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Effectiveness of Contrasting Approaches to Response-Contingent Learning Among Children With Significant Developmental Delays and Disabilities

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Abstract

Findings from a randomized controlled design study of an ability-based versus needs-based approach to response-contingent learning among children with significant developmental delays and disabilities who did not use instrumental behavior to produce reinforcing consequences are reported. The ability-based intervention and needs-based intervention differed in terms of how child behavior was identified and used to elicit reinforcing consequences as part of response-contingent learning games implemented by the children's parents. For the ability-based group, behavior that children were capable of producing, but did not yet use intentionally, was identified and used to elicit reinforcing consequences. For the needs-based group, behavior children did not yet produce, but were expected to learn, was identified through a developmental assessment and used to elicit reinforcing consequences. Results showed that the children in the ability-based group had more learning opportunities, acquired more response-contingent behavior, and demonstrated more efficient learning compared with children in the needs-based group.

Keywords

ability-based, needs-based, early child intervention, response-contingent behavior, child learning

One of the most important instrumental skills young children with (Dunst, Cushing, & Vance, 1985; Gazdag & Warren, 2000) and without (e.g., Lewis, Sullivan, & Brooks-Gunn, 1985; Rovee-Collier & Capatides, 1979) delays or disabilities learn early in life is the ability to use social and nonsocial behavior to produce interesting or reinforcing environmental consequences (Bower, 1997). This type of instrumental learning was described by Watson and Ramey (1972) as response-contingent stimulation because an environmental effect (stimulation) is contingent on a child's behavioral response, and by Piaget (1952), as secondary circular reactions where a child's repeated actions on the social and nonsocial environment result in interesting consequences. According to Gunnar (1980), this type of learning is important because contingency experiences provide young children with opportunities to learn to control environmental events.

Research reviews of studies investigating response-contingent learning indicate that young children acquire the ability to use vocalizations, smiling, visual attention, arm and leg movements, head turns, and other behavior to produce environmental consequences as young as 3 to 4 months of age (e.g., Dunst, 2007; Dunst, Gorman, & Hamby, 2010; Hulsebus, 1973; Lipsitt, 1969, 1971; Rovee-Collier & Gekoski, 1979). Results from studies in these reviews indicate that the reactions of young children with and without delays

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or disabilities to contingent stimulation are much the same but that children with delays or disabilities often take longer to learn to detect contingencies (Dunst, Trivette, Raab, & Masiello, 2008; O'Brien, Glenn, & Cunningham, 1994) and therefore demonstrate a latency-to-learn compared with their counterparts without disabilities (Hutto, 2007).

A number of researchers have developed early childhood intervention practices specifically designed to promote response-contingent learning among young children with significant developmental delays and disabilities (e.g., Lancioni, 1980; Ramey, Starr, Pallas, Whitten, & Reed, 1975; Sullivan & Lewis, 1990). Early childhood intervention for these children not only encompass practices for infants and toddlers birth to 3 years of age but also include interventions with older children who are functioning developmentally at much younger ages (e.g., 3 or 4 months).

Incorporating response-contingent practices into routine early childhood intervention has been done in either of two ways: (a) promoting children's intentional use of behavior in a child's repertoire but not used to produce environmental consequences, or (b) promoting use of behavior that a child is not able to produce to facilitate acquisition of that behavior. Eloff and Ebersöhn (2001) described these contrasting types of practices as asset-based and needs-based approaches to early childhood intervention, respectively. The two approaches constitute different paradigms as part of conceptualizing and operationalizing early childhood intervention practices (Dunst, 2000).

Asset-based approaches to early childhood intervention use existing child behavior (strengths, abilities, interests) as the building blocks for promoting acquisition of instrumental and functional behavior (Campbell, Milbourne, & Silverman, 2001; Wilson, Mott, & Batman, 2004). Asset-based intervention is premised on the supposition that human growth and development are best facilitated when existing behavioral competencies are changed or modified as a result of new or challenging learning opportunities. Lap games such as peek-a-boo where a child's interest in interacting with a parent is facilitated by the child using his or her existing ability (e.g., grasping action) to remove a cloth placed over the child's face is an example of an asset-based learning activity (Hodapp & Goldfield, 1983).

Needs-based approaches to early childhood intervention focus on promoting acquisition of behavior that is considered needed but which are missing skills. Needs-based intervention is premised on the belief that foundational behavior not in a person's repertoire needs to be targeted and taught using practices intended to promote use of the behavior. As noted by Allen and Cowdery (2015) and New and Cochran (2007), this approach to early childhood intervention focuses on identifying delayed or missing skills and then intervening to teach or facilitate children's acquisition of those skills.

The needs-based approach is part of a long-standing tradition of using developmental test results to identify behavior to target intervention outcomes (Dunst, 1986; Dunst, Snyder, & Mankinen, 1988). Ludlow (1987), as part of describing how developmental test results are used to identify the targets for early childhood intervention, noted that this typically involves identification of delays or missing skills and interventions aimed at enhancing child acquisition of those skills. In contrast, the ability- or asset-based approach presumes that all children have existing behavior capabilities as well as the capacity to become more competent, and that with the use of competency strengthening learning experiences, can develop instrumental and functional behavior (Wilson, 2006). This approach to early childhood intervention uses children's interests, preferences, strengths, and other abilities as personal factors for promoting child learning and development (e.g., Campbell et al., 2001; Dunst, Herter, & Shields, 2000; Moss, 2006).

