

## Investigating The Effect of Puzzles on Trainable Mentally Retarded Children's Developmental Domains\*

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### Abstract

This study aims to investigate the effect of puzzles on the developmental domains (cognitive, language, motor, social and emotional development) of trainable mentally retarded children. Mentally retarded children attending to a special education center were included in the study using random sampling method. The study group consisted of randomly selected one child from the selected special education center. The experimental design of the study was with multiple probe design across behaviors and 'Demographical Information Form' together with 'Brigance Inventory of Early Development –II' which was developed by Brigance (2004) and adapted to Turkish by Aral et al. (2008) were used in the study. The child in the study group was trained one hour a day and two days a week for five weeks with ten puzzle prototypes which could be integrated into the educational system. Graphical analysis was used in the study. According to the findings, the trainable mentally retarded child gave at least nine correct responses in each session. In addition, when daily probe results were screened, it was found out that the child's success at color concepts (red, yellow, and blue) and shape concepts (square, triangle, and circle) met the pre-established criteria. At the end of the evaluation process of the child's scores from the sub-dimensions of Brigance Inventory of Early Development–II, it was found out that the child showed high progress at gross motor, fine motor, receptive language and academic cognitive sub-dimensions and low progress at expressive language, daily life and social-emotional sub-dimensions.

**Keywords:** Trainable Mentally Retarded Children, Developmental Domains (Cognitive, Language, Motor, Social And Emotional Development), Puzzle.

### INTRODUCTION

Mental retardation is a deficiency occurring during the development process and is characterized by significant limitations in the ability to adapt to the environment accompanied by distortion in various dimensions of intelligence such as cognitive, language, motor and social-emotional skills (Witt et al, 2003; Abasiubong et al, 2006; Heward, 2009; Keskin et al, 2010).

Mentally retarded children constitute a vast majority among the ones in need of special education and since this group is not homogeneous, the children are likely to show individual differences according to some characteristics (Maciag et al, 2000; Aral and Gürsoy, 2009; Eratay, 2010). Mentally retarded children are divided into four groups depending on their level of need for special education: mild mental retardation (trainable), an IQ of 55 to 50, moderate mental retardation (teachable), with IQ's 40 to 35, severe mental retardation in the IQ 25-20 values, spiritual and profound retardation as an IQ under 25 (Aral and Gürsoy, 2009). Of all the children with mental retardation, approximately 85% are trainable ones.

In educating mentally retarded children, as in all children, the objective is to teach living without being dependent of others by being self-sufficient and integrating with the society at all points (Aral and Gürsoy, 2009; Aslan and Eratay, 2009; Eripek and Vuran, 2010).

Trainable mentally retarded children cannot benefit adequately from the normal elementary curriculum. These children are thought to have potential to develop social adaptation skills for living independently in the society together with academic trainability at elementary level and professional skills at certain areas by receiving partial or full support from others when they are adults (Maciag et al, 2000; İlhan, 2008).

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Mentally retarded children can learn basic academic skills such as literacy and math. They can acquire the necessary skills for self-care and they may even display the expected behaviors. These children can also develop at a certain profession to make a living in the future. Early diagnosed mentally retarded children can start elementary school on time or later than their peers and learn academic skills with the help of well-designed educational programs while their developmental areas are also being supported (Özer et al, 1999; Eripek and Vuran, 2010).

Mentally retarded children are likely to show inadequacy at using methods necessary for arranging their cognitive processes effectively on their own (Arabsolghar and Elkins, 2000). In the case of mentally retarded children, it is important to use appropriate educational materials in teaching metacognitive knowledge which includes understanding and controlling their cognitive processes. Puzzles, which have a crucial role in transmitting cognitive knowledge, can also be used for enriching the learning process and embodying the knowledge. In addition, puzzles are effective instructional materials in that they support children's developmental areas (cognitive, language, motor, social and emotional development), creative skills, interests and needs, by providing an entertaining learning environment (Oğuzkan and Avcı, 2000; Atalay and Aral, 2001; Sull, 2006). As children play with the puzzles, they recognize the concepts and objects and learn their features and functions. Such a learning promotes the accumulation of knowledge in mind. Throughout this process, children think, perceive, understand and symbolize. These cognitive processes carried out during the play also promote the related cognitive skills. Apart from these, while children play with puzzles they gain social skills such as waiting for their turn, sharing and cooperating as well as some improvements observed in fine and gross motor skills (Gunter et al, 2008; Özer et al, 2006). Evidently, Aral et al. (2012) found out that puzzles had been effective in supporting the cognitive, language, motor, social and emotional developmental areas of six year old children showing normal developmental characteristics. Among the studies carried out so far, it can easily be seen that puzzles emerge as one of the educational materials for enhancing the development of children. In this context, puzzles can be considered as an effective tool in the education of mentally retarded children. From this point of view, this study aims to investigate the effect of puzzles on the developmental domains (cognitive, language, motor, social and emotional development) of trainable mentally retarded children.

