Symmetrical Learning Behavior in Cantonese-Speaking Children with Down Syndrome, and with Other Mental Retardation: A Comparative Study

by

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A dissertation submitted in partial fulfillment of the requirements for the degree of

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Abstract of dissertation titled

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Visual perception is an important ability in learning Chinese characters. There is no rule telling the relationship between sound, shape and meaning of each Chinese characters, learning Chinese characters may be a difficult task to some children, especially for children with limited intellectual abilities. Past research suggested that symmetry provokes perceptual advantage, and facilitates performance in cognitive tasks. And it is observed that many Chinese characters are symmetrically structured. Purpose of the present study is to examine whether symmetry facilitates visual perception and thus help children in learning Chinese characters. Performance in children with different intellectual functioning may give an understanding of the cognitive development of children.

There are three groups of children participated in the present study. They are children with average intelligence, with mental retardation, and with Down syndrome.

Cognitive tasks, matching and memory tests, are used to examine performance with different types of stimuli in the three groups of children. Stimuli include symmetries, asymmetries, words, and non-word.

Results suggest that symmetry did facilitate performance in children with average intelligence and children with mental retardation. Although children with Down syndrome is more affected by previous experience with stimuli instead of symmetry, their performance is not significantly different form children with average intelligence. Results validate Western research about symmetry with stimuli from real life, whereas the previous research was conducted with stimuli designed for experimental purpose. Performance of children with Down syndrome also supported to extend the "developmental position" to children with mental retardation associated with clear etiology. The "development position" in cognitive development of children with mental retardation stated that cognitive development of children with mental retardation develop along the same path as normally developed children. Results showed that performance with children with Down syndrome is not significantly different from children with average intelligence further support extension of the "development position" to children with mental retardation associated with clear etiology.

Declaration

I declare that this study represents my own work, and that it has not been previously included in a thesis, dissertation or report submitted to this University or to any other institution for a degree, diploma or other qualification.

Signed ______________________________

Lau Wai-yin, Vanessa

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CHAPTER I

INTRODUCTION

1. Statement of the Problem

In Hong Kong, children with mental retardation, who usually have an IQ below 75 are defined as children with special educational needs (SEN children), and they received education in special schools (Curriculum Development Council, 1996). Special schools are funded or aided by the Hong Kong government to provide special education for children with different types of handicaps. These include the blind, deaf, physically handicapped, maladjusted and socially deprived, mental handicapped (including Down syndrome and other mental retardation), and slow learning children. Statistics provided by the Education Department from 1986 to 1992 shows that children with mental retardation account for over 50% of enrollment in special education. At pre-school level, young children with mental retardation receive education together with normally developing children in integrated nurseries or kindergarten. At primary and secondary level, children with mental retardation study in special schools or special classes in ordinary schools (Rehabilitation Division, Health and Welfare Branch, 1996)

The Curriculum Development Council of the Hong Kong Education Department has prepared guides for heads or teachers of special schools to design their own curricula. Curriculum areas involve motor development, language training, number concepts, and general social concepts (Curriculum Development Council, 1985). Guides to curricula for mental retardation are written according to the level of mental retardation which ranges from mild to severe grade. Children with the same level of mental retardation are taught according to the same curriculum regardless of the etiology of their mental retardation. For example, children with Down syndrome are taught no differently from children with other types of mental retardation.

However, children with Down syndrome are biologically and cognitively different from other children with mental retardation, although both groups of children may range from mild to profound levels of mental retardation. Ellis (1963), Zigler and Hodapp (1986) suggested that the cognitive development of children with mental retardation of different etiologies is different. Down syndrome is one kind of mental retardation, which can be identified with a specific etiology at birth. The syndrome is a genetic disorder caused by the presence of an extra chromosome in the twenty-first pair (trisomy 21).

Affected by different genetic endowment and intellectual abilities, children with mental retardation and Down syndrome may accordingly learn in a different way. However, in Hong Kong, all the children with mental retardation regardless of etiology are taught with the same strategy, materials and curriculum. This may be detrimental to their development, and children may not be benefit fully from their education. Therefore, the first problem that needs to be addressed is whether cognitive development of children with Down syndrome is different from children with other mental retardation.

One of the major areas of cognitive development is visual perception. Visual perception and discrimination of the shape of characters is an important process in learning to read and write including the learning of Chinese characters (Woo & Hoosain, 1984), which is a difficult task for some children (Tzeng & Wang, 1983), especially children of limited intellectual abilities. Therefore visual perception of Chinese characters will be the focus of this study in order to reveal the cognitive development of children.

The structure of Chinese language makes learning Chinese characters a difficult task for children (Tzeng & Wang, 1983). Chinese characters are different from English or other alphabetical languages in that there is no rule governing the relationship between the sound and shape of the characters. Children need to rote learn the sound for each character and learning to read and write Chinese characters involves a lot of rote memorizing and copying, and a relatively high loading is put on the memory of children (Hoosain, 1986). This makes learning Chinese characters an especially difficult task for children, who are limited in intellectual functioning and deficient in memory abilities.

Visual perception is closely related to learning Chinese characters. Evidence from the development of Chinese writing (Wang, 1973), the types of errors made by children with dyslexia who use Chinese language (Stevenson et. al, 1982; Woo & Hoosain, 1984), the better performance of Chinese readers in visual discrimination tasks (Carlson, 1962; Lesser, Fifer, & Clark, 1965; The psychological Corporation, 1981), and the meaning of Chinese language is more easily manifested and can be assessed more directly and faster from the shape of characters (Biederman & Tsao, 1979; Chao, 1968; Hoosain & Osgood, 1983; Tzeng & Wang, 1983), all directly or indirectly give support to the view that visual discrimination and processing is important in learning the language.

Considerable previous literature in visual perception showed that people perceived symmetry differently from other stimuli structure. Symmetry refers to the shape of a pattern such that the two sides around the axis are identical, just as can be seen when you put a mirror in the middle of the pattern. People perform better in cognitive tasks with symmetrical stimuli. They prefer symmetry to asymmetry (Arnheim, 1974; Berlyne, 1971; Birkhoff, 1933; Paraskevopoulos, 1968; Rock, 1973; Valentin, 1925). People also detected faster, discriminated more accurately, and remembered better with symmetries (Adams, Fitts, Rappaport, & Weinstein, 1954; Alexander & Carey, 1968; Arnheim, 1974; Barlow & Reeves, 1979; Berlyne, 1971; Bruce & Morgan, 1975; Corballis & Roldan, 1975; Fisher & Bornstein, 1982; Garner, 1974; Garner & Sutliff, 1974; Gibson, 1929; Hogben, Julesz & Ross, 1976; Julesz, 1971; Pomerantz, 1977; Valentine, 1925). Perceptual advantage of symmetry over asymmetry is so robust that it also facilitates performance in different populations, such as children with mental retardation (Carlin & Soraci, 1993; Caruso & Detterman, 1983; House, 1966; Soraci, Carlin, Deckner, & Baumeister, 1990), and children with Down syndrome (Stratford, 1979, 1981). However, all the experimental work was conducted with stimuli designed for research purposes, and no symmetrical stimuli from real life was used.

To take a careful look at the shape of Chinese characters, it is interesting to find out that many of them or their component parts are symmetrically structured. Watanabe (1976) reported that among all educational kanji (Chinese characters) used in Japan, 70 % of them are symmetrical or consist of symmetrical elements (cited in Saito, 1986). For example, the Chinese characters "人" (man), "大" (big), "小" (small), "火" (fire), "木" (wood), "田" (farmland), "天" (sky), "口" (mouth), "日" (sun), "土" (soil), "門" (door), "山" (hill), etc., are symmetrically structured. The right- and left-hand sides are identical. Symmetrical Chinese characters provide ready-made stimuli from real life for experimental work about symmetry.

Therefore, the second problem that needs to be solved in the present study is whether symmetry in Chinese characters facilitates learning the language in children. The results may further substantiate Western findings about the symmetrical perceptual advantage with stimuli from life instead of designed patterns. A summary of the above statement of the problem is as follows:

1) To examine whether cognitive development of children with other mental retardation, children with Down syndrome, and children with average intelligence is different.

2) To examine whether Symmetry can facilitate visual perception in learning Chinese characters, and the differences between the above three groups of children.

2. Objectives of the Research

In view of the above mentioned problems, the present research is conducted with the following objectives:

1) Comparing visual perception, which is an important ability in learning Chinese characters, in children with average intelligence, mental retardation, and Down syndrome to reveal their cognitive development.

2) Examining visual perception in symmetrical Chinese characters to see whether symmetry can facilitate children's learning of Chinese characters, and to test cross-cultural validation of previous research about symmetry which has been conducted with designed patterns for experimental purpose in Western culture.

3. Significance of the Research

The present research compare visual perception in three groups of children, who are genetically different and have different intellectual abilities. If results reveal information about the cognitive development of these three groups of children, with particular reference to differences between children with mental retardation of different etiologies, and compared to normally developed children, the information will be useful for teachers, especially those who cater to the needs of different children at the same time, e.g., in the integrated nurseries or special class in ordinary schools. Teachers may design teaching strategies and materials according to the development and needs of different children.

The study examines whether symmetry can facilitate learning Chinese characters. Results may contribute more information to help children in learning Chinese characters. As mentioned, learning Chinese characters is a relatively difficult task for children. Choosing suitable teaching materials to start with may help to enhance performance and learning motivation in children, especially in children with mental retardation. Research suggests that symmetry provokes a perceptual advantage, and many of the Chinese characters are symmetrically structured. The present study examines whether symmetrical properties facilitate learning Chinese characters in different groups of children, and it may help in designing teaching materials to capitalized on children's strengths and minimize their weaknesses.

Moreover, the present study examines visual perception of symmetry with stimuli from life in Chinese culture. Results may further substantiate previous Western findings about symmetrical perceptual advantages. From the literature review, almost all the research about symmetries was conducted with patterns designed by researchers for experimental purposes. The present study tries to apply previous findings to real life stimuli – symmetrical and asymmetrical Chinese characters. The research design simulates a reading situation which will include both symmetrical and asymmetrical elements in each trial. Results may provide cross-cultural information to Western findings and the application of research findings to other reading situations.

4. Overview of the Research

The literature review consists of several parts. The first part gives an account of cognitive development of individuals with mental retardation in order to give the background of the present research. It briefly summarizes theories about cognitive development of children with mental retardation compared to children with average intelligence, and asks whether children with mental retardation develop along the same path as the children with normal intelligence or develop differently. The two schools of thought in the field about cognitive development of mental retardation are described. They are the "developmental approach" and the " difference approach".

Stimulus organization is an important variable of performance in perceptual tasks. The second part of the literature review focuses on the stimulus organization used in the present research—symmetry. Symmetry is a special stimulus organization, and people perceive it differently from other stimuli structure. Research about symmetry has been carried out involving different populations. This part of literature describes definitions of symmetry, and perception of symmetry in the three groups of participants in the present research. The groups are individuals with average intelligence, with mental retardation, and with Down syndrome. Research involving symmetrical letters or characters is also reviewed.