Dunst, Raab, and their colleagues, as part of a line of research and practice on asset-, strengths-, and interest-based early childhood intervention practices, have extensively investigated the characteristics and consequences of ability-based response-contingent learning among children with significant developmental delays and multiple disabilities (Dunst, Raab, Trivette, Parkey, et al., 2007; Dunst, Raab, Trivette, Wilson, et al., 2007; Raab, Dunst, Wilson, & Parkey, 2009). The majority of the children in these studies were between 3 and 5 years of age but functioning developmentally between 1 and 6 months of age. The children were first observed using an investigator-developed recording form to identify behavior the children could produce but were not using intentionally to elicit environmental consequences. Response-contingent learning games were developed in collaboration with either the children's parents or teachers where child behavior resulted in interesting or reinforcing consequences (e.g., leg kicks producing movement of a mobile by

means of a ribbon attached to the child's ankle and the mobile). Results from these studies showed that the majority of children increased their rates of instrumental behavior after only a dozen or so learning opportunities and that it was not unusual to find 85% or more trials resulting in child behavior producing reinforcing consequences after playing as few as four or five learning games.

Early in this line of research and practice, the investigators noted that as the children became more proficient and competent, the parents and teachers afforded them more learning opportunities and often became creative in terms of developing new learning games for the children. This was correlated with parent and teacher comments about the benefits of the learning games and observed changes in the children's capabilities, and by noting the differences in the ability-based approach to early childhood intervention compared with the interventions the children had been receiving (Dunst, Raab, Trivette, Parkey, et al., 2007; Dunst, Raab, Trivette, Wilson, et al., 2007; Raab et al., 2009). This was ascertained by Dunst, Raab, Wilson, and Parkey (2007) in a study comparing the efficiency of response-contingent learning games compared with interventions not involving contingency experiences. Results showed that the learning games were considerably more efficient in affecting changes in child behavior competence compared with the interventions that were conducted prior to introducing the response-contingent learning opportunities.

The purpose of the study described in this article was to compare the ability-based versus needs-based approach with response-contingent learning among children with significant delays and disabilities to determine whether, in fact, the two approaches differ in terms of their characteristics and consequences. The study is a randomized controlled trial that includes different measures of child learning opportunities, child response-contingent learning, and child learning efficiency. The four hypotheses of the study were as follows:

Hypothesis 1: Children in the ability-based group will be afforded more learning opportunities (number of games and number of learning trials per game) compared with the children in the needs-based group.
Hypothesis 2: Children in the ability-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 with the children in the needs-based group.
Hypothesis 3: The response-contingent learning opportunities afforded to the children in the ability-based group will result in more efficient learning (percent of response-contingent behavior per number of trials and average number of response-contingent behavior per minute) compared with the children in the needs-based group.
Hypothesis 4: The rates of change on the different child learning measures will increase more rapidly among the children in the ability-based group compared with the children in the needs-based group.

The results reported in this article are for children who completed 8 weeks of either of the two approaches to intervention at the time this research report was prepared, and constitute approximately half of the sample that will eventually experience either of the two types of response-contingent learning. Early reporting was indicated based on preliminary data analysis suggesting immediate and sustained differences between the two groups of children on a number of learning measures. As noted by Estabrooks, Teare, and Norton (2012), early reporting is warranted when preliminary findings are particularly robust and results have the potential of altering "business-as-usual" in favor of more effective practices.

Method

Participants

The participants were 48 children (27 boys and 21 girls) birth to 6 years of age and their parents or other primary caregivers. The children were recruited from early intervention programs, preschool programs, hospitals, specialty clinics, physician practices, and parent and disability organizations in three states in 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.,

