.

Garwood, S. G. (1979). Special education and child development: A new perspective. In S. G. Garwood, P. Alberto, R. F. DuBose, B. A. Hare, J. M. Hare, J. Kauffman, … D. A. Page (Eds.), *Educating young handicapped children: A developmental approach* (pp. 3-37). Germantown, MD: Aspen Systems.

Granlund, M., Wilder, J., & Almqvist, L. (2013). Severe multiple disabilities. In M. L. Wehmeyer (Ed.), *The Oxford handbook of positive psychology and disability* (pp. 452-474). New York: Oxford University Press. https://dx.doi.org/10.1093/oxfordhb/9780195398786.013.013.0028

Green, B. L., McAllister, C. L., & Tarte, J. M. (2004). The Strengths-Based Practices Inventory: A tool for measuring strengths-based service delivery in early childhood and family support programs. *Families in Society*, *85*, 327-334. https://dx.doi.org/10.1606/1044-3894.1493

Gunnar, M. R. (1980). Contingent stimulation: A review of its role in early development. In S. Levine, & H. Ursin (Eds.), *Coping and health* (pp. 101-119). New York: Springer. https://dx.doi.org/10.1007/978-1-4684-1042-6_6

Hanson, M. J., & Hanline, M. F. (1985). An analysis of response-contingent learning experiences for young children. *Journal of the Association for Persons with Severe Handicaps*, *10*, 31-40. https://dx.doi.org/10.1177/154079698501000104

Hartung, P. J. (2015). Life design in childhood: Antecedents and advancement. In L. Nota, & J. Rossier (Eds.), *Handbook of life design: From practice to theory and from theory to practice* (pp. 89-102). Boston: Hogrefe Publishing.

Haskett, J., & Hollar, W. D. (1978). Sensory reinforcement and contingency awareness of profoundly retarded children. *American Journal of Mental Deficiency*, *83*, 60-68.

Hebbeler, K., Spiker, D., Bailey, D., Scarborough, A., Mallik, S., Simeonsson, R., … Nelson, L. (2007). *Early intervention for infants and toddlers with disabilities and their families: Participants, services, and outcomes: Final Report of the National Early Intervention Longitudinal Study (NEILS)*. Menlo Park, CA: SRI International. Retreived from http://www.sri.com/neils/pdfs/NEILS_Report_02_07_Final2.pdf

Hollingshead, A. B. (1975). *Four factor index of social status* (Unpublished manuscript). Yale University, Department of Sociology, New Haven, CT.

Hulsebus, R. C. (1973). Operant conditioning of infant behavior: A review. *Advances in Child Development and Behavior*, *8*, 111-158. https://dx.doi.org/10.1016/S0065-2407(08)60494-2

Hutto, M. D. (2007). *Latency to learn in contingency studies of young children with disabilities or developmental delays*. Asheville, NC: Winterberry Press.

Lancioni, G. E. (1980). Infant operant conditioning and its implications for early intervention. *Psychological Bulletin*, *88*, 516-534. https://dx.doi.org/10.1037/0033-2909.88.2.516

Lancioni, G. E., O'Reilly, M. F., Oliva, D., & Coppa, M. M. (2001). A microswitch for vocalization responses to foster environmental control in children with multiple disabilities. *Journal of Intellectual Disability Research*, *45*(3), 271-275. https://dx.doi.org/10.1046/j.1365-2788.2001.00323.x

Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Oliva, D., & Groeneweg, J. (2005). Enabling a girl with multiple disabilities to control her favorite stimuli through vocalization and a dual-microphone microswitch. *Journal of Visual Impairment & Blindness*, *99*(3).

Laub, K. W., & Dunst, C. J. (1974, May). *Effects of imitative and non-imitative adult vocalizations on a developmentally delayed infant's rate of vocalization*. Paper presented at the annual meeting of the North Carolina Speech and Hearing Association, Durham.

Leffert, N., Benson, P. L., & Roehlkepartain, J. L. (1997). *Starting out right: Developmental assets for children*. Minneapolis, MN: Search Institute.

Lipsey, M. W., Puzio, K., Yun, C., Hebert, M. A., Steinka-Fry, K., Cole, M. W., … Busick, M. D. (2012). *Translating the statistical representation of the effects of education interventions into more readily interpretable forms*. Washington, DC: U. S. Department of Education, Institute of Education Sciences, National Center for Special Education Research. Retrieved from http://files.eric.ed.gov/fulltext/ED537446.pdf

Lipsitt, L. P. (1969). Learning capacities of the human infant. In R. J. Robinson (Ed.), *Brain and early behaviour development in the fetus and infant: Proceedings of a C.A.S.D.S. Study Group on "brain mechanisms of early behavioural development"* (pp. 227-249). London: Academic Press.

Maier, H. W. (1978). *Three theories of child development* (3rd ed.). New York: Harper & Row.

Mullen, E. M. (1995). *Mullen scales of early learning: AGS edition*. Circle Pines, MN: American Guidance Service.

Neill, J. (2006). ZCalc: *For converting a standardised mean effect size (ES) into a z score and in expressing various ways* (Version 0.1). Retrieved from http://www.wilderdom.com/research/ZCalc.xls

New, R. S., & Cochran, M. M. (2007). *Early childhood education: An international encyclopedia* (Vol. 1). Westport, CT: Praeger Publishers.