As many Chinese characters are symmetrically organized, they have been chosen as stimuli in the present study. The last part of the literature review describes characteristics of Chinese characters. Apart from its property of symmetry, there are other characteristics of Chinese characters, which can affect its perception and learning, for example, the shape of the Chinese characters, its relationship between shape and meaning, and shape and sound, etc. All of these characteristics contribute to the different cognitive processes and perception. The last part of the literature focuses on these aspects of Chinese characteristic.

This research consists of four studies. In addition, a pilot study to test the research design, procedures, and stimuli was carried out. Study one was conducted with children with average intelligence to examine the validation of Western findings about symmetry using Chinese characters. It provided a foundation for studies two to four. Studies two and three were conducted with children with mental retardation and Down syndrome respectively. It aimed to examine symmetrical perceptual advantages in two groups of genetically different children. Study four compared performances of all three groups of children to give the implications of their different cognitive development.

CHPATER II

COGNITIVE DEVELOPMENT OF CHILDREN WITH MENTAL RETARDATION – LITERATURE REVIEW

How is the cognitive development of children with mental retardation different from that of normally developed children? Are the children with mental retardation deficient in all areas of development compared with normally developed children? Do the two groups of children develop in different or similar patterns and sequences? These are interesting questions asked by researchers in the field about the cognitive development of children with mental retardation. In this part, literature about cognitive development of children with mental retardation is reviewed. In this area of research, there are two major schools of thoughts, they are the "developmental position" and the "different position".

1. The Developmental Position

This position assumes that differences between individual with and without mental retardation are due to their different rate of development and to upper limits of abilities achieved. The position predicts that performances of children matched on mental age will be the same. The strongest proponent of the development position is Zigler (1966, 1969).

The first feature of Zigler's developmental position is the similar sequence and structure hypotheses. According to the "similar sequence hypothesis", children's development follows a universal sequence of development. Children with mental retardation develop in the same sequence as the normally developing children. The "similar structure hypothesis" states that children with mental retardation did not have any particular defect in structure of their cognitive system. Children with mental retardation only developed at a slower rate and have a lower upper limit. With these hypotheses, it is predicted that children if matched on mental age will show a similar performance. However, the similar sequence and structure hypotheses cannot be equally applied to all individuals with mental retardation.

The second feature of the developmental position is the two-group approach to mental retardation, which concerns the applications of the developmental position to individuals with mental retardation. Zigler and Hodapp (1986) divided individuals with mental retardation into two main groups. One of the groups comprised individuals with mental retardation associated with an organic defect for which a clear etiology can be found. Organic forms of mental retardation can be prenatal, perinatal, or postnatal. For example for an individual with Down syndrome, an obvious organic problem is found where an extra chromosome is present in the twenty-first pair of chromosomes. The other group is made up of individuals with cultural-familial retardation for which no clear organic etiologies can be found. Cultural-familiar mental retardation is associated with environmental deprivation, lower parental IQ, lower socioeconomic class. For example, it has been reported that Romanian babies orphaned as a result of the revolution in that country who were crowed into orphanages where they received no stimulation, have grown into mentally retarded teenagers. It is only to the group with cultural-familiar mental retardation that Zigler applied his ideas of the developmental position.

Zigler also suggested that the experience and personality of children with mental retardation is an important variable affecting their performance in cognitive tasks. Experiences help to shape the personality of an individual. This is true of both children with and without mental retardation. Zigler found that many of the individuals who participated in past research were institutionalized, which implied social deprivation of the participants. Social deprivation is defined as "lack of continuity of care by parents or other caretakers; an excessive desire by the parents to institutionalize their children; impoverished economic circumstances, or a family history of marital discord, mental illness, and child abuse or neglect." (Zigler & Balla, 1982, p.13; Zigler & Burack, 1989, p. 230). Zigler, Hodgden and Stevenson (1958) found that different performance between familial retarded individuals and their mental-age-matched non-retarded children is due to the greater social deprivation of the institutionalized retarded individual.

Zigler and his colleagues (Zigler & Balla, 1982; Zigler & Burack, 1989; Zigler & Hodapp, 1997) summarized similar lists of characteristics of individuals with mental retardation. They illustrate that motivation and personality is an important variable in considering cognitive performance in individuals with mental retardation. They also pinpointed the need for further research in that direction and not just focusing on the cognitive defect, to obtain a more complete picture of mental retardation. The several personality characteristics are described as followed:

Positive- and Negative- Tendency

The first characteristics are positive- and negative-reaction tendencies, which are closely related to institutionalization. Positive reaction tendency refers to the increased motivation to receive attention and other forms of reinforcement from supportive adults.

Research found that a positive-reaction tendency is more often related to mentally retarded and institutionalized individuals (Balla, Butterfield, & Zigler, 1974; ; Balla & Zigler, 1975; Zigler, 1961; Zigler & Balla, 1972; Zigler, Balla, & Butterfield, 1968). On the other hand, negative reaction tendency refers to the reluctance and wariness to interact with surrounding adults because of the long period of social deprivation (Balla, Kossan, & Zigler, 1980; Harter & Zigler, 1968; Irons & Zigler, 1969; Shallenberger & Zigler, 1961; Weaver, Balla, & Zigler, 1971).

The positive- and negative- reaction tendencies seem to be contradictory. It is controversial whether social deprivation or institutionalization leads the retarded individual to become more sensitive and have a desire for social interaction and reinforcement, or to become more withdrawn and unwilling to contact with strangers (Cox, 1953; Freud & Burlingham, 1944; Goldfarb, 1953; Irvine, 1952; Spitz & Wolf, 1946; Whittenborn & Myers, 1957). Zigler and Balla (1982) stated that whether social deprivation leads to an increased or decreased desire for social interaction depends on the different psychological defenses employed by different groups of subjects.

Although the controversy is not settled, both the positive-and negative-reaction tendencies adversely affect their performance in cognitive tasks. Children with mental retardation affected by negative reaction tendency are more likely to withdrawn in experimental conditions and wary of the experimenter. This lessens their effectiveness and performance in cognitive tasks. On the other hand, positive reaction tendency also leads mentally retarded individual to become overly dependent on the surrounding adults for solutions (Harter, 1967). This tendency is even stronger for institutionalized than non-institutionalized children (Gruen & Zigler, 1968), and for individual with a lower mental age level (Zigler & Balla, 1972).

The Reinforcer Hierarchy

Reinforcer hierarchy is another motivational-personality characteristic of individuals with mental retardation. Reinforcer hierarchy refers to the different amount of motivation of individuals to tangible and intangible reinforcement. Matched on mental age, children with mental retardation are less responsive to intangible reinforcement, e.g., acknowledgement that their response is correct by the experimenter (Zigler, 1962; Zigler & de Labry, 1962; Zigler & Unell, 1962), especially children from a lower social economic class (Zigler & de Labry, 1962; Zigler & Unell, 1962). Children's performance is improved when tangible reinforcement is given (Plenderleith, 1956; Stevenson & Zigler, 1957).

Intrinsic reinforcement, which refers to the self motivation and internal gratification of being correct, regardless of whether there is external tangible or intangible reinforcers, also affects performance in cognitive tasks. Harter and Zigler

(1974) measured different aspects of motivation, including variation seeking, curiosity, mastery for the sake of competence, and preference of challenging tasks. Results indicate that those children with mental retardation show less self motivation than normally developed children. These tendencies meant children with mental retardation derived less pleasure in solving problems. They are less likely to chose more difficult, challenging tasks, or those with various dimensions.

Lower Expectance of Success

Higher expectance of failure is another characteristic of the individual with mental retardation compared to those without mental retardation (Cromwell, 1963). Children with mental retardation are more likely to blame themselves for not being able to complete the task at hand (MacMillan, 1969; MacMillan & Keogh, 1971; MacMillan& Knopf, 1971). Moreover, limited by their intellectual capacity, children with mental retardation are more likely to experience failure. The frequent failure experience by children with mental retardation will lead them to expect a lower level of achievement for themselves. However successful experience may lead to higher expectance of success (Ollendick, Balla, & Zigler, 1971). This is not only true in experimental conditions, but is also found in life-like settings (Gruen, Ottinger, & Ollendick, 1974). With lower expectance of success, children are not willing to try different strategies in problem solving, and are more likely to persistently choose the partially reinforced stimulus (Gruen & Zigler, 1968; Kier, Styfco, & Zigler, 1977; Ollendick & Gruen, 1971; Stevenson & Zigler, 1958).

Outerdirectedness

Outerdirectedness is a problem solving style where individuals depend on external cues in the environment rather than on his or her own cognitive abilities to solve a problem. Outerdirectedness has been found to decease with increasing mental age or level of cognitive development. With increased mental age, children with mental retardation become less dependent on external cues provided by adults or their environment; instead they depend more on their own cognitive abilities to solve a problem (Balla, Styfco, & Zigler, 1971; Gordon & MacLean, 1977; Turnure, 1970a, b). Experimental work also showed that frequent experience of failure of children with mental retardation also increase their degree of outerdirectedness in problem solving situations (Achenbach & Zigler, 1968; Balla, Styfco, & Zigler, 1971; Sanders, Zigler, & Butterfield, 1968; Turnure & Zigler, 1964; Yando & Zigler, 1971).

Self-concept

In research about self-concept, three aspects have been investigated. They are the real self-image (individual's current self-concept), the ideal self-image (the way individual would ideally like to be), and the disparity between the real and ideal self-image. The disparity between the two selves is an index of maturity attained. It is expected that disparity between the two selves will be increased with higher levels of cognitive differentiation. (Light, Zax, & Gardener, 1965; Werner, 1948; Witkin, Dyk, Faterson, Goodenough, & Karp, 1962). Children with mental retardation had a lower ideal self-image than the children with average intellectual abilities (Leahy, Balla, and Zigler, 1982; Zigler, Balla, & Watson; 1972).

In the previous literature review, Zigler's "developmental position" is summarized. Literature showed that children with mental retardation are not deficient in their cognitive system. They only develop in a slower rate and can achieve at a lower level compared to children with average intelligence. Environmental and motivational factors instead of cognitive defect did contribute to their difference performance in cognitive tasks. Their developmental paths are similar to those of children with average intelligence.

2. The Different Position

Opposed to the developmental position is the different position in the field of cognitive development of individuals with mental retardation. The different position states that children with mental retardation develop in a different way compared to children with average intelligence. The difference can be accounted for by the structural or process deficiency in the cognitive system of individuals with mental retardation. Although there is no unifying theory to describe the different position, researchers who subscribe to the different position, conduct research to locate the deficient parts in the cognitive system of individuals with mental retardation. Researches try to identify the less competent performance in cognitive tasks of individual with mental retardation with specific defect in cognitive system, and their findings are summarized as follows.

Rigidity

Lewin (1935) and Kounin (1941a, b) were among the first to propose the "defect theory" in mental retardation. They tested children using drawings, pressing and raising level, or sorting cards, and suggested that children with mental retardation, affected by their defective structure of cognitive system, are more rigid in their ways of problems solving. Their behavior is less flexible, repetitive, and unchanging comparing to individuals with average intelligence.