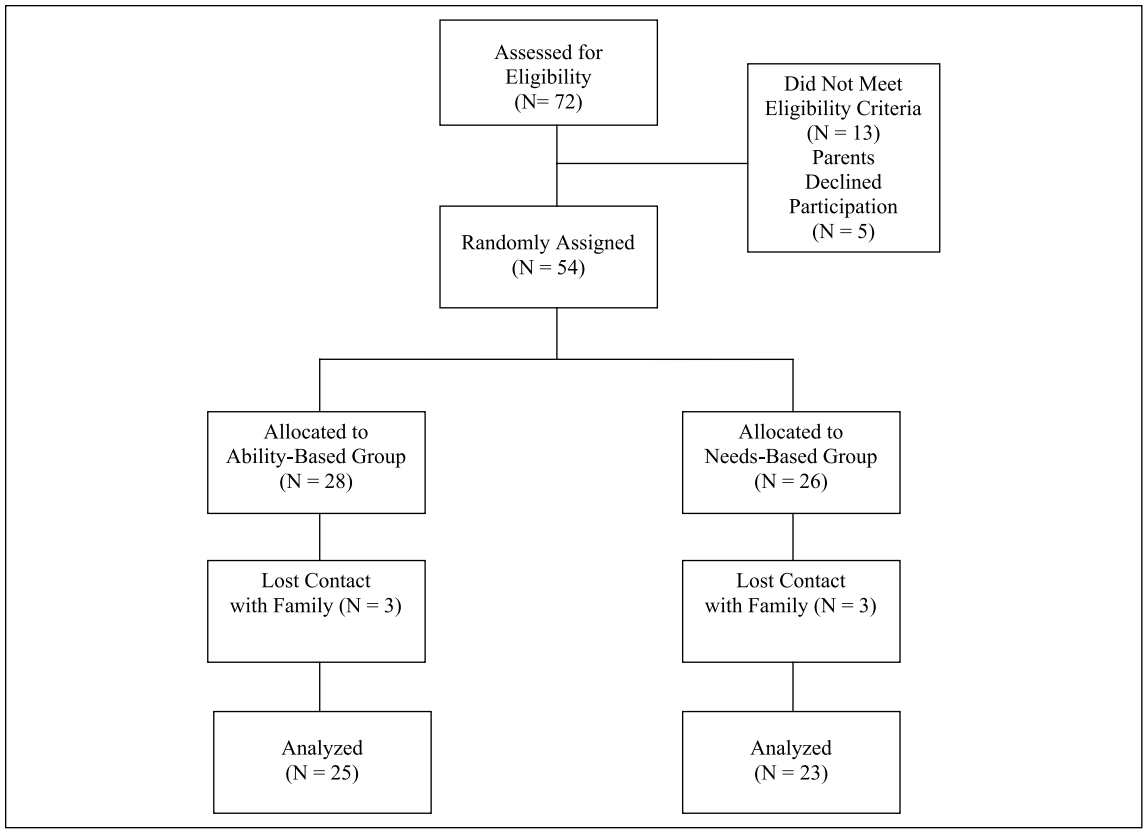

Figure 1. Flow diagram for assignment of children meeting the study eligibility criteria to the two intervention groups.

congenital anomalies or genetic disorders), severe or profound 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 intraventricular hemorrhaging); were functioning below a 6- to 8-month age level of development; and were not yet demonstrating intentional use of behavior to produce interesting or reinforcing environmental consequences. Children who met the eligibility criteria were randomly assigned to either the ability-based or needs-based intervention groups. Figure 1 shows the flowchart of how many children were referred to the study thus far, the number of children who did and did not meet the eligibility criteria, the number of children lost to attrition and the reasons for not completing the intervention, and the number of children who completed the intervention.

The Mullen (1995) *Scales of Early Learning* were administered to each child at the beginning of the study. The children were, on average, 20 months of age (*SD* = 12) but functioning developmentally, on average, at only 5 months of age (*SD* = 3). Three fourths of the children had a Mullen Subscale *T* Score of 20, which is the minimum score attainable, and represents a score of three or more standard deviations below a mean of 50. Ninety percent of the children had subscale *T* Scores of two or more standard deviations below the mean.

Inasmuch as the majority of the children had a subscale *T* Score of 20, the children's developmental quotients (DQ) were estimated by dividing each child's developmental age by his or her chronological age and multiplying the result by 100. Eighty percent of the children had DQs three or more standard deviations below the mean, and 54% had DQs four 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 and developmental ages, DQs, Mullen's Early Learning Composite Score, and the Mullen Subscale *T* Scores were very much

Table 1. Characteristics of the Children and Parents at Entry Into the Study.

Background measures	Ability group		Needs group			
	M	*SD*	*M*	*SD*	*t* test	*p* value
Child characteristics						
Chronological age (months)	20.52	14.46	19.39	8.42	0.33	.7405
Developmental age (months)	5.13	3.31	4.98	2.98	0.16	.8736
Developmental quotient[a]	38.86	27.44	32.31	21.05	0.93	.3556
Mullen Early Learning Composite[b]	58.12	13.39	52.30	6.38	1.95	.0599
Mullen Gross Motor *T* Score[c]	23.13	7.15	23.87	8.20	0.33	.7461
Mullen Visual Reception *T* Score[c]	25.12	8.61	22.35	4.67	1.40	.1694
Mullen Fine Motor *T* Score[c]	25.24	8.15	21.87	4.40	1.80	.0797
Mullen Receptive Language *T* Score[c]	26.20	9.84	22.04	4.71	1.89	.0671
Mullen Expressive Language *T* Score[c]	27.56	10.72	24.52	8.26	1.11	.2752
Parent characteristics						
Parents' age (years)	34.58	7.12	31.73	7.27	1.30	.2000
Parents' education (years)	14.17	1.66	13.52	1.25	1.45	.1540
Family socioeconomic status[d]	35.82	15.95	32.55	9.17	0.83	.4130

[a]Computed as Child Developmental Age divided by Child Chronological Age × 100.
[b]Standard Score: *M* = 100, *SD* = 15.
[c]Standard *T* Scores: *M* = 50, *SD* = 10.
[d]Hollingshead (1975).

the same in both groups as indicated by no statistically significant between-group differences. There were no significant between-group differences in either the parents' ages or years of formal education or family socioeconomic status (Hollingshead, 1975). There were also no statistically significant differences in the percentages of children with different diagnoses in the two intervention groups, $\chi^2 = 6.26$, $df = 3$, $p = .1000$, nor were there any differences in the percentages of children in the two groups who were receiving special instruction/special education ($\chi^2 = .001$, $df = 1$, $p = .979$), speech therapy ($\chi^2 = .708$, $df = 1$, $p = .400$), occupational therapy ($\chi^2 = 2.09$, $df = 1$, $p = .148$), physical therapy ($\chi^2 = .31$, $df = 1$, $p = .575$), nursing ($\chi^2 = .27$, $df = 1$, $p = .605$), vision ($\chi^2 = .03$, $df = 1$, $p = .857$), or other services ($\chi^2 = .08$, $df = 1$, $p = .775$) from other early childhood intervention or therapy programs. These results, taken together, are an indication that randomization resulted in the children and parents in the two intervention groups being more similar than different.