## **METHODOLOGY**

### **The Model of the Research**

In this study, in order to investigate the effect of simultaneous prompting on individual teaching of colors (yellow, red, blue) and shapes (square, triangle, circle) through the use of puzzles prototypes, "multiple probe design across behaviors model" which is one of the single subject research models was used. In this sense, the dependent variable is the color and shape concepts while teaching style is the independent variable.

Single subject research is an experimental method that provides documentation of the causal or functional relationships between the dependent and the independent variable. The effectiveness of the treatment is revealed by repetition in such a model. In single subject research, the dependent variable is the target behavior whereas the treatment is called the independent variable. The effect of the independent variable is investigated through a series of implementation. In the case that there occurs a change on the dependent variable due to the implementation of the independent variable, then the researcher can talk about the existence of a cause-effect relationship. This kind of research is preferred by specialists who develop individual teaching supportive programs and researchers who are interested specifically in the behavioral treatment of mentally retarded individuals (Tekin, 2000; Alberto and Troutman, 2005; Dere Çiftçi, 2007).

Single subject research investigates the effect of an educational method on the particular individual. They give more reliable results while studying small groups and it is easier to transfer the outcomes to clinical settings. The particular individual's performance levels before

the treatment, whilst the treatment and after the treatment are evaluated and compared (Dere Çiftçi, 2007).

In multiple probe design across behaviors model, the subject's performance is evaluated by carrying out two or more treatments. At the starting phase, data are collected occasionally and these sessions are named as probes. This phase is just for gathering the baseline data for the initial part of the study. Multiple probe model is carried out respectively as follows: gathering baseline data, first implementation, second implementation and eventually both first and second implementation (Kırcaali İftar and Tekin, 1997; Tekin, 2000). During this study, at the beginning of each implementation "Daily Probe Checklist" was filled out to evaluate the previous implementation. The aim of the individual educational program was to teach color (red, yellow, blue) and shape (square, triangle, and circle) concepts through the use of puzzle prototypes.

### **The Study Group**

The research was carried out with only one child who was randomly selected among the trainable mentally retarded children attending to a special education center located in Ankara and affiliated to Turkish Ministry of National Education. The trainable mentally retarded child was the second and the last child who had been attending to the special education center for three years. The child's parents were relatives, within a range of 30-39 years old and received not more than elementary level education. The mother was a housewife and the father was a worker. The household was comprised of father, mother, and an elder brother with no more close relative living together in the house.

### **Data Collection Tools**

In this study, in order to collect data about the child and the family, Demographical Information Form and 'Brigance Inventory of Early Development-II' which was developed by Brigance (2004) and adapted to Turkish by Aral et al. (2008) with the aim of determining the developmental level of the mentally retarded child were used in the study.

**Demographical Information Form** included questions regarding the child's date of birth, gender, birth order, number of siblings, mother and father's ages, their level of education and their professions. This form was filled out by the parents of the trainable mentally retarded child.

**Brigance Inventory of Early Development-II** was developed by Brigance (2004) in order to evaluate the children's development from birth up to age seven and was adapted to Turkish by Aral et al. (2008).

Brigance Inventory of Early Development-II includes the following five domains: motor skills (fine and gross), receptive and expressive language skills, academic/cognitive skills, social emotional skills, and daily life skills. Each correct answer is awarded 1 point, while incorrect responses receive no points. The total score for the inventory is calculated by adding a separate score for each domain and the sum of the scores obtained from the domains. The higher the domain and total scores the more advanced are the general development skills. Questions are answered by either oral or written response or by pointing to pictures. Two other components of the test are direct observation of the child by the examiner and an interview with an adult (parents, caregiver, teacher, etc.) who takes care of the child to gather additional information about the child's skills. The inventory takes from 20 to 55 minutes to complete, depending on the child's age (Brigance, 2004; Aral et al, 2008).