Experimental work in response to Lewin's (1935) and Kounin's (1941a, b) theory provide mixed findings. There were studies which supported Lewin and Kounins' view that individuals with mental retardation are more rigid than individuals without mental retardation (Halpin, 1958; Heal, 1966; Heal, Ross, & Sanders, 1966; Iwahara & Sugimura, 1962; Lobb & Stogdill, 1974; O' Malley, Dunn, & Rudnick, 1975; Penney, Croskery, & Allen, 1962; Richman, Adams, Nida, & Richman, 1978; Shanab & McClure, 1983; Umetani, Kitao, & Katada, 1985). On the other hand, there are also experimental work showing that there are no differences in rigidity between individual with and without mental retardation (Budoff & Pagell, 1968; Rondal & Lambert, 1975; Sanders, Ross, & Heal, 1965).

Findings concerning Lewin's and Kounin's theories are controversial. However, they provide a starting point for further research to investigate the concept of rigidity with different cognitive tasks and the definition of rigidity (e.g. Siegel and Foshee, 1960; Smith and Siegel, 1986; Strauss & Werner, 1942; Werner, 1946, 1948b). Recently, Ellis and associates examined cognitive inertia, which is a similar concept to cognitive rigidity, in children with mental retardation with variations of the Stoop effect. Results generally support the suggestion that children with mental retardation are cognitively more rigid than children with average intelligence (Dulaney & Ellis, 1994; Ellis & Dulaney, 1991; Ellis, Woodley-Zanthos, Dulaney, & Palmer, 1989).

Attention

Attention is an important construct in understanding different performances in individuals with and without mental retardation. An individual with mental retardation is deficient in pre-attentive processes and this affects their cognitive processes in later stages and performance (Dugas & Baumeister, 1968; Thor & Thor, 1970). In detection tasks, the deficient pre-attentive process is responsible for the consistently poor performance of individuals with mental retardation (Fox & Oross; 1988, 1990, & 1992). Moreover, affected by their poorly functioning central nervous system, individuals with mental retardation are inefficient in orienting to stimuli, and choosing stimuli for focusing attention (Luria, 1963; Sokolov, 1963). The weak orienting response is associated with slow habituation in individuals with mental retardation, who may sustain their attention on irrelevant stimuli (Ball, Barber, & Kohler, 1975; Bower & Das, 1972; Elliott & Johnson, 1971; Furby (1974); Powazek & Johnson, 1973).

Physiological data provide further information that individuals with mental retardation are different from those without, in terms of physiological response, and it makes them less efficient in mobilizing their attention in response to warning signals and preparing for target stimuli (Krupski, 1975; Runcie & O'Bannon, 1975).

Moreover, individuals with mental retardation are less able to focus attention to relevant aspects of stimuli. They need more training trials to identify the task appropriate elements of complex stimuli in discrimination tasks (Zeaman & House, 1963, 1979; Fisher and Zeaman, 1973), and are able to attend to fewer stimulus dimensions compared to participants of similar mental age in matching task (Whiteley, Zaparniuk, and Asmundson, 1987).

Attention allocation can not only help to extract relevant elements for processing but can also help to suppress irrelevant stimuli. Individuals with mental retardation are more affected by distractors, and are less able to suppress effects of irrelevant stimuli, this adversely affects their performance (Cha, 1992; Cha and Merrill, 1994; Hagen & Huntsman, 1971; Nugent & Mosley, 1987). Ability to sustain attention on tasks also affects cognitive processing performance. Research has found that the ability of sustain attention develops later in children with mental retardation compared to children without mental retardation (Kirby, Nettelbeck, & Thomas, 1979).

Memory

Memory is another important construct to explain different performances between individuals with and without mental retardation in cognitive tasks. Memory can be classified into four stages: 1) very short-term memory; 2) primary memory; 3) secondary memory; and 4) tertiary memory. Information is kept for each stage for some time and then transfer or transformed to another. Most of the research about memory in individuals with mental retardation is based on Ellis's (1970) model.

Very short-term memory is basically a sensory-specific representation of stimulus events (Ellis, 1970). It has no limit in capacity and is of extremely brief duration (250-

2,000 msec). Information can be lost from very short-term memory through decay or masking by new stimuli over the previous stimuli (Averbach & Coriell, 1961). Studies using partial-report techniques reported that individuals with mental retardation are deficient in the very short term memory (Headrick & Ellis, 1964; Libkuman & Friedrich, 1972; Pennington & Luszcz, 1975). Other research using masking techniques to investigate very short-term memory of individuals with mental retardation, support their findings (Galbraith & Gliddon, 1972; Hornstein & Mosley, 1987; Spitz & Thor, 1968; Welsandt & Meyer, 1974). This affects information processing in the later stages.

Primary memory is of longer duration and is limited in capacity. Studies about primary memory varied in their experimental methodology, findings and conclusion. No agreement is reached on whether there is a difference in primary memory between individuals with mental retardation. There is research suggesting no difference is found in primary memory between individuals with and without mental retardation (Belmont & Butterfield, 1969; Ellis 1970; Ferretti 1982). However, there are studies reporting deficiency in primary memory in individuals with mental retardation (Dugas & Kellas, 1974; Scott & Scott, 1968). Different causes are found which contribute to the deficiency, such as structural deficits and a rapid rate of forgetting (Ellis & Wooldridge, 1985), or slower speed of information processing which depends on the nature of tasks and types of stimuli (Davies, Sperber, & McCauley, 1981; Merrill & Mar, 1987; Sperber & McCauley, 1984).

Secondary memory is of greater capacity and longer duration than primary memory. Rehearsal strategies are involved in transferring information to and from secondary memory. Rehearsal strategies include simply repetition and some organization or transforming of stimuli. Ellis (1970) suggested that an individual with mental retardation suffers from a rehearsal deficit, and they fail to use active rehearsal processes in cognitive tasks. These findings are supported by research that shows people with mental retardation are less likely to use rehearsal (Borkowski & Cavanaugh, 1979; Butterfield & Belmont, 1977b; Campione, Brown, & Ferrara, 1982).

Tertiary memory has no limit of capacity or duration. It is a durable long-term store of information. However, information can be lost through interference or may be inaccessible because of retrieval problems. Studies about tertiary memory in individuals with mental retardation vary in their findings and suffer from methodological problems. They used different assessing methods or participants who are different in their pre-test learning levels. Detterman (1979) stated that the majority of studies about tertiary memory of people with mental retardation suffer from methodological problems. In this situation, contradictory results are derived. For example, Prehm and Mayfeld (1970) reported that individuals with mental retardation are deficient in long-term retention. However, another study reported that long-term retention is equal in individuals with and without mental retardation. Individual with high IQ learn and forget more rapidly than those with relatively lower IQ (Klausmeier, Feldhusen, & Check, 1959).

Also, as mentioned, individuals with mental retardation are deficient in the very short-term memory, primary memory, and secondary memory. Cognitive processing in tertiary memory is affected by those previous deficient-processing stages. Either tertiary memory or interaction between other previous memory stages may cause different performance in cognitive tasks. In view of the situation, valid conclusions cannot be made easily. As Hale and Borkowski (1991) said,

> Too few sound studies can be found in the literature to support or refute a TM [tertiary memory] deficit in mentally retarded individuals......we must wonder whether TM can ever be unequivocally measured in view of these initial differences in the memory chain. (p. 517)

Information stored in tertiary memory can be lost due to retrieval problems. Research on retrieval processes in individuals with mental retardation may give more understanding to the issue. The retrieval process involves storage and usage of information. Research suggests that individuals with mental retardation have problems of storing information efficiently (Brown, 1974; Harris, 1972; Spitz, 1973), and knowledge of category information, so that they cannot easily retrieve information (Blount, 1968; Glidden & Mar, 1978; Haywood & Switzky, 1974; Stephens, 1966).

3. Summary

As mentioned above, the developmental-difference controversy has spurred a great deal of research aimed at generally investigating the cognitive development or specifically the different cognitive processes. However, no clear solution has been found to settle the argument. Instead, supportive evidence is found for the two positions. For example, Weisz and Yeates (1981) reviewed research comparing the performance of individuals with and without mental retardation on Piagetian tasks. They focused on 30 pieces of research, which consist of 104 comparisons between individuals with and without mental retardation. Analysis of the research results showed that 72 % of the comparisons supported the developmental position, that with matched cognitive development, individuals with mental retardation perform as well as those without mental retardation. On the other hand, Weiss, Weisz, and Bromfield (1986), using the same techniques employed in the previous review, reviewed research on performance of individuals with and without mental retardation on non-Piatgetian tasks. They concluded that most of the research findings supported the difference position. In view of this, they argued that individuals with mental retardation suffer from various cognitive deficits that are more than a simple developmental delay. As empirical evidence is sought to support both positions, it is difficult to determine whether development of individuals with mental retardation follows the development or different position.

Detterman (1987) offered a solution to the problem. He suggested that the two positions are not contradictory to each other. Whether individuals with mental retardation develop in a similar or different way from individuals without mental retardation depends on the level of measurement and the theoretical approach adopted by the researchers. He proposed that the two positions actually involve different levels of measurement of abilities ranging from molar to molecular levels of the system. According to Detterman (1987), researchers supporting the different position and suggesting deficiency in individuals with mental retardation are referring to the molecular level of the system and focusing on specific abilities. Those who support the developmental position are referring to the molar level of the system. Detterman (1987) proposed that the two positions are actually referring to different but interrelated aspects of a complex system.

Borkowski and Turner (1988) also offer solutions to the controversy. They criticized past research for tending to overlook the developmental changes which emerge across the life span. Sternberg (1990) also supports this view. Borkowski and Turner (1988) suggested that future research should focus on how the structural deficit interacts and changes with the environmental and motivational factors of the individual. This direction of research may give a clearer picture of the cognitive development of individuals with mental retardation.

CHAPTER III

VISUAL PERCEPTION OF SYMMETRY --

LITERATURE REVIEW

Stimulus organization is an important aspect and worthy of attention in studies of cognitive processing. As Garner (1970a) stated,

> Too many of the experiments, interpretation, and concepts that have been used in studies of information processing have emphasized the processing part of the problem to the neglect of the information part of it. Too often has the nature of the input been ignored, with the consequence of incorrect assessment of the nature of information processing at worst, or an inadequate picture at best (p.350).

The present chapter will focus on "symmetry" -- the stimuli organization chosen in the present study. Symmetry can be simply defined as a pattern of which two sides along the axis are identical. The following literature review describes theories about the definition of symmetry, and studies about perception of symmetry in three groups of children, namely children with average intelligence, children with familial mental retardation, and children with Down syndrome.

1. Symmetry

Gestaltists were perhaps the first to emphasize the fundamental importance of symmetry as a construct in perceptual theory (Palmer, 1982). Their view can be seen clearly in Wertheimer's (1923) law of Praganz, which is the central law of Gestalt Psychology. The law states that psychological organization should always be as "good" as the prevailing conditions allow. It implies that people will perceive all the things as "good form" when the stimulus cannot be seen clearly, such as in brief exposure or low intensity, and the ambiguous part will be completed as well as possible. In this view, what exactly is "good form" is left undefined, however, according to Koffka (1953) it clearly embraces the perceptual properties of symmetry, regularity, and simplicity. Gestaltists propose that there exist psychological "forces" toward good form that emphasize symmetries and regularities in perceived figures. However, the definition of "good form" was simply based on human intuition about figural goodness. Objective measurement of stimulus goodness was not determined.