Procedure

Three or four early childhood staff were assigned to implement either the ability-based intervention, which used children's existing behavior capabilities as target behavior as part of response-contingent learning opportunities, or the needs-based intervention, which used behavior children needed to learn as target behavior. The staff 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 did not interact with one another.

Investigator-trained early childhood staff were taught the intervention practices in the respective approaches over a 2-month period of time using an evidence-based adult learning procedure (Dunst & Trivette, 2009). These early childhood staff, in turn, taught parents to use the practices in the families' homes. The adult learning procedure involved staff's active participation in four phases of learning either of the two interventions: (a) acquiring information about and examples of the intervention practices, (b) practicing use of the intervention and evaluating the characteristics and outcomes of their practices, (c) reflecting on their overall understanding and mastery of the practices, and (d) identifying and participating in additional opportunities to learn to use their particular approach to intervention. Staff were introduced to the intervention practices using procedural manuals that were identical for the two intervention groups,

except for descriptions of the methods used to identify target behaviors (see below). Video examples of response-contingent learning opportunities were used both to demonstrate the practices and to provide staff opportunities for using and understanding how the interventions were implemented. Hypothetical examples and role-playing were used to provide staff opportunities to practice the interventions in a manner consistent with the study procedures. A project investigator and staff member used videos of study participants to examine the interventions and provide feedback on an ongoing basis.

The children in both groups were first assessed to identify behavior that the children would use to produce environmental consequences as part of response-contingent learning opportunities (described to the staff and parents as learning games). The two interventions differed only in the procedures for selecting target behavior.

The children in the ability-based group were observed in their homes and their parents queried to identify behavior in the children's repertoires but not used intentionally to produce reinforcing or interesting effects. An investigator-developed checklist was used to record the occurrence and frequency of 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 was selected as target behavior to be used as part of response-contingent learning opportunities. For example, if a child demonstrated back-and-forth head movements while in a supine position, rotating the head to midline to have a blinking light activated, would constitute an ability-based game.

The children in the needs-based group were administered the birth to 3-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 each domain on the scale. The AEPS assesses children's performance in six developmental domains (fine motor, gross motor, adaptive, cognitive, social-communication, and social). Results were used to select different child behavior in each domain as the intervention targets, and response-contingent learning games were used to facilitate acquisition of those behavior targets. For example, if the lack of use of arm movements was identified at a child's ceiling level of performance in the fine motor domain, the movement of a mobile in response to arm movements would constitute a needs-based game. The AEPS was not used as intended by assessment system developers but rather was used simply to identify intervention targets for response-contingent learning opportunities.

Second, as part of the assessments administered to both groups of children, observations and parent interviews were used to identify the people, materials, activities, events, and so forth that elicited or maintained the children's attention to identify child-specific interesting consequences or reinforcers. This was accomplished in the same way in both intervention groups 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 for identifying reinforcers compared with 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 elicit or produce interesting or 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 selected targeted behavior (Tarabulsy, Tessier, & Kappas, 1996).

Intervention staff and the children's parents developed four to six child-specific learning games so that targeted behavior was associated with child-specific reinforcers to increase the children's acquisition of response-contingent behavior. Both social and nonsocial games were developed for each child. Social learning games involved a child's use of a targeted behavior to elicit a social response from the parent (e.g., a parent tickling the child on the tummy each time she turned her head from side to midline). Nonsocial learning games involved a child's use of a targeted behavior to elicit a nonsocial environmental consequence (e.g., a child activating an adapted toy using a microswitch to illuminate a light source).

Parents were taught to implement the learning games by intervention staff using the same adult learning procedure used to train the staff (Dunst & Trivette, 2009). For each game that was developed, staff engaged a parent in completing a *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 considerations (e.g., wait time, types of prompts, etc.). Staff described the key characteristics of a game, demonstrated the use of the game, and then had the parent practice implementing the game. Feedback and guidance were provided as necessary to ensure the parents understood how to implement the learning games in the ways intended. Intervention staff 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 teach the parents how to engage their children in the learning games.

The parents maintained weekly logs, which were used to determine procedural fidelity in terms of the number of games developed for a child compared with the number of games implemented with a child, and the frequency of child participation in the games per week. There were, on average for each child, 2.92 ($SD = 0.99$) different games planned and 2.76 ($SD = 1.08$) games implemented per week, $t = 0.54$, $df = 46$, $p = .5952$. The games were played, on average, 4.45 days per week ($SD = 1.85$). There was no statistically significant difference in the frequency of days per week that the children experienced the games in the two intervention groups, $t = .50$, $df = 46$, $p = .9600$. Results indicated that the groups did not differ in terms of either planned and implemented games or how often the parents used the games with the children.