O'Brien, Y., Glenn, S., & Cunningham, C. (1994). Contingency awareness in infants and children with severe and profound learning disabilities. *International Journal of Disability, Development, and Education*, *41*, 231-243. https://dx.doi.org/10.1080/0156655940410307

Panitch, M. (1993). *A literature review of early intervention*. North York, Ontario, Canada: L'Institut Roeher, York University. Retrieved from http://eric.ed.gov/?id=ED390199

Piaget, J. (1952). *The origins of intelligence in children* (M. Cook, Trans.). New York, NY: Norton. https://dx.doi.org/10.1037/11494-000

Piazza, C. C., Fisher, W. W., Hagopian, L. P., Bowman, L. G., & Toole, L. (1996). Using a choice assessment to predict reinforcer effectiveness. *Journal of Applied Behavior Analysis*, *29*, 1-9. https://dx.doi.org/10.1901/jaba.1996.29-1

Raab, M., Dunst, C. J., & Hamby, D. W. (2016). Effectiveness of contrasting approaches to response-contingent learning among children with significant developmental delays and disabilities. *Research and Practice for Persons with Severe Disabilities*, *41*(1), 36-51. https://dx.doi.org/10.1177/1540796915621189

Raab, M., Dunst, C. J., & Trivette, C. M. (2013). Adult learning procedure for promoting caregiver use of everyday child language learning practices. *Everyday Child Language Learning Reports*, *3*, 1-9.

Raab, M., Dunst, C. J., Wilson, L. L., & Parkey, C. (2009). Early contingency learning and child and teacher concomitant social-emotional behavior. *International Journal of Early Childhood Special Education*, *1*(1), 1-14.

Raudenbush, S. W., Bryk, A. S., Cheong, Y. F., Congdon, R. T., & du Toit, M. (2011). *HLM 7: Hierarchical linear and nonlinear modeling*. Lincolnwood, IL: Scientific Software International.

Reese, H. W., & Overton, W. F. (1980). Models, methods, and ethics of intervention. In R. R. Turner, & H. W. Reese (Eds.), *Life-span developmental psychology: Intervention* (pp. 29-47). New York, NY: Academic Press. https://dx.doi.org/10.1016/B978-0-12-704150-6.50008-8

Rovee-Collier, C. K., & Gekoski, M. J. (1979). The economics of infancy: A review of conjugate reinforcement. *Advances in Child Development and Behavior*, *13*, 195-255. https://dx.doi.org/10.1016/S0065-2407(08)60348-1

Sullivan, M. W., & Lewis, M. (1990). Contingency intervention: A program portrait. *Journal of Early Intervention*, *14*, 367-375. https://dx.doi.org/10.1177/105381519001400408

Sullivan, M. W., Laverick, D. H., & Lewis, M. (1995). Fostering environmental control in a young child with Rett syndrome: A case study. *Journal of Autism and Developmental Disorders*, *25*, 215-221. https://dx.doi.org/10.1007/BF02178506

Swanson, J., Raab, M., & Dunst, C. J. (2011). Strengthening family capacity to provide young children everyday natural learning opportunities. *Journal of Early Childhood Research*, *9*, 66-80. https://dx.doi.org/10.1177/1476718X10368588

Tarabulsy, G. M., Tessier, R., & Kappas, A. (1996). Contingency detection and the contingent organization of behavior in interactions: Implications for socioemotional development in infancy. *Psychological Bulletin*, *120*, 25-41. https://dx.doi.org/10.1037/0033-2909.120.1.25

Turner, R. R., & Reese, H. W. (Eds.). (1980). *Life-span developmental psychology: Intervention*. New York, NY: Academic Press.

Utley, B., Duncan, D., Strain, P., & Scanlon, K. (1983). Effects of contingent and noncontingent visual stimulation on visual fixation in multiply handicapped children. *Journal of the Association for Persons with Severe Handicaps*, *8*(3), 29-42. https://dx.doi.org/10.1177/154079698300800305

Watson, J. S. (1966). The development and generalization of "contingency awareness" in early infancy: Some hypotheses. *Merrill-Palmer Quarterly*, *12*, 123-135.

Watson, J. S., & Ramey, C. T. (1972). Reactions to response-contingent stimulation in early infancy. *Merrill-Palmer Quarterly*, *18*, 219-227.

Watson, J. S., Hayes, L. A., & Vietze, P. (1982). Response-contingent stimulation as a treatment for developmental failure in infancy. *Journal of Applied Developmental Psychology*, *3*, 191-203. https://dx.doi.org/10.1016/0193-3973(82)90015-6

What Works Clearinghouse. (2006). *Phonological awareness training plus letter knowledge training*. Washington, DC: U. S. Department of Education, Institute of Education Sciences. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/intervention_reports/WWC_PAT_Letter_Knowledge_122806.pdf

What Works Clearinghouse. (2014). *What Works Clearinghouse procedures and standards handbook*. Washington, DC: U. S. Department of Education, Institute of Education Sciences. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/reference_resources/wwc_procedures_v3_0_standards_handbook.pdf

What Works Clearinghouse. (n.d.-a). *WWC standards brief: Attrition standard*. Washington, DC: U. S. Department of Education, Institute of Education Sciences. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/reference_resources/wwc_brief_attrition_080715.pdf

What Works Clearinghouse. (n.d.-b). *WWC standards brief: Baseline equivalence*. Washington, DC: U. S. Department of Education, Institute of Education Sciences. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/reference_resources/wwc_brief_baseline_080715.pdf.

Williams, B. A. (2001). The critical dimensions of the response-reinforcer contingency. *Behavioural Processes*, *54*, 111-126. https://dx.doi.org/10.1016/S0376-6357(01)00153-X

Wilson, L. L., Mott, D. W., & Batman, D. (2004). The Asset-Based Context Matrix: A tool for assessing children's learning opportunities and participation in natural environments. *Topics in Early Childhood Special Education*, *24*, 110-120. https://dx.doi.org/10.1177/02711214040240020601

Woodhead, M. (2006). Changing perspectives on early childhood: Theory, research and policy. *International Journal of Equity and Innovation in Early Childhood*, *4*(2), 1-43.