Information theory makes an advance in understanding symmetry by defining "good form" in term of redundancy. The construct of redundancy is related to concepts of identity and sameness. Attneave (1954) and Hochberg and McAlister (1953) independently proposed that "good" figures contain less information than "bad" ones in the sense of information theory. Information theory makes human perception analogous to a system of computer processing. In "good" figures, information on each side of the axis of symmetry is identical; in other words they contain redundant information. The information is redundant in the sense that processing information on only one side of the axis is adequate to recognize the whole figure. As Atteneave (1954) and Leeuwenberg (1971) stated, individual figures can be redundant if local parts within the figure are the same as other local parts.

Garner (1974), with his theoretical roots in information theory, defines figural goodness in terms of "rotation and reflection (R & R) subsets". His concept about symmetry is related to figural transformation, and he defines the goodness of a figure in terms of the size of the set of equivalent figures generated under a rigid spatial transformation of reflection and 90 degrees rotation. To measure pattern goodness, the figure is rotated by 90, 180, or 270 degrees and / or then reflected about their horizontal, vertical, and diagonal axes, and the fewer the figures generated by rotating or reflecting, the better the figure. Therefore, the size of the subset is a decreasing function of figural goodness. It is found that subset size is a powerful predictor of many dependent variables in perceptual tasks. Figures with smaller subset sizes are encoded more rapidly (Garner & Sutliff, 1974), and remembered better (Royer, 1971) than figures with larger subset sizes. With definitions to pattern goodness, experiments about symmetry can be done in a more objective manner, and the nature of symmetry in human perception can be further explored.

2. Symmetry Perception in Individual with Average Intelligence

Symmetry is a special stimuli organization. There are numerous studies involving symmetry in different cognitive tasks. Although different kinds of symmetrical patterns are used, results consistently suggest that people perform better in cognitive tasks involving symmetrical stimuli. Also, people prefer symmetry to asymmetry (Arnheim, 1974; Berlyne, 1971; Birkhoff, 1933; Paraskevopoulos, 1968; Rock, 1973; Valentine, 1925). Past research also repeatedly showed that symmetry is detected faster, discriminated more accurately, and remembered better (Adams, Fitts, Rappaport, & Weinstein, 1954; Alexander & Carey, 1968; Arnheim, 1974; Barlow & Reeves, 1979; Berlyne, 1971; Bruce & Morgan, 1975; Corballis & Roldan, 1975; Fisher & Bornstein, 1982; Garner, 1974; Garner & Sutliff, 1974; Gibson, 1929; Hogben, Julesz, & Ross, 1976; Julesz, 1971; Pomerantz, 1977; Valentine, 1925).

Symmetry is salient to human perception. However, not all types of symmetry led to equivalent perceptual advantage over asymmetry. Different types of symmetry are defined according to the position of axes of symmetry. For example, patterns having a vertical axis is defined as vertical symmetry. Among all the different types of symmetry, vertical symmetry leads to the most perceptual advantage over other symmetries, such as horizontal, oblique symmetry or asymmetry. Research shows that when compared to oblique symmetries, horizontal symmetries, and asymmetries, vertical symmetries are preferred (Szilagyi & Baird, 1977). In cognitive tasks, vertical symmetry is detected, identified, and sorted better and more accurately (Barlow & Reeves, 1979; Corballis & Roldan, 1975; Fitts & Simon, 1952; Fitts, Weinstein, Rappaport, Anderson, Leonard, 1956; Julesz, 1971; Palmer & Hemenway, 1978; Rock & Leaman, 1963). Vertical symmetries are also remembered better than other symmetries in reproduction tasks (Deregowski, 1971; Howe, 1980).

The perceptual advantage of vertical symmetry is so robust that it can be found in early infancy. Bornstein, Ferdinandsen, and Gross (1981), used a habituate-dishabituate paradigm to test information processing in infants. (Habituation-dishabituate is a method used to study infant discrimination. It is assumed that infant will spend more time in looking at novel than familiar objects. By comparing the time spent in looking at different objects or pattern, researchers can tell whether infants can discriminate patterns shown to them.) They found that infants as early as four-month-old processed vertical symmetries more quickly and more completely than horizontal symmetries and asymmetries. Similar research also found that four-month-old infants can discriminate vertical symmetries from horizontal and asymmetries, however, they cannot discriminate horizontal symmetries from asymmetries (Fisher, Ferdinandsen, & Bornstein, 1981). Also, when preference for pattern emerged, preference for vertical symmetry emerged first by twelve month of age (Bornstein et. al, 1981).

Vertical symmetry is a unique organization in perception. In addition to vertical symmetry, both horizontal and oblique symmetries structures provoke relative perceptual advantages over asymmetry. However, it is controversial that whether horizontal or oblique symmetries have relatively more perceptual advantage over asymmetry.

On one hand, the concept of mental rotation favours the idea that oblique symmetry is better perceived than horizontal symmetry. When looking at patterns like symmetry, people will mentally rotate a non-vertical pattern to the vertical position in order to process them more efficiently (Kubovy & Podgorny, 1981; Shephard & Metzler, 1971). Corballis and Roldan (1975) conducted research and asked participants to decide whether the pattern is symmetrical or not. They found that the decision time is the shortest when the axis is vertical, and the decision time increased as a function of the angle between the axes and the vertical. It is suggested that people first mentally rotate the pattern to a vertical position before judgements are made. The further the axis from vertical, the longer it takes to make decisions. Therefore, in comparing horizontal and oblique symmetries, oblique symmetry is relatively nearer to vertical than the horizontal symmetry. It is suggested that oblique symmetry is better perceived than horizontal symmetry.

On the other hand, the concept "oblique effect", supports the opposite idea which states that vertical and horizontal are better perceived than oblique orientations. Appelle (1972) reviewed past research and found that the oblique effect can be found in human adults (e.g., Bouma & Andriessen, 1968), children (e.g., Bryant, 1969), and even animals like octopi (Sutherland, 1957), goldfish (Mackintosh & Sutherland, 1963), and pigeons (Zeigler & Schmerler, 1965) etc. The idea of oblique effects favours the idea that both vertical and horizontal symmetries are better perceived than oblique symmetry. This idea is confirmed in experimental work involving different types of symmetries (Attneave & Curlee, 1977; Barlow & Reeves, 1979; Fisher & Bornstein, 1982; Garner, 1970b; Goldmeier, 1972; Palmer & Hemenway, 1978; Royer, 1981).

For example, Goldmeier (1972) reported that in experiments about similarity judgement, people show a preference for vertical symmetry followed by horizontal and diagonal symmetries. Palmer and Hemenway (1978) found that detection time was the fastest for vertical symmetry followed by horizontal symmetry with the right- and left-diagonal symmetries the slowest. Royer (1981) also found that detection time is fastest for multiple symmetry. Vertical and horizontal symmetries were detected faster than oblique symmetry and centric patterns. Also Fisher and Bornstein (1982) suggested that performance in identification of symmetries with no explicit axes, indicated that vertical and horizontal symmetries shows a stronger perceptual advantage over oblique, and this general advantage follows retinal coordinates in human vision. Bornstein and Krinsky (1985) also found that as early as four-month-old, infants processed vertical symmetry more efficiently than vertical repeated patterns or oblique symmetrical patterns.

All this experimental evidence suggests that the relative perceptual advantage follows the sequence of vertical-horizontal-oblique, and that horizontal symmetry has a relatively stronger perceptual advantage over oblique symmetry. Developmental data about symmetry perception may also shed light on the perceptual advantage sequence.

Paraskevopoulos (1968) reported a developmental trend in preference for different types of symmetry. He tested children of different ages, and found children less than 6 years old did not process symmetry effectively. At six years old, children processed double symmetry (including both vertical and horizontal symmetries), at seven or eight years of age they processed vertical symmetry, and not until eleven, did children process horizontal symmetry. Although, oblique symmetry was not included in his study, Paraskevopoulos demonstrated a progressive development trend of processing symmetries, with the double symmetry developing first, follow by vertical and then horizontal symmetries.

Bornstein and Stiles-Davis (1984) included oblique symmetries when testing children of four to six years of age about symmetry discrimination. Results showed that the four-year-old group discriminate vertical symmetry more easily than they discriminate horizontal and oblique symmetries. Between 4.5 and 5.5 of age, children began to discriminate horizontal symmetry. At 6 children can discriminate all three kinds of symmetries equally well. In another two experiments, older children were tested with more complex patterns in pattern discrimination, and tested in memory-reproduction tasks. Their performance also followed the developmental sequence of vertical to horizontal to oblique. Bornstein and Stiles-Davis concluded that the development sequence for symmetry perception is vertical-horizontal-oblique, and demonstrated that horizontal symmetry leads to relatively more perceptual advantage than oblique symmetry, and is developed earlier.

Although evidence supporting both sides of the argument can be found, most experimental work and developmental data seem to favour the perceptual sequence of vertical-horizontal-oblique. The perceptual advantage of vertical symmetry is so robust that it can be found across different age groups in different perceptual tasks. In sum, vertically symmetrical patterns are detected earlier developmentally and are processed more efficiently than are horizontal or asymmetry.

3. Perception of Symmetry in Children with Mental Retardation

As suggested by the "developmental approach", children with familial mental retardation should have the same performance as normally developed children matched on mental age. This part of the literature review will focus on symmetry perception in children with mental retardation, to determine whether the same perceptual pattern can be found as in children with normal intelligence.

House (1966) studied discrimination abilities of individuals with mental retardation of a wide range of IQ. House compared performance of individuals with mental retardation using symmetrical and asymmetrical dot patterns, and found that symmetry clearly produced a strong facilitating effect on discrimination abilities. House showed that individuals with mental retardation also benefited from the stimulus structure of symmetry as did individuals with normal intelligence.

Another experiment also showed that individuals with and without mental retardation were equally affected by the structural characteristics of symmetry and adjacency in the stimuli. Caruso and Detterman (1983) manipulated structural organization of checkerboard-like patterns in a four-choice match-to-sample task. They classified the stimuli into two groups of highly structured and random patterns, in which the highly structured patterns were symmetrical. Although in terms of correct rate and reaction time, individuals without mental retardation performed better than those with mental retardation, both groups of participants were equally affected by the structural organization, and had a better performance with highly structured patterns of symmetry.

Following Caruso and Detterman (1983), Soraci, Carlin. Deckner, and Baumeister (1990) refined their research. Instead of two extreme categories of patterns, Soraci et al. (1990) included stimuli with intermediate levels of structural organization. Stimuli were also varied in terms of symmetry and adjacency. They replicated the findings in Caruso and Detterman's (1983). Both the individuals with and without mental retardation would detect the target efficiently, either when the target stimuli were highly organized or when there was a high disparity between target and distractor (i.e., highly structure target and randomly organized distractor or vice versa). However, with stimuli of intermediate levels of structure, individuals with mental retardation were less effective in utilizing the minimal inter-stimulus disparity. They may be less sensitive to structural organization than individuals without mental retardation, and more easily confused by stimuli with minimal stimuli disparity.