Dependent Measures

Investigator-developed recording forms were used to code different information about the learning games during the home visits by the intervention staff with the children and their parents. Each recording form included space for recording up to 15 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 interesting consequence. The recording form included codes for non-prompted child behavior that elicited a reinforcing consequence, physically and verbally prompted child contingency behavior, child behavior that had no environmental effects, and space for recording each learning opportunity trial. A trial lasted up to 6 s 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 elicit or produce a predetermined reinforcing consequence and lasted until a child ceased attempts to elicit a reinforcement or interesting consequence, or lost interest in a game. Each child had an average of five data collection sessions during the 8 weeks of intervention. Three games on average were played with each child per session where each game lasted an average of 6 min. Each game included an average of 12 trials.

The information on the recording forms was used to calculate 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 played with a child during a home visit. The child response-contingent behavior measures included the total number of non-prompted response-contingent behavior that resulted in an interesting or reinforcing consequence and the average number of non-prompted child response-contingent behavior per game. A non-prompted response-contingent behavior was defined as a child's use of a targeted behavior to produce a reinforcing or interesting consequence that was not prompted by either a parent's or an intervention staff member's verbal or nonverbal behavior. The child learning efficiency measures included the percent of non-prompted child behavior having reinforcing consequences per number of learning opportunities (trials) and the average number of non-prompted child behavior having reinforcing consequences per game minute.

Interrater Agreement

Research assistants (one for each intervention group) made joint visits with the intervention staff in their respective groups on 58 occasions during the course of the 8 weeks of intervention and used the same recording forms to code the number of games played during the visits, length of the games in minutes, number of learning trials per game, and number of non-prompted response-contingent child behavior. Twenty-five percent of the total number of intervention sessions were coded by the research assistants for calculating interrater agreement for each of the dependent measures. 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 89% agreement on the number of trials during the learning games (range = 84 to 95), and 88% agreement on the number of non-prompted child response-contingent behavior (range = 86 to 92).

Data Analysis

Repeated measures linear growth curve analysis was used to analyze each of the dependent measures (Schluchter, 1992). Each analysis included a two between-group (ability-based vs. needs-based) comparison, a test for a linear trend (change) in the dependent measures across measurement occasions, and a test for a Between group × Linear trend interaction. For each term in an analysis, a Wald type chi-square statistic was used to test whether the average slope for all children combined was different from zero, the *Y* intercepts for the two groups were the same or different, and the slopes for changes in the two groups were the same or different. The chi-square tests for each term were based on one degree of freedom and were converted to Cohen's *d* effect sizes for estimating the size of effects of interventions on differences and changes in the dependent measures. The data were also analyzed replacing the linear trend factor with a repeated measures factor to determine whether there were between-group differences on the six dependent measures inasmuch as tests for between-group differences on the *Y* intercepts in the linear trend analyses did not yield chi-square statistics to evaluate the study hypotheses.

Results

Table 2 shows the results from the linear growth curve analyses for each of the six dependent measures. Results indicated that there were linear growth curve changes in the dependent measures over the course of the 8 weeks of intervention, between-group differences on the *Y* intercepts on all six learning measures, and Intervention group × Linear trend interactions for four of the six dependent measures.

The linear trend results indicated that for both groups of children combined, there were increases in child learning opportunities, the children's response-contingent behavior, and the learning efficiency of the response-contingent learning games over the course of the interventions. The Cohen's *d* effect sizes for all linear trends were very large, and the slopes for all of the growth curves were significantly different from zero.

The repeated measures analyses produced between-group differences on five of six child learning measures. Table 3 shows the mean scores for the between-group differences on the six learning measures for the two groups of children. The results showed that the children in the ability-based group had more learning opportunities (trials per game), produced more response-contingent behavior, and demonstrated more efficient learning compared with the children in the needs-based group. The Cohen's *d* effect sizes for the between-group differences were all very large (with the exception of number of learning games) and indicate that the effects of the contrasting interventions were quite different favoring the ability-based group.

The linear growth curve analyses (Table 2) produced Between group × Linear trend interactions for four of the six child learning measures, indicating that the slopes for the two groups of children differed as evidenced by the very large Cohen's *d* effect sizes and the *p* values for the differences in the slopes. We illustrate the nature of these results for three of the learning measures, which controlled for differences in either the number of games played with the children (number of trials per game, number of response-contingent

Table 2. Linear Growth Curve Results for the Different Child Learning Measures.

	Linear trends			Between-group differences[a]			Group × linear trend interactions		
Child learning measures	χ^2	*p* value	Cohen's *d*	χ^2	*p* value	Cohen's *d*	χ^2	*p* value	Cohen's *d*
Child learning opportunities									
Number of games	68.52	.0000	14.04	4.92	.0265	0.68	1.51	.2186	0.36
Number of learning trials per game	38.54	.0000	4.04	13.36	.0003	1.24	6.80	.0091	0.81
Child RC[b] behavior									
Total number of RC[b] behavior	57.91	.0000	14.04	38.58	.0000	4.05	18.66	.0000	1.60
Average number of RC[b] behavior per game	20.53	.0000	1.73	29.99	.0000	2.58	9.07	.0026	0.97
Child learning efficiency									
Percentage of RC[b] behavior per number of trials	56.59	.0000	14.04	169.29	.0000	14.04	14.71	.0001	1.33
Average RC[b] behavior per minute	10.98	.0009	1.11	34.97	.0000	3.41	0.31	.5788	0.16

Note. RC = response-contingent.
[a]Tests for differences in the *Y* intercepts for the two intervention groups.
[b]Non-prompted child response-contingent behavior.