Brigance Inventory of Early Development-II was adapted for use in Turkey by Aral et al. (2008) with a study sample comprising 464 Turkish children under the age of 6. Correlations among all domains were significant ( $p < .01$ ); internal consistency reliability coefficients varied between .67-.98; test-retest correlation revealed consistent results over time ( $r = .72-.96$ ); concurrent validity results were consistent ( $p < .05$ ,  $p < .01$ ); lower 27% and upper 27% item analysis showed

the items of the inventory had acceptable levels of discriminate validity (Aral et al, 2008).

Evaluation of the trainable mentally retarded child's developmental progress was carried out according to the domains of Brigance Inventory of Early Development-II. Motor skills were evaluated as fine and gross while language dimension was evaluated as receptive and expressive separately.

### **Preparation of the Education Program**

In the education program designed for trainable mentally retarded children included ten trial and probe games for each session based on the puzzle prototypes which were prepared according to color (red, yellow, blue) and shape (square, triangle, circle) concepts. The education program included concrete objects (three dimensional), concept cards, large and small sized pictures and early literacy pages as well as games prepared according to the puzzles.

### **Data Collection Method**

The administrative staff of the special education center was informed about the purpose of the study. According to the educators' suggestions, Brigance Inventory of Early Development-II was administered as a pretest to the selected trainable mentally retarded child.

The child in the study group was trained 45-50 minutes a day and two days a week for five weeks with ten puzzle prototypes which could be integrated into the educational system. At the beginning of each implementation, 'Daily Probe Checklist' was filled out in order to evaluate the previous session. During the probe sessions, 'only chance method' was utilized to collect data. This method is all about observing the child directly and assessing the observable behaviors after giving only the main instruction. In this sense, the child is expected to move on all the phases for the skill by following only the main instruction which is not repeated during the implementation by the assessor. Meanwhile, the assessor does not respond in any way to the child's correct or incorrect responses (Cavkaytar, 1999).

Data collection was carried out during the probe phase as follows: the assessor and the child sit face to face on a table. The child's name is called out so that the child looks at the assessor. Then the assessor holds two balls using both hands and draws the child's attention towards the balls by saying 'Look here now!'. The assessor puts down the yellow ball on the table without making any explanations. While the assessor is putting down the red ball, he/she introduces the ball by saying 'This is the red ball'. Later on, the child is given instruction for the related skill. The assessor says: 'Show me the red ball'. If the child can show the red ball, the assessor praises the child by clapping his/her hands while saying 'Well done! Yes, this is the red ball'. In contrast, if the child is unable to show the correct ball, the assessor takes the red ball and says: 'This is the red ball'. The assessor waits for five seconds to see whether the child initiates the first step of skill analysis. When the subject performs well in the first step of skill analysis, the assessor marks (+) in the correct responses column in the Daily Probe Checklist and observes for five seconds whether the subject moves on with the next step.

If the subject is unable to perform the expected behavior, then the assessor marks (-) and finishes the probe session. In the case that the subject does not response either after he/she is given the instruction or after he/she performs well in the previous step, the assessor writes (n.r.) for "no response" and finishes the probe. In this study, in order to determine that the change in the dependent variable is caused solely by teaching with simultaneous prompting procedure, the subject's correct responses were continuously reinforced by word of mouth.

Having finished the implementation of puzzle prototypes, the trainable mentally retarded child was given 'Brigance Inventory of Early Development-II' again but as a posttest this time.

### **Data Analysis**

Multiple probe design across behaviors model was used in this study which was carried out with

a single trainable mentally retarded child. In single subject researches, the number of subjects represents the population and does not comply with the assumption of variance homogeneity. Therefore, it would be more appropriate to use graphical analysis. Such research models stress the importance of the significance of the implementation rather than the statistical relationships since their methods are based on visual data analysis. Graphs used in single-subject research are composed of axes, data points, population change lines, phase codes and shape identification items (Dere Çiftçi, 2007). In this study, graphical analysis was used so the trainable mentally retarded child's pretest posttest results from Brigance Inventory of Early Development-II are shown graphically.

**FINDINGS AND DISCUSSION**

The results derived from this study aiming to investigate the effect of puzzles on trainable mentally retarded children's developmental areas (cognitive, language, motor, social and emotional development) were stated below and discussed.