Considering that in Soraci and his associates' study (1990), stimuli are varied in two dimensions of both adjacency and symmetry, Carlin and Soraci (1993) further examined whether the findings would extend to similar stimuli varying only in symmetry. There were three groups of participants, namely individuals with mental retardation, individuals with matched mental age, and an other group matched on chronological age. Stimuli included four kinds of symmetry i.e., double, vertical, horizontal, and asymmetrical in checkerboard and polygon form-like stimuli. Polygon form-like stimuli were similar to those used by Palmer and Hemenway (1978). Results replicated the previous study that detection rates were highest in stimuli with maximum disparity between target and distractor. Particularly, the vertically symmetrical targets were the most easily detected. There was no significant difference across groups or stimuli type (checkerboard or polygon). This indicates that the symmetry effect is robust across groups differing in intelligence and across physically dissimilar stimulus types. Among different types of symmetries, vertical symmetry provokes the most perceptual advantage, and is most easily detected.

4. Symmetry Perception in Children with Down Syndrome

Although there is an abundance of literature on the perceptual advantages of symmetry, there is relatively little research which focuses on performance differences between individuals with and without mental retardation, particularly with specific reference to individuals with Down syndrome.

Stratford (1979) compared the performance of three groups of children, namely children with Down syndrome, children with other mental retardation, and normally developed children of matched mental age. He found that in matching and memory-reproduction tasks, children with Down syndrome are particularly attracted to symmetrical patterns. Their performance is as good as normally developed children matched with mental age with symmetrical stimuli. And this tendency is especially shown in memory-reproduction tasks, where children with Down syndrome are more likely to reproduce symmetrical pattern in response to asymmetrical stimuli.

In another study, Stratford (1981) suggested that children with Down syndrome are able to attend to both horizontal and vertical cues in discrimination tasks, however, distortion may be involved. As children with Down syndrome are attracted to "good form" (symmetry), with visual distortion, they may reverse or rotate the stimuli in order to produce a "good form". Stratford suggested that findings did not imply the tendency of attraction to good form is exclusively associated with Down syndrome, but that would also be found among other groups of children with mental retardation.

After reviewing the literature about symmetry perception in three groups of children, it can be concluded that symmetry is a special organization in visual perception. Among all types of symmetry, vertical symmetry provokes the most perceptual advantage, and is most easily processed. The robust advantage of symmetry, especially vertical symmetry, can be found across groups differing in age, intelligence, and also across different perceptual tasks using various stimuli.

5. Perception of Symmetrical Letters and Characters

As the fact that symmetry can provoke perceptual advantage over asymmetry is now established, application of the findings requires research conducted with stimuli from daily life. The previously mentioned research was conducted with stimuli designed by the researchers. Only a few of them used stimuli from real life. In this section studies using English letters as stimuli to investigate the property of symmetry are summarized.

Grindley and Townsend (1973) compared the perception and retention of four blocks of capital letters and four simple "nonsense" figures. They found that letters are better remembered than nonsense figures, which may explained by the fact that memory of letters is aided by verbalization, however, the mental imagery, which is supposed to help in remembering nonsense figures, is not stable enough. This made remembering nonsense figures a more difficult task. In some subsidiary experiments, they found that apart from verbalization, symmetry of the stimuli is also a factor which enhances performance. 10 out of 12 participants were able to draw one of the patterns, which was symmetrically structured with 4 "T"s, correctly without hesitation. They suggested that some of the purely geometrical qualities, which form a "good gestalt", is an important element helping participants to remember.

Fox (1975) also conducted a study using symmetrical English letters as stimuli to investigate processes underlining certain perceptual judgements. Fox reported that bilateral symmetry has a "diagnostic" significance for visual matching tasks. Diagnostic significance refers to a property with which participants can make a response to stimuli without any other analysis.

Satio (1986) examined how participants collect and integrate information and make inferences to respond during brief tachistoscopic presentations in perceptual tasks. Stimuli included symmetrical and asymmetrical "kanji" (Chinese characters) in Japanese of high, medium, and low levels of complexity according to the number of strokes. Saito reported that for symmetrical kanji, there was a marked decrease in the number of sections viewed by participants as the number of stroke increased, and that symmetrical Kanji are easier to identify than asymmetrical ones in the medium and high complexity groups. This result reflects that participants know the rules governing the structure of symmetrical characters, and they may generate the mirror image on their own after viewing part of the characters.

Perceptual advantage of symmetry is an established fact with people of different age, word level of intellectual function, however, relatively few studies of symmetry are conducted with real life stimuli. As in Grindley and Townsend's (1973) study, although they used English letters as stimuli, their findings is derived from some subsidiary study. Moreover, no experimental work has been done with Chinese characters, even one has been done with Japanese kanji, which is similar to Chinese characters. One of the aims of the present study is to apply the established findings about symmetry to learning Chinese characters.

CHAPTER IV

CHINESE CHARACTERS –

LITERATURE REVIEW

Chinese language has a very long history and is a special language, different from European languages. There are some characteristics unique to Chinese language, which affect its perception and learning. As mentioned, many Chinese characters are symmetrically shaped, and they are chosen as stimuli in the present study. Literature about its configuration and structure, which affects perception and learning of the language, is described in this chapter.

1. Structure and Learning of Chinese Characters

Language can be classified into three types depending on the nature of its orthography. The three types of language are alphabetic, syllabic and morphemic. Alphabetic language is a language where a graphic unit represents the phonemes (the smallest unit of sound); syllabic language is a language where the graphic represent a syllable; in morphemic language, the graphic represents a morpheme (the smallest unit of meaning). Learning language is different according to the different type of the language.

Chinese is a morphemic language, in which each Chinese character independently represents a unit of meaning, and each character is pronounced as a syllable. In alphabetic and syllabic languages, the graphics are matched on sound; rules governing the relationship between sound and shape of the graphic units facilitate reading of the language. However, in morphemic languages, graphic units are matched to meaning, there are no associations between sound and shape, and people learning morphemic language need to rote memorize sounds and make associations of their own for different characters. This leads to difficulties in learning Chinese, as there is quite a high loading on children's memory for sound, shape and meaning of each of the characters (Hoosain, 1986).

Characteristics of Chinese language helps to explain traditional emphasis on rote reading practice in classroom when learning the language, and abilities required in learning specific to different language scripts. As Tzeng and Wang (1983) suggested that,

> "It may be more difficult for a Chinese or Japanese child to learn to convert script to sound automatically, owing to the fact that the information about pronunciation is not always specified in the logographs. That is why reciting aloud plays so important a role in the early acquisition of reading skills in both China and Japan." (p. 242)

As there is no rule defining the relationship between sound and shape of Chinese characters, visual perception and discrimination of a characters' shape is important in learning the language. Development or formation of Chinese writing systems may give a hint on the importance of visual perception of the shape of characters. At first, primitive people draw picture of objects on rocks to communicate and express ideas. These paintings and drawings on rocks are called semasiography (Gelb, 1952). As the writing system developed, drawing may have become inconvenient and people have invented symbols instead to represent the spoken language. Some symbols which were carried over from the previous drawings are called pictograms (for example, the Chinese character "木" represent a tree). There are also ideograms which are formed by putting several pictograms together (For example, two pictograms "木"are put together to form "林", and three to form "森" which means "grove" and "forest" respectively). In addition phonograms are invented to represent abstract concepts. Phonograms are made up of semantic and phonetic components, which give hints on meaning and sound to reader respectively. The Chinese writing system was formed with these three rules (Wang, as cited in Hung & Tzeng, 1981). As can been seen, the Chinese writing system is formed of pictograms, ideograms, and phonograms, which are indirectly derived from drawings and pictures, and the shape of individual Chinese characters may give a hint on its processing. This reveals that visual discrimination of shape is more important in learning Chinese than the relationship between word components when learning an alphabetic language. Although no definite causal relationship can be derived, the importance of visual processing in learning Chinese language is indirectly confirmed by the finding that Chinese readers perform better in visual discrimination tasks than English speaking participants (Carlson, 1962; Lesser, Fifer, & Clark, 1965; The Psychological Corporation, 1981).

Experimental work also supports the view that memory of Chinese characters is more closely related to visual codes. Tzeng and Wang (1983) also found that Chinese readers were superior in recalling materials in serial lists presented visually, no matter whether they were asked to report orally or in written form. This difference is not found in English readers. This result suggests that processing logographs (Chinese characters) involves more visual memory than processing alphabetic scripts.

In analyzing errors made by Chinese dyslexic children (people with reading disabilities) further evidence is given of the fact that visual processing is important in learning Chinese language. Children aged seven to ten were compared with control participants in several tests including a Chinese characters recognition test, the Frostig Developmental Test of Visual Perception, the Auditory Association Test of the Illinois Test of Psycholinguistic Abilities, and a digit span test. Results showed that children with Dyslexia made significantly more visual than auditory errors. Also a significant group difference was found in visual tests but not in auditory tests (Woo & Hoosain, 1984). A similar finding also supports the idea that reading disabilities in Chinese are more related to visual-spatial processing (Stevenson et. al., 1982). These results indicate that visual processing is important in learning the Chinese language.

Literature described above shows that the unique configuration and structure of Chinese characters affects learning of the language. As mentioned, distinctive mapping of shape to its sound and meaning for each individual character may place a relative high loading on children learning to read. As there is no rule giving the relationship of shape to sound in Chinese characters, it helps to explain the traditional way of teaching the language, which focuses on rote memorizing and reciting practice. The relationships between shape and sound or meaning also indicate that visual processing is important in learning Chinese language. It is directly or indirectly supported by the formation and development of Chinese characters, the better performance of Chinese readers in visual discrimination tasks, and in the types of errors made by Chinese dyslexic children.

2. Visual Perception of Chinese Characters

Visual discrimination and processing is important in learning the Chinese language, and characteristics of Chinese characters affect their perception, which in turn affects reading performance. Literature shows that the unique Chinese orthography does affect perception, which is different from alphabetic languages. For example, the way Chinese text is presented in written form, the configuration of Chinese characters, syntax and semantic processing of Chinese language, all account for perceptual differences. In this section, literature about the relationship between distinctive characteristics of Chinese language and its visual perception is reviewed.

Chinese text has its own way of presentation in a written form, and this accounts for perceptual differences. In the past, Chinese texts were read vertically from top to bottom; whereas English texts are read horizontally from right to left. In modern Chinese, texts arranged horizontally from right to left are found more frequently. As can be seen in Chinese newspapers, both arrangements of text can be found on the same page. Research found that reading habits associated with a particular orthography affects visual acuity. Freeman (1980) reported that American participants find it more difficult to identify random English letters arranged vertically rather than horizontally. However, this difference is not found in Chinese readers. There is no significant acuity difference in Chinese readers who perceive Chinese characters either in rows or in columns.

However, this acuity difference is not due to racial factors, because the same difference cannot be found in young American children, who have not yet begun to read. The difference can be attributed to the reading experience associated with a particular orthography, as Chinese readers are used to reading text arranged either vertically or horizontally. This experiment shows that reading experience does affect visual perception.