Table 3. Between-Group Repeated Measures Differences for the Child Learning Measures.

	Ability group		Needs group				
Child learning measures	*M*	*SD*	*M*	*SD*	Between group χ^2	*p* value	Cohen's *d*
Child learning opportunities							
Number of games	2.79	0.69	2.62	0.60	1.71	.2786	.32
Number of trials per game	15.88	8.02	7.36	3.26	21.55	.0000	1.81
Child RC[a] behavior							
Total number of RC[a] behavior	36.16	19.00	7.70	7.86	63.27	.0000	14.04
Average number of RC[a] behavior per game	13.60	8.01	2.79	2.84	38.90	.0000	4.14
Learning efficiency							
Percentage RC[a] behavior per number of trials	80.45	15.58	30.32	21.36	101.94	.0000	14.04
Average RC[a] behavior per minute	3.08	1.83	0.34	0.32	62.38	.0000	14.04

Note. RC = response-contingent.
[a]Non-prompted child response-contingent behavior.

behavior per game) or number of learning opportunities (percentage of response-contingent behavior per number of trials).

Figure 2 shows the interaction between the numbers of learning opportunities (trials) per game for the two groups of children. The children in the ability-based group had more learning opportunities per game at the start of the intervention, and the number of trials per game increased at a more rapid rate in the ability-based group compared with the needs-based group. The results indicate that although there were no differences in the number of games played with the two groups of children as evidenced from the parent log data and the investigator recording form data, the ways in which child behavior was selected for the ability-based group had both immediate and value-added benefits in terms of the number of learning opportunities the children had compared with the children in the needs-based group.

The between group by linear trend interaction for the number of non-prompted response-contingent child behavior per game is shown in Figure 3. The games for the children in the ability-based group resulted in more child response-contingent behavior per game compared with the needs-based group throughout the

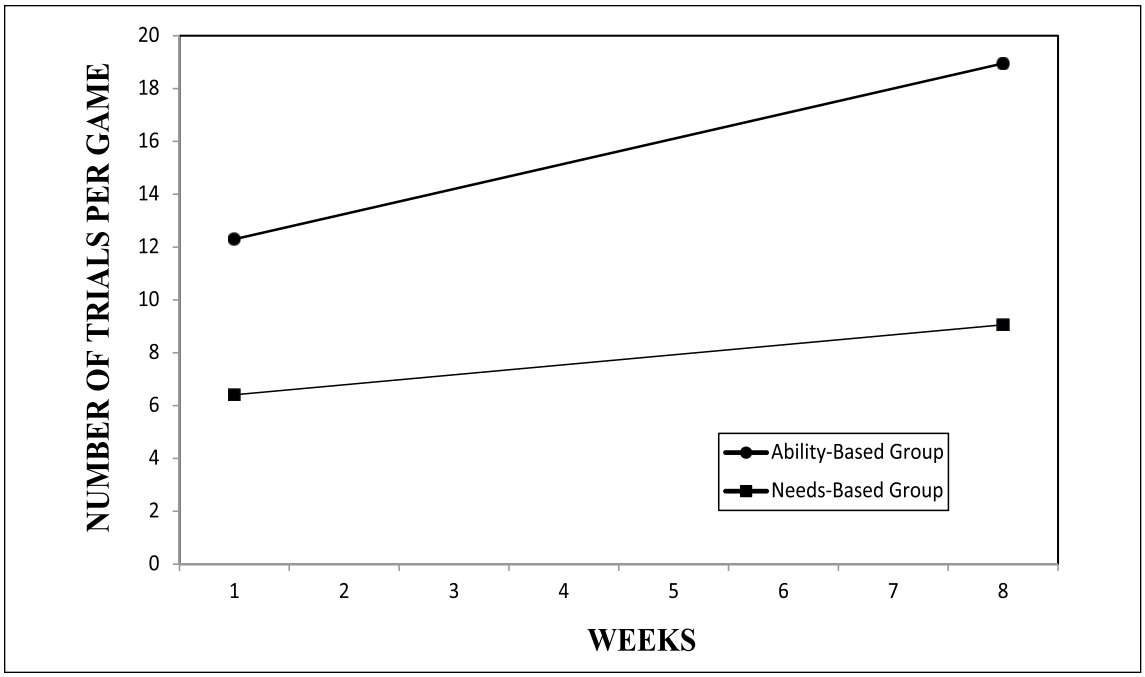

Figure 2. Number of learning opportunities (trials) afforded the children per game over the eight weeks of intervention.