**Table 1.** Daily probe results of the trainable mentally retarded child

Attempts	1 <sup>st</sup> Session Red	2 <sup>nd</sup> Session Yellow	3 <sup>rd</sup> Session Blue	4 <sup>th</sup> Session R-Y-B	5 <sup>th</sup> Session R-Y-B	6 <sup>th</sup> Session Square	7 <sup>th</sup> Session Tri-angle	8 <sup>th</sup> Session Circle	9 <sup>th</sup> Session S-T-C	10 <sup>th</sup> Session S-T-C
1 <sup>st</sup> Attempt	-	-	+	+	+	+	+	+	+	+
2 <sup>nd</sup> Attempt	+	+	+	-	+	+	+	+	+	+
3 <sup>rd</sup> Attempt	+	+	+	+	+	+	+	+	+	+
4 <sup>th</sup> Attempt	+	+	+	+	+	+	+	+	+	+
5 <sup>th</sup> Attempt	+	+	+	+	+	+	+	+	+	+
6 <sup>th</sup> Attempt	+	+	+	+	+	+	+	+	+	+
7 <sup>th</sup> Attempt	+	+	+	+	+	+	+	+	+	+
8 <sup>th</sup> Attempt	+	+	+	+	+	+	-	+	+	+
9 <sup>th</sup> Attempt	+	+	+	+	+	+	+	+	+	+
10 <sup>th</sup> Attempt	+	+	+	+	-	+	+	+	+	+
Total	9	9	10	9	9	10	9	10	10	10

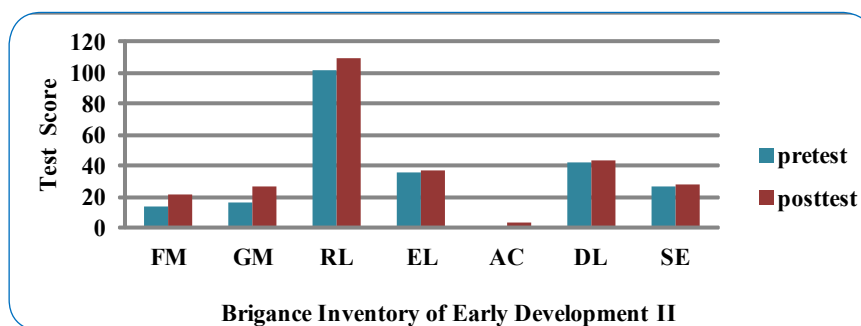
- Two sessions (on different days) a week were conducted for five weeks.
- A session is conducted for each concept (red, yellow, blue, red-yellow-blue, square, triangle, circle, square-triangle-circle, and square-triangle-circle) (10 sessions in total).
- A total number of 100 sessions were conducted by making 10 attempts in 10 sessions.

Table 1 shows that the trainable mentally retarded child gave at least nine correct responses in each session. During the implementations, the mentally retarded child was supposed to respond correctly after not more than eight attempts out of ten. Thus, when the number of correct response was less than eight, the assessor didn't move on with the next session. Accordingly, daily probe results show that the child's performance at color concepts (red, yellow, and blue) and shape concepts (square, triangle, and circle) met the pre-established criteria. This finding suggests that puzzle prototype implementation was effectual in underpinning the trainable mentally retarded child's developmental areas.

**Table 2.** The trainable mentally retarded child's pretest and posttest scores from Brigance Inventory of Early Development-II

<i>Brigance Inventory of Early Development-II</i>		<i>Pretest</i>	<i>Posttest</i>	<i>Achievement Score</i>
Motor Skills	<i>Fine motor</i>	14	22	8
	<i>Gross motor</i>	16	27	11
Language Skills	<i>Receptive language</i>	102	109	7
	<i>Expressive language</i>	36	37	1
Academic/Cognitive Skills		0	4	4
Daily Life Skills		42	43	1
Social Emotional Skills		27	28	1

**Graph 1.** The trainable mentally retarded child's pretest and posttest scores from Brigance Inventory of Early Development-II



*FM= fine motor, GM=gross motor, RL=receptive language, EL=expressive language, AC=academic cognitive, DL=daily life, SE=social-emotional*

Table 2 and Graph 1 both display the trainable mentally retarded child's pretest and posttest scores from Brigance Inventory of Early Development-II. The findings revealed that the trainable mentally retarded child scored higher on all the posttests in comparison with the pretest scores. The child's achievement scores for each domain are as follows: Fine Motor: 8, Gross Motor: 11, Receptive Language: 7, Expressive Language: 1, Academic Cognitive: 4, Daily Life: 1 and Social-Emotional: 1. By taking the achievement scores into consideration, it is obvious, in the light of these findings, that the trainable mentally retarded child showed remarkable progress on gross motor, fine motor, receptive language and academic cognitive domains while the amount of progress made on expressive language, daily life and social-emotional domains were lower. As a result, the findings suggest that puzzle prototype implementation is effective in supporting the mentally retarded children's developmental areas.