Orthography also affects eye movement when reading texts. Saccadic movement, which is abrupt with quick jumps, is common in reading. Reading speed depends on the span of saccadic movement between each fixation, and the need to move back to previous parts to retrieve missed information. Peng, Orchard, and Stern (1983) reported that there is a difference in the frequency of saccadic movement in reading Chinese and English texts. They found that Chinese participants required more saccades per line of reading Chinese text than American participants when reading English text. The difference can be attributed to orthographic differences of the two languages. Chinese syntax may contribute to its compactness. English language has inflections, like "-ed" or "-ing" to express tenses, with no regular width. However, unlike English, Chinese characters are confined within a square. Chinese text is more compact and dense, and requires readers to pay more attention to each character. However, it does not mean that Chinese readers are slower compared to American readers. As research found that the duration of each fixation of eye is similar for Chinese and American readers, although Chinese readers required more frequent and smaller saccadic movements, the difference is reduced to zero in terms of the number of words read. Results suggest that configuration of characters and syntax of language do account for differences in perception and reading. Apart from configuration and syntax differences, semantic processing of Chinese language is an aspect unique to the language.

Processing of meaning of morphemic symbols (Chinese language) could be more direct than that of alphabetic symbols (Chao, 1968). Experimental work gives evidence supporting the hypothesis that the meanings of Chinese characters are more manifested by their shape and can be read more directly from their orthographic configuration. Visual perception of Chinese characters may give hints to its meaning. Hoosain and Osgood (1983) presented words of opposite affective meanings (e.g. HEAVEN and HELL) and participants were asked to indicate whether the words were positive or negative. Results showed that Chinese readers could respond faster than American participants who responded to equivalent words matched for a mean number of syllables. Results suggested that the meaning of Chinese characters can be assessed faster and more directly than alphabetic orthography.

Studies of the Stroop Effect (1935) conducted with Chinese characters gives further support to the fact Chinese characteristics are more manifested (please refer to previous section for details of Stoop effects). In experiment of the Stroop Effect, participants are required to respond to stimuli with incongruent aspects. For example, if the word "BLUE" is printed using "RED" ink, the answer is RED. People need to suppress the meaning of words and direct their attention to other aspects in order to response correctly. Biederman and Tsao (1979) reported that Stroop interference is greater for Chinese characters. This indicates that it is more difficult to avoid noticing the meaning of colour words in Chinese, and that the meaning is more directly assessed in Chinese characters.

Tzeng and Wang (1983) reported that in an experiment of a similar nature, participants were asked to indicate which numbers were bigger in physical size in a pair of numbers. The number pairs were written in Chinese, Arabic numbers, or English. It was found that participants took a longer time to name the bigger number in physical size which was actually smaller in numeric value; however, this effect was seen with Chinese and Arabic numbers only and not with numbers written in English.

From the literature review, it can be noted that Chinese language is special in its orthography, which contributes to perceptual differences and different performances particular associated with the Chinese language. It can be seen that the way Chinese language is presented, in text, in configuration of characters, and in its syntax, all of which shape readers' reading habits, may affect their eye movement when reading, and thus contribute to perceptual differences in reading. The meaning of Chinese characters are manifested more, and can be assessed more directly compared to English words. This is supported by research conducted with different types of Chinese characters, like affective meaning words, colour words, and numbers.

Visual processing and the shape of Chinese characters is important in learning the language; however, which aspects of the shape of characters contribute to make a difference in processing learning is left unexplored. One of the aims of the present study is to apply past research findings to further investigate whether the symmetrical property of some Chinese characters contributes to a difference in their processing.

CHPATER V

DEFINITIONS AND HYPOTHESES

1. Operational Definition

The present study aims at comparing the performance of learning symmetrical three different groups of children. Operational definitions of terms used in the present research are described as follows:

1. **Learning.** Performance is the observable behavior which can be used as a basis to determine whether learning has taken place (Ross, 1976). In the present study learning is measured by the performance of children in matching and memory tasks.

Performance in Matching Tasks. It is measured by the score obtained from correctly matched stimuli. One additional point will be given to a correctly matched stimulus plate comprised of three characters.

Performance in Memory Tasks. It is measured by the score obtained from correctly memorized stimuli. One additional point will be given to a correctly memorized stimulus plate comprised of three characters.

2. **Stimuli Organization**. The nature of stimuli is an important factor in deriving a complete picture of performance in a cognitive task (Garner, 1970). The stimuli used in the present study are symmetrical or asymmetrical.

Symmetry. It refers to stimuli with an assumed vertical axis, where the patterns on the right-and left- hand sides are mirror images of each other.

Asymmetry. It refers to stimuli with an assumed vertical axis, where the patterns on the right- and left-hand sides are not mirror image of each other.

3. **Language Structure**. Language structure affects learning and processing. For example, there is no rule telling relationship between shape, sound, and meaning of each chinese character, and learning Chinese characters may be a difficult task for children (Tzeng & Wang, 1983). As Chinese characters are used as stimuli non-words are included as control stimuli.

Words. It refers to real Chinese characters which are chosen from textbooks used in kindergarten. Both symmetrical and asymmetrical words are included.

Non-words. It refers to pseudo characters designed to look like real Chinese characters as control stimuli in the present study. Both symmetrical and asymmetrical structures are included.

4. Different Types of Children. Affected by different constitutional characteristics including intellectual functioning; learning performance therefore is likely to be different. The present study compares the performance of three groups of children. They are children with average intelligence, with mental retardation, with Down syndrome.

Children with average intelligence. It refers to children with chronological age of 43 to 77 months with a normal range of intelligence, i.e., with intelligence quotient between 85 to115.

Children with mental retardation. It refers to children with chronological age of 81 to 162 months mild grade mental retardation, i.e., with an intelligence quotient between 50 to 70, without any known etiology.

Children with Down syndrome. It refers to children with chronological age of 88 to 209 months, identified as having an extra chromosome in the twenty-first pair with mild grade mental retardation i.e., with an intelligence quotient between 50 to 70.

2. Hypotheses and Rationale

From the literature reviewed in previous chapters, several hypotheses are derived, and the relevant rationale are described as follow:

Hypothesis One (Study One):

a) Symmetrical stimuli (including words and non-words) are matched significantly better than asymmetrical patterns in children with average intelligence.

b) Symmetrical stimuli (including words and non-words) are memorized significantly better than asymmetrical patterns in children with average intelligence.

It is confirmed that symmetrical stimuli lead to a perceptual advantage over asymmetrical patterns. The advantage is so robust that in various tasks of a different nature, people have a much better performance with symmetrical than asymmetrical stimuli. Symmetry is detected faster, discriminated more accurately and remembered better than asymmetry (Adam, Fitts, Rappaport, & Weinstein, 1954; Alexander & Carey, 1968; Arnheim, 1974; Barlow & Reeves, 1979; Berlyne, 1971; Bruce & Morgan, 1975; Corballis & Roldan, 1975; Fisher & Bornstein, 1982; Garner, 1974; Garner & Sutliff, 1974; Gibson, 1929; Hogben, Julesz, & Ross, 1976; Julesz, 1971; Pomerantz, 1977; Valentine, 1925). Furthermore, vertical symmetry can lead to the most perceptual advantage among all types of symmetries, e.g., horizontal, oblique symmetries. Symmetrical stimuli used in the present study are all vertically structured symmetry. The phenomenon also can be found across different cognitive tasks, such as detection, recognition, and memory (Barlow & Reeves, 1979; Corballis & Roldan, 1975; Deregowski, 1971; Fitts & Simon, 1952; Fitts, Weinstein, Rappaport, Anderson, & Leonard, 1956; Howe, 1980; Julesz, 1971; Palmer & Hemenway, 1978; Rock & Leaman, 1963).

Hypothesis Two (Study Two):

a) Symmetrical stimuli (including words and non-words) are matched significantly better than asymmetrical stimuli in children with mental retardation.

b) Symmetrical stimuli (including words and non-words) are memorized significantly better than asymmetrical stimuli in children with mental retardation.

The literature shows that children with mental retardation also benefit from symmetrically structured stimuli. Research found that children with mental retardation perform better with symmetrical stimuli in discrimination tasks (House, 1966), match-to-sample tasks (Caruso & Detterman, 1983) and detection tasks (Carlin & Soraci, 1993) with different kinds of stimuli, e.g., checkerboard and polygon form-like stimuli. Among different types of symmetries, children with mental retardation also attained better performances with vertical symmetry (Carlin & Soraci, 1993).

Hypothesis Three (Study Three):

a) Symmetrical stimuli (including words and non-words) are matched significantly better than asymmetrical stimuli in children with Down syndrome.

b) Symmetrical stimuli (including words and non-words) are memorized significantly better than asymmetrical stimuli in children with Down syndrome.

Experimental studies found that children with Down syndrome are attracted to symmetrical stimuli, and this is shown by their performance in memory tasks. They are more likely to reproduce symmetrical stimuli, even if there is no equivalent stimuli presented in the question (Stratford, 1979). As children with Down syndrome are attracted to symmetry, they may try to reverse or rotate the stimuli in order to produce symmetry in discrimination tasks (Stratford, 1981).

Hypothesis Four (Study Four):

a) With matched mental age, performances of the matching test in children with average intelligence and children with mental retardation, or children with average intelligence and children with Down syndrome are not significantly different.

b) With matched mental age, performances of the memory test in children with average intelligence and children with mental retardation, or children with average intelligence and children with Down syndrome are not significantly different.

According to the "similar structure hypothesis" of Zigler's "developmental position" (1966, 1969), it is predicted that children matched on mental age will have a similar performance. Although the hypothesis of the "developmental position" applied to individuals with cultural-familial retardation in which no clear etiology of organic abnormalities can be found (Zigler & Hodapp, 1986), research aimed at extending the position to children with clear etiology is on-going (Zigler & Hodapp, 1997). Down syndrome is a genetic disorder caused by the presence of an extra chromosome in the twenty-first pair, and can be identified at birth.

Hypothesis Five (Study One, Two, and Three respectively):

a) Words are matched significantly better than non-words in all the three groups of children (children with average intelligence, children with mental retardation, and children with Down syndrome).

b) Words are memorized significantly better than non-words in all the three groups of children (children with average intelligence, children with mental retardation, and children with Down syndrome).

It is apparent that previous experience of Chinese characters may help children to have a better performance. Literature also shows that verbalization of stimuli helps participants to remember in perceptual tasks (e.g. Grindley & Townsend, 1973). Verbalization of Chinese characters enhances performance in matching and memory tasks, and the meaning of Chinese characters can be assessed more directly, and more easily (e.g. Hoosain & Osgood, 1983; Tzeng & Wang, 1983). The meaning associated with Chinese characters can also contribute to better performances with word rather than non-word; even though the non-words are designed to look like real Chinese characters.

CHAPTER VI

PILOT STUDY

1. Introduction

In the main study, each group of children needed to complete three tasks. These were the Goodnenough-Harris Drawing Test (Harris, 1963) to derive their mental age, the matching test, and the memory test. As very young children and children with mental retardation were involved in the research, it was necessary to make sure they fully understood the instructions of each task in order to obtain objective results. Moreover, the instructions of drawing test were in English, and not suitable for Cantonese-speaking children. The instructions were translated into Chinese using wordings comprehensible to children. The pilot test was carried out to test the three sets of instructions used in the Drawing, matching, and memory tests. Moreover, as Chinese characters and designed pseudo characters were used as stimuli in the research, the pilot study also tested the stimuli, especially the pseudo characters, used in the research.