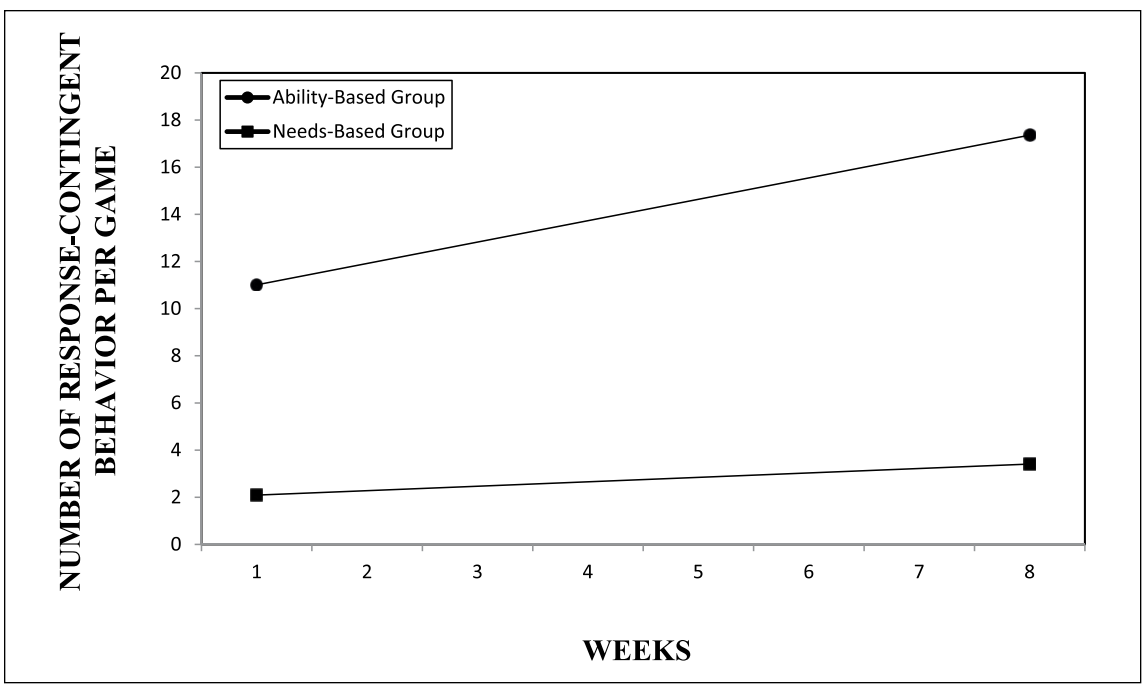

Figure 3. Number of child response-contingent behavior produced per learning game over the eight weeks of intervention.

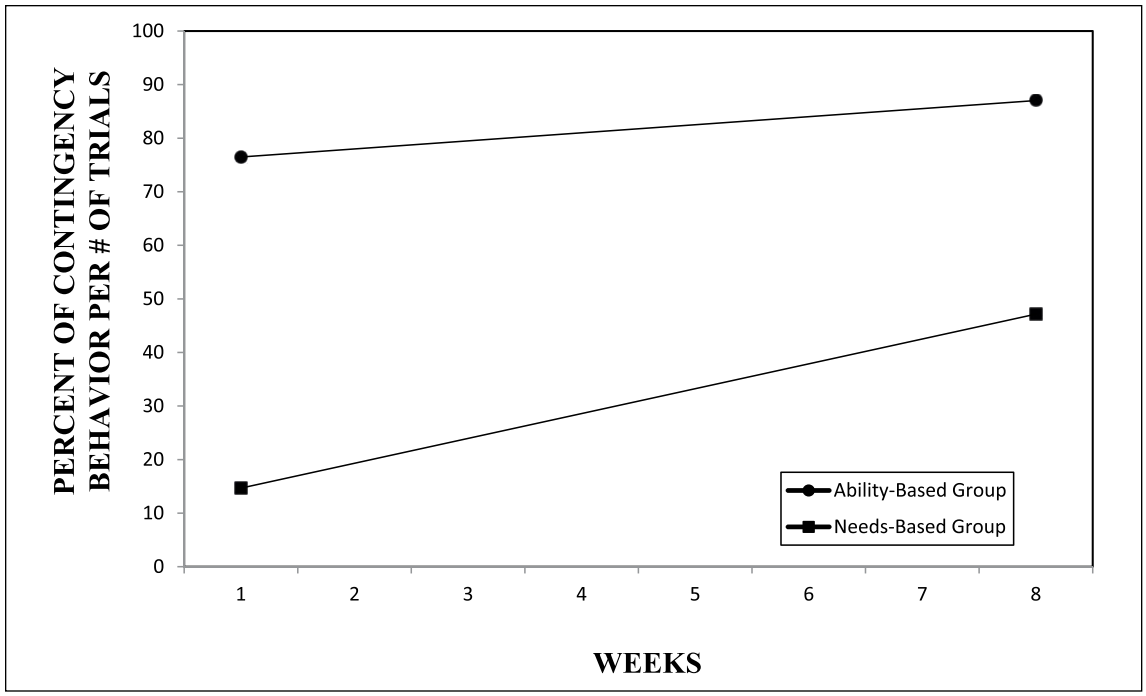

Figure 4. Percentage of child response-contingent behavior per number of learning trials over the eight weeks of intervention.

course of the interventions, and the rate of increase in child response-contingent behavior per game was more rapid compared with the needs-based group. The results showed that the differences in how targeted behavior were selected and used to produce interesting or reinforcing consequences were more effective for the ability-based intervention.