The education program included concrete objects (three dimensional), concept cards, large and small sized pictures and early literacy pages as well as games prepared according to the puzzles. During the puzzle games simultaneous prompting procedure was followed. The fact that the child had the opportunity to learn by doing while playing with puzzles and met the pre-established criteria suggests that puzzle prototypes are effectual in individual education.

Dere Çiftçi (2007) used multiple probe design across subjects in her study investigating the effect of teaching with simultaneous prompting on teaching color concepts to mentally retarded children. She concluded that teaching with simultaneous prompting affected teaching the concepts namely; red, yellow, blue and green in both individual teaching and group teaching settings. Özmen and Vayiç (2007) as a result of their research, which aimed to investigate the effectiveness of Read-Underline-Split-Merge strategy provided according to the Self-Regulation Strategies Development Model on syllable recognition skills of mentally retarded students through the use of multi probe design across subjects, found out that the children were successful in fulfilling the syllable recognition skills. At the end of training, the students were able to read the syllables regardless of the flashcards and the words formed using these syllables. They also managed to generalize their reading of the aforementioned syllables within sentences and maintained this skill during the monitoring assessments carried out after five weeks following the implementation. Maciag et al. (2000) conducted a study determining the effectiveness of teaching with simultaneous prompting on gluing boxes which was characterized as a vocational skill and this method was shown to be effective in teaching chained tasks. Parrot et al. (2000), in their study investigating the effect of simultaneous prompting on teaching the skill of hand washing, found out that simultaneous prompting had an effect upon teaching the skill of hand washing to children with moderate and severe mental retardation; that is three out of five children were able to fulfill the assigned task. On the other hand, Tekeli (1999), as a result of a research investigating the level of benefit from special education program based on individual and group teaching which lasted for four years and prepared according to Portage Program, claimed that the study group showed the fastest progress at cognitive domain whereas the slowest progress was detected at social domain. Sewell et al. (1998), in their study on pre-school children with developmental delay, tried to teach the skill of dressing by using simultaneous prompting. As a result, they concluded that simultaneous prompting was effective both in teaching the skill of dressing on children with developmental delay and in the retention of this skill following the teaching process. Similar studies reached the same conclusion asserting that the use of simultaneous prompting was effective in teaching various skills (color, number concepts, teaching the name of the object, pointing the image said, etc.) to mentally retarded children in various age groups (Doğan, 2001; Akmanoğlu, 2002; Birkan, 2002-2003; Tekin İftar et al, 2003; Toper, 2006; Kanpolat, 2008; Karabulut and Yıkılmış, 2010). The findings of this study are consistent with the aforementioned previous findings in the literature in that the child met the pre-established criteria in identifying the concept of color (red, yellow, blue) and the concept of shape (square, triangle, circle). Development and movement are inherent in the nature of children. The development occurs as a whole encompassing all the domains such as cognitive, language, motor, emotional and social. According to this approach, in raising children, the connections between the experiences must always be taken into consideration. For example, motor development (muscle development) is all related to the individual's movement. Admittedly, the ability to move freely affects the social development positively. Skills that are relevant with movement enable children to learn about their environment. This also contributes to their cognitive and language development. In parallel with the findings of this study, it can be suggested that puzzle prototype implementation is effective in supporting trainable mentally retarded child's developmental domains.

### **CONCLUSION AND RECOMMENDATION**

As a conclusion of this study which was planned to investigate the possibility of puzzles

being used as an educational material for supporting trainable mentally retarded children's developmental domains (cognitive, language, motor, social and emotional development), the trainable mentally retarded child was found out to give at least nine responses in each session. Accordingly, when daily probe results were screened, it was found out that the child's success at color concepts (red, yellow, and blue) and shape concepts (square, triangle, and circle) met the pre-established criteria. At the end of the evaluation process of the child's scores from the sub-dimensions of Brigance Inventory of Early Development-II, it was found out that the child showed high progress at gross motor, fine motor, receptive language and academic cognitive sub-dimensions and low progress at expressive language, daily life and social-emotional sub-dimensions. The findings suggest that puzzles are effective in supporting trainable mentally retarded child's developmental domains.

In the light of these findings, some recommendation may be provided for educators:

- Making some amendments and revisions in the curriculum of the training program for pre-service special education teachers so that these pre-service teachers will be proficient in implementing puzzle activities.
- Puzzles can be used as an educational tool facilitating the educational settings for trainable mentally retarded children.
- Following studies may set the time during which child is trained longer than one hour.
- Seminars and in-service training sessions regarding the use of puzzles at educational settings may be organized.

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