A pilot study was conducted to test procedures and measurements used in the main study. Following is a list of the purposes of the pilot study: 1) to test the translated instructions of the Goodenough-Harris Drawing Test; 2) to test whether children understand the instructions and task requirements of matching and memory tests; 3) to test characters and pseudo characters used in the main study.

2. Methodology

Participants

5 children with average intelligence and 5 children with mild grade mental retardation participated in the pilot study. Children with average intelligence range in chronological age (CA) from 42 to 56 months. There were three boys and two girls. They attend normal nursery schools. The children with mild grade mental retardation were from CA 96 to 138 months. They attend special schools for children with mild grade mental retardation. There were four girls and one boy.

Testing Materials

To test the instructions of the drawing test, instructions of the Goodenough-Harris Drawing Test (Harris, 1963) was translated into Chinese (see appendix 1 & 2). Standardized instructions for matching (appendix 3 & 4) and memory tests (appendix 5 & 6) were also written.

Two sets of characters, real Chinese characters and pseudo characters, were used in both matching and memory tests. Real Chinese characters were chosen from textbooks used in schools. Pseudo characters were designed to look like real Chinese characters (see appendix 7). Characters were produced by filling squares on graph paper to ensure symmetrical properties. In every trial, children matched or remembered three characters printed on cardboard. Characters in the same trial occupied the number of squares, i.e., they were of same area.

Procedure

The examiner followed pre-set instructions and asked children to complete the Goodenough-Harris Drawing Test (Harris, 1963). The drawing test required children to draw three pictures of his or her mother, father, and self. Children were given a pencil and eraser to draw the pictures with a time limit of 5 minutes for each picture.

In the matching test, the examiner first laid three characters on the table. Children were then given three characters, which were the same as those on the table. Children were asked to match characters in hand to those on the table by putting the matched one below the other.

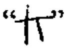
In the memory test, the examiner also followed pre-set instructions and asked children to remember characters on the table. At first the examiner placed three characters on the table and asked children to memorize them. Children were asked to indicate when they can remember all the three characters. The examiner then covered the characters, and a set of three characters was given to children. Children needed to reproduce the characters in exactly the same position and order they had just seen.

3. Results and Discussion

As only a small number of children participated in the pilot study, and not all the children completed the three tasks, the results were obtained by casual observation and by asking children questions, and no statistical results are reported. Results are discussed as follows.

Apart from one child with mild grade mental retardation, all the other nine children with or without mental retardation understood the instructions for the three tasks. Their understanding was demonstrated by their performance in the tasks. After children indicated that they understood the instruction, several trials were given to them to test their understanding. The failure of the only child who failed to complete the tasks was to her lack of corporation. Furthermore, it was observed that having the examiner demonstrate when giving instructions gave the children a better understanding, although sometimes the examiner needed to repeat the instructions.

In the memory task, it was found that the amount of time children needed to remember the stimuli varied. Children with average intelligence required less time to remember stimuli than children with mental retardation. In the two groups of children, the time required ranged from 3 to 23 seconds, and the average was about 10 seconds. Results suggested that the maximum viewing time in the memory task should be 10 seconds in the main study.

Some problems were found with the pseudo characters. It was found that children made an association of pseudo characters with other characters or objects to aid memory in the memory task. Some examples are listed as follow. The stimuli "X" and "T" were perceived as English alphabets "x" and "t" respectively. The stimuli " ㄐ " was referred to as the Arabic number " 4 ". One child reported the stimuli "" as a giraffe. Results suggested that when designing pseudo characters, they should be designed so as not to provide hints or confusion for the children, as some pseudo characters were interpreted as characters or letters of languages other than Chinese. Also associations made by children may affect their performance in the tasks, and introduce variables other than symmetry to the stimuli. In the main study, pseudo characters, which proved to be problematic, were replaced by other pseudo characters.

CHAPTER VII

MAIN STUDY: METHODOLOGY

1. Participants

Three groups of children participated in this study. They were a) children with average intelligence; b) children with mental retardation; and c) children with Down syndrome. There were 30 children in each group. Children with average intelligence were from one normal nursery. Children with Down syndrome and children with mental retardation were from two special schools for children with mild grade mental retardation. Both children with Down syndrome and children with mental retardation lived at home. Children were randomly chosen to be participants after their parents' consent was obtained.

The children with average intelligence were from CA 43 to 77 months (mean: 65.2 months; SD: 9.6 months). Their mental age derived from the Goodenough-Harris Drawing Test (Harris, 1963) ranged from 90 to 151 months (mean: 111.4 months; SD: 15.3).

The children with mental retardation were from CA 81 to 162 months (mean: 115.3; DS: 17.7). Their mental age derived from the Goodenough-Harris Drawing Test (Harris, 1963) ranged from 56 to 107 months (mean: 74.2; SD: 12.4). The children with mental retardation were assessed and found to be of mild grade mental retardation for which there are no known etiologies before their school placement.

The children with Down syndrome were from CA 88 to 209 months (mean: 141.1; SD: 39.8). Their mental age derived from the Goodenough-Harris Drawing Test (Harris, 1963) ranged from 53 to 89 months (mean: 70.9; SD: 10.4). Children with Down syndrome are identified with an extra chromosome at the twenty-first pair; they were assessed and found to be of mild grade mental retardation before their school placement. Table 1 summarizes demographic data of the three groups of children.

Table 1

Demographic Data of Three Groups of Children

	Children		
	Average Intelligence	Mental Retardation	Down Syndrome
Chronological age			
Minimum	43	81	88
Maximum	77	162	209
Mean	65.2	115.3	141.1
SD	9.6	17.7	39.8
Mental age			
Minimum	90	56	53
Maximum	151	107	89
Mean	111.4	74.2	70.9
SD	15.3	12.4	10.4

Note: Numbers are reported in months

2. Measurements and Rationale

Goodenough-Harris Drawing Test

The Goodenough-Harris Drawing Test (Harris, 1963) was used to measure cognitive maturity of the children participants in the study. The test can be administered individually or to a group of children aged between three and sixteen. Although the Test does not yield a score identical to the IQ derived from a well-administered individual intelligence test, a crude index of mental development can be obtained. According to Sattler (1992),

> "The purpose of the Test is to measure intellectual maturity—the ability to form concepts of an abstract character. This ability involves perception (discrimination of likenesses and differences), abstraction (classification of objects), and generalization (assigning newly experienced objects to the correct class)." (p. 311).

The test measured the cognitive abilities of perceptual discrimination, abstraction, and generalization, which are relevant to the aspects (visual perception) of the main study (Sattler, 1992).

The Test is reliable and valid in measuring children's cognitive ability. After reviewing studies, Scott (1981) indicated that the Test is reliable (Mdn test-retest r_{xx} = .74). Interrater reliabilities are satisfactory (Mdn r's = .90 for Draw-A-Man and .94 for

Draw-A-Woman), and the test effectively discriminates the performance of children aged between 5 to 12.

The test is suitable for testing children with mental retardation. The Goodenough-Harris Drawing Test is non-verbal, and only requires children to draw three pictures (their mother, father, and self), and is suitable for children with language difficulties (some children with mental retardation have language difficulties). The Test is easy to administer and not time consuming. Drawing is an interesting activity which arouses children's interest in doing the subsequent matching and memory tests, and helps to build up a rapport between the examiner and children.

<u>Matching and Memory tests</u>

Learning is closely related to perception, as perception affect materials learnt during the learning process (Uhr, 1973). According to Ross (1967) performance in tasks is the observable behavior to determine whether learning has been occurred. This study used two perceptual tasks to measure learning in children, they were the matching and memory tests. Similar methodology has been adopted in previous research to compare performance in children with Down syndrome, with other mental retardation and with average intelligence of their discrimination (Stratford & Metcalfe, 1981), or recognition and recall (Stratford & Metcalfe, 1982)

Also, perceptual skill has been studies with many different tasks. Proctor and Dutta (1995) reviewed previous research involving cognitive tasks and summarized that task can be classified according to the type of judgement required. These are detection, discrimination, recognition, identification, memory search, and visual search. In the matching test of the present study, identification and discrimination were involved, subjects needed to identify target stimuli and discriminate them from other stimuli. And in memorizing stimuli, recognition and memory search was involved, subjects needed to recognize the presented stimuli and search from memory to response. The present study follows the methodology adopted in previous research involving the three groups of children, and uses matching and memory tests to examine perceptual skills which are considered important in learning.

3. Stimuli

There were two perception tests in the present study. They were the matching test and the memory test. Similar sets of stimuli were used in both tests.

In both the matching and memory tests, there were twelve plates of stimuli with three characters printed on each. Three characters were used because according to the syntax of Chinese language, the simplest phrase can be constructed by "structure + verb + object" which can be represented by three Chinese characters, e.g. "我 爱 你" (I love you). However, no meaningful character combination was used to avoid introducing an extraneous variable to the study.

In each plate, both symmetrical and asymmetrical characters were included to simulate reading in real life. In symmetrical plates, there were more symmetrical characters than asymmetrical, i.e., two symmetrical and one asymmetrical, and vice versa in asymmetrical plates. All possible combinations of symmetrical and asymmetrical stimuli were used, i.e. AAS, ASA, SAA, SSA, SAS, and AAS (A = asymmetry and S = symmetry). The total twelve stimuli plates included two sets of the combinations described, i.e., thirty-six characters, of which eighteen were symmetrical and eighteen were asymmetrical. Of the symmetrical and asymmetrical stimuli, nine of them were real characters and nine of them pseudo characters. Real Chinese characters chosen are commonly found in textbooks used in nurseries and special schools in Hong Kong; pseudo characters were designed to look like real Chinese as control characters.

To control the symmetrical property of the stimuli, they were produced by filling in squares on graph paper. After considering several printed styles of Chinese characters, it was found that some characteristics of Chinese characters affected the symmetrical property and perception of participants. For example, the beginning and end of each stroke are thicker than the remaining part; if affected by these elements, the word would not be perceived as absolutely symmetrical. Therefore, each character was produced by filling a 7 x 7 square made up of 0.6 x 0.6 cm squares on graph paper to eliminate the problem and to have a better control over the stimuli. The three characters on each plate occupied the same number of squares. There were corresponding pseudo characters, which occupied the same area on each plate as the real characters. Please refer to appendix 12 for the complete sets of stimuli used in the study.

4. Procedures

An information sheet explaining the purpose, procedure, and format of the test, and explaining their right to consent or withdraw was sent to parents through the schools. Parents were asked to sign the consent form which was obtained in advance of the test.

Goodenough-Harris Darwing Test

Before the main study was conducted, the Goodenough-Harris Drawing Test (Harris, 1963) was administered. Children were asked to draw three pictures on three pieces of A4 paper with pencil, an eraser was also given to children to make any corrections if necessary. The examiner explained the task to children following the translated version of instructions from the manual (Appendix 1 & 2). Children were first asked to draw their father, followed by their mother and then themselves.