Figure 4 shows the interaction for the percentage of child response-contingent behavior per number of trials during the learning games for the two groups of children. The results showed that the ability-based group demonstrated more efficient learning throughout the intervention compared with the needs-based group, and although the needs-based group showed linear increases in learning efficiency, the percentage of trials per game that were associated with reinforcing or interesting consequences never reached the same levels as in the ability-based group. The results indicate that not only did the children in the ability-based group produce more response-contingent behavior, but the children were also considerably more efficient in terms of eliciting interesting or reinforcing environmental consequences.

Discussion

The results from the different analyses of the child learning measures indicated that the children in the ability-based group benefited significantly more from the response-contingent learning games compared with the children in the needs-based group. Findings showed that the children in the ability-based group had more learning opportunities and demonstrated greater amounts of response-contingent behavior, and the learning games resulted in more efficient learning compared with the children in the needs-based group. The results provide support for the four study hypotheses, and demonstrate that the ways in which child behavior are 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 Ebersöhn's (2001) contention that the ability-based and needs-based approaches to early childhood intervention differ both conceptually and procedurally and in turn differ in their consequences.

The findings are best understood by considering the fact that the different learning measures are interrelated. Post hoc analyses of the correlations among the learning measures showed that the average scores for five of the six learning measures (Table 3) were correlated (rs = .60 to .89; ps = .0000). Based on these results, experiences from the study thus far, and our previous research and practice (e.g., Raab et al., 2009), the ability-based group outperformed the needs-based group by the fact that existing child behavior made it immediately possible for the children to be successful (average number of response-contingent behavior per game); the more successful the children were, the more learning opportunities the children were afforded (number of trials per game); and the more trials per game that resulted in child success, the more efficient was child learning (percent of response-contingent behavior per number of trials). In contrast, the children in the needs-based group were less successful in producing response-contingent behavior because the behavior identified as missing skills was more difficult for the children to use; the less successful the children were, the fewer learning opportunities they had; and the fewer trials that resulted in eliciting reinforcing consequences, the less efficient was child learning.

It is important to point out that the effects of ability-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 et al., 1994; Utley, Duncan, Strain, & Scanlon, 1983) including earlier studies conducted as part of the line of research and practice described in this article (e.g., Dunst et al., 1985). We believe this is the case because the ability-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, 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).

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 (Ludlow, 1987). As noted in the introduction, 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. 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) or as described earlier "missing skills."

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 article (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, for example, Dunst, 1986). In the absence of the findings from the children in the ability-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. However, it was not nearly as effective as the ability-based intervention as evidenced by the findings reported in the article.

We place the study and results in a broader context by noting that the ability-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 et al., 2001; Green, McAllister, & Tarte, 2004; Swanson, Raab, & Dunst, 2011). Accordingly, the learning games for the ability-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 article.

The results reported in this article have a number of implications for research. It would be of investigative interest, for example, to know how, in what manner, and which types of response-contingent learning

opportunities for young children with significant developmental delays and disabilities contribute to, and promote the development of, more advanced behavioral capabilities (e.g., the relationship between the use of child vocalizations to elicit adult social responsiveness and child language acquisition). As of yet, few studies investigating response-contingent learning among young children with significant delays or disabilities have included the effects of different types of contingency experiences on subsequent learning and development. It would also be of interest to know how and in what manner the contexts of contingency learning games influence the rate of acquisition of response-contingent behavior (e.g., naturally occurring learning opportunities vs. planned interventions). Research in related areas suggests that contingency experiences embedded in everyday activities may be more effective than interventions that are not contextualized (Dunst, Bruder, Trivette, & Hamby, 2005, 2006).

The implications for practice are both straightforward and highly indicated. 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 article and elsewhere (see Dunst, Raab, Wilson, & Parkey, 2007; O'Brien et al., 1994) indicate that identifying behavior that children already demonstrate (intentionally or non-intentionally), and using these behavior as the building blocks to promote acquisition of higher level capabilities, is a more productive approach to early childhood intervention.

As is generally the case with primary studies, there are certain limitations that deserve comment. One is the fact that although the ability-based and needs-based interventions were operationally defined and implemented as two different approaches to response-contingent child learning, everyday early childhood intervention practices would not likely be so clear-cut. The particular outcomes or goals for individual children, for example, might indicate the use of a combination of practices. Another limitation has to do with context in which the interventions were carried out. Although many of the children in the study were involved in either Individuals With Disabilities Education Act (IDEA) early intervention or preschool special education programs, none of the requirements of either program needed to be considered as part of the design and implementation of the contingency interventions. The IDEA regulations, for example, and the manner in which early intervention staff are asked or required to work with children and their families, might thwart the use of certain types of practices (see especially Dunst, 2012). Notwithstanding these limitations, the potential values of ability-based practices for redefining early childhood intervention deserve serious attention.

Authors' Note

The opinions expressed are those of the authors and do not necessarily represent the opinions or official positions of the U.S. Department of Education or the Institute of Education Sciences.

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