Matching Test

The matching test was administered after the drawing test. The examiner explained the test to the children, following the standardize instructions (appendix 3 & 4). The children were given several practice trials to make sure they understood the task. The test was administered individually. Firstly, the examiner laid a plate on the table before the participant. Secondly, three characters, which were the same as those laid on table, were given to the children. Thirdly, children were required to discriminate and match characters in their hand to those laid on the table. The children responded by placing the matched characters below the stimuli. The whole matching test consisted of six trials with real Chinese characters, followed by another six trials with pseudo characters. Children took a short break after completing the matching test.

<u>Memory Test</u>

The procedure of the memory test was similar to that of the matching test, except that memory was involved. The examiner explained to children according to the standardize instructions (appendix 5 & 6). As in the matching test, several practice trials were given to children to make sure they understood the task. Firstly, the examiner laid a plate with three characters on the table. Secondly, the children were asked to pay attention for a maximum time of ten seconds and remember the three characters, both the appearance and the positions. The examiner then covered the plate, and gave the same set of three cards to the children and asked them to reproduce the characters they had just seen in exactly the same orientation and positions. The whole memory test consisted of six trials of real Chinese characters followed by another six trials with pseudo characters as control.

5. Scoring Method

<u>The Goodenough-Harris Drawing Test</u>

The scoring of drawings by children followed procedures set by the Goodenough-Harris Drawing Test Manual (Harris, 1963). A point scale, which measures the presence, and proportion of different body parts was used. The Man-point-scale (appendix 17) and Woman-point-scale (appendix 18) were used for father and mother respectively. For the self-picture, a different point-scale was used according to gender of the children. Raw scores were then converted to standardized scores according to age of each child. An index of cognitive development was obtained by taking an average of standardized scores of the three pictures drawn by each child. Children's mental ages were matched according to this average score.

Matching and Memory Test

The scoring of the Matching and Memory tests was the same. Each stimulus plate consisted of three characters. One point was given to a response when all the three characters on a plate were matched or remembered correctly. No point was given to responses with only one or no characters were matched or memorized correctly.

A stimulus plate instead of a character was counted as a response unit. It is because each child was given three characters each time, once one of the characters had been placed incorrectly, the possibility for the other two characters to be correct is immediately affected. In that case, score would not by independent. Therefore, it would be unfair to score each character individually. Instead the whole plate with three characters on each was considered as one response unit.

6. Data Analysis

Descriptive data, mean scores and standard deviations, were used to summarize the performance of children in difference studies. Repeated measures were used to analyze the performances of children. Word and symmetry were the two within-subject variables, and group was the between-subject variable in the present study. 2 (word) x 2 (symmetry) ANOVA repeated measures were calculated to analyze performance in each group of children to see whether performance is better with word or non-word, and symmetry or asymmetry. 2 (word) x 2 (symmetry) x 3 (group) ANOVA were calculated to compare performances with different types of stimuli between two groups of children.

CHAPTER VIII

REPORTS OF STUDIES ONE TO FOUR

STUDY ONE: CHILDREN WITH AVERAGE INTELLLIGENCE

The structure of the Chinese language makes learning Chinese characters a difficult task for children (Tzeng & Wang, 1983). Chinese is a morphemic language, in which each character is pronounced as a syllable, and represents a meaningful unit. However, there is no rule governing the relationship between the sound and shape of each character. Children learning Chinese need to rote memorize mapping between each graphic character, sound, and meaning. High loading on children's memory for sound, shape, and meaning of each character reveals difficulties in learning the Chinese language (Hoosain, 1986).

On the other hand, symmetry is a special stimulus organization which leads to a perceptual advantage in perception. A vast amount of research has found that people have a better performance with symmetry than asymmetry in different cognitive tasks, such as discrimination, detection, and memory (Adams, Fitts, Rappaport, & Weinstein, 1954; Alexander & Carey, 1968; Arnheim, 1974; Barlow & Reeves, 1979; Berlyne, 1971; Bornstein, Ferdinandsen, & Gross, 1981; Bruce & Morgan, 1975; Corballis & Roldan, 1975; Fisher & Bornstein, 1982; Garner, 1974; Garner & Sutliff, 1974; Gibson, 1929; Hogben, Julesz, & Ross, 1976; Julesz, 1971; Pomerantz, 1977; Valentine, 1925). Among all types of symmetries, vertical symmetry leads to the most perceptual advantage compared with other symmetries, such as horizontal, oblique symmetries (Barlow & Reeves, 1979; Corballis & Roldan, 1975; Deregowski, 1971; Fitts & Simon, 1952; Fitts, Weinstein, Rappaport, Anderson, & Leonard, 1956; Howe, 1980; Julesz, 1971; Palmer & Hemenway, 1978; Rock & Leaman, 1963).

Numerous experiments support the view that symmetry is salient in human perception, however, all the research has been conducted in Western culture using artificial patterns, such as polygons, and checkerboards, as stimuli. No stimuli from real life were used. This study conducted research about symmetry in a Chinese culture with Chinese characters to validate research finding established in Western cultures. A survey conducted in Japan showed that over 70 % of "hanji" (Chinese characters) are symmetrical or contain symmetrical elements (cited in Saito, 1986). As many of the Chinese characters are vertically structured or contain symmetrical elements, this provides ready-made symmetrical stimuli from life in the present study. The purpose of the present study is to validate Western findings about symmetry in Chinese culture using stimuli from life, and results may provide information to help children in learning Chinese characters.

Matching and memory tests involving discrimination, recognition, and memory, which are important abilities in learning are used in the present study to examine children's performance with different stimuli. Non-word pattern designed to look like Chinese characters was used to control the variable of previous experience with stimuli, which may affect the performance. This study was conducted with two objectives: 1) to test findings about symmetry in Chinese culture using stimuli from life; 2) to examine whether symmetry facilitates reading and memory in young children. Two hypotheses were tested, they are: 1) symmetrical patterns, either word or non-word, were matched and memorized significantly better than asymmetrical patterns; 2) Words were matched and memorized significantly better than non-words in children with average intelligence.

Methodology

Participants

30 children with average intelligence participated in the present study. They attend normal nursery, and were aged form 43 to 77 months (mean: 65.2 months; SD: 9.6 months).

Stimuli

Similar sets of stimuli were used in the matching and memory tests. There were twelve plates of stimuli with three characters printed on each. In each plate, both symmetrical and asymmetrical characters are included to simulate reading in real life. In symmetrical plates, there are more symmetrical characters than asymmetrical, i.e., two symmetrical and one asymmetrical, and vice versa in asymmetrical plates. All possible combinations of symmetrical and asymmetrical stimuli were used, i.e., AAS, ASA, SAA, SSA, SAS, and ASS (A = asymmetry and S = symmetry). The number of symmetrical and asymmetrical are equal. Real Chinese characters chosen are characters which are commonly found in textbooks used in nursery and special school in Hong Kong; pseudo characters are designed to look like real Chinese characters and were used as control characters.

Procedure

Matching Test. Firstly, the examiner laid a plate on the table before the participant. Secondly, three characters, which were the same as those laid on table, were given to children. Thirdly, the children were required to discriminate and match characters in hand to those laid on the table. The children responded by placing the matched characters below the stimuli.

Memory Test. Firstly, the examiner laid a plate with three characters on the table in each trial. Secondly, the children were asked to pay attention and remember the three characters, including the appearance and positions. There was no limit to the time spent on viewing the stimuli. After children indicated that they could remember all the characters, the plate was covered. Thirdly, the examiner gave the same set of three cards to children and asked them to reproduce the characters they just saw in exactly the same orientation and positions.

Results

Matching Test

Comparison of mean scores and standard deviation of each type of stimuli are summarized in Table 2. Mean scores showed that children had a good performance in the matching test. All children matched all stimuli correctly, except for a few mistakes made with symmetrical non-words (SNW). To examine whether symmetry or word affect matching in children with average intelligence, 2-way ANOVA repeated measures were computed with matching scores of children. Results indicated that no significant main effects were found, regardless of symmetry/ asymmetry or word/ non-word, $F(1, 29) = 1.0$, $p > .05$.

Table 2

Mean Scores of Matching Test in Children with Average Intelligence (N = 30)

	Mean (SD)	
	Symmetry	Asymmetry
Word	3 (--)	3 (--)
Non-word	2.97 (0.18)	3 (--)

Note: Maximum score = 3

Memory Test

Performance with symmetry was better than with asymmetry. The mean scores for symmetry was higher than for asymmetry with both word and non-word stimuli. Words were also better remembered than non-words; SW were better remembered than SNW, and AW better than ANW. Mean scores showed that the performance with SNW and AW was similar. The mean score of ANW stimuli is the lowest (1.53) (Table 3).

2-way ANOVA repeated measures were computed with scores of memory performance. Results showed that the main effects were significant. Children remembered symmetry significantly better than asymmetry, $F(1, 29) = 4.427$, $p < .05$. Words were better remembered than non-words, $F(1, 29) = 11.744$, $p < .01$. Interaction between symmetry/ asymmetry and word/ non-word was also significant, $F(1, 29) = 4.223$, $p < .05$.

Table 3

Mean Scores of Memory Test in Children with Average Intelligence

	Mean (SD)	
	Symmetry	Asymmetry
Word	2.23 (0.73)	2.13 (0.94)
Non-word	2.13 (0.97)	1.53 (1.01)

Note: Maximum score = 3

Discussion

The performance in the memory test supports the hypothesis that symmetry leads to a perceptual advantage, and is remembered better than asymmetry ($p<.05$). Conducted in Chinese with stimuli from real life, the results further validate findings about symmetry established in Western cultures. Much past research suggests a perceptual advantage associated with symmetries, however, as noted above stimuli used were designed patterns or checkerboards. This study used symmetrical stimuli from life to test previous research findings. To simulate reading, both symmetrical and asymmetrical patterns were included in a same stimulus plate as stimuli in the study. It was found that children remembered plates with more symmetrical elements better than those with more asymmetrical elements. The results support the hypothesis that symmetry is remembered better than asymmetry.

It also suggests that symmetry facilitates reading and memory, main effects for word versus non-word is significant ($p < .01$). Interaction between the two factors, symmetry and word, suggests that symmetry together with experience with stimuli enhances performance. Although the results showed that children remembered words better than non-words, the symmetrical perceptual advantage enhanced performance with symmetrical non-words to maintain a similar performance to symmetrical words. Performance with non-words was enhanced when it was also symmetrical. However, for asymmetrical non-words, having no symmetry or previous experience to facilitate memory, they were remembered significantly less than other stimuli, and the mean score was the lowest compared to other stimuli. Results suggest that previous experience together with the symmetrical perceptual advantage did facilitate memory.

No differences were significant in the matching test. Children matched symmetry and asymmetry, or word and non-word, without any significant difference, and task requirements of the matching test may account for the results. Results showed that children had a good performance in the matching test. In fact children could match all the stimuli equally well regardless of symmetry, asymmetry, word or non-word. Mean scores suggested a ceiling effect with children's performance. They matched correctly with almost all the stimuli, and only made a few mistakes with symmetrical non-word. The matching task requirements help to explain the results. Matching stimuli requires visual perception and discrimination, which are intact abilities in children, and the task may be too easy for children with average intelligence to differentiate performance with different types of stimuli. In this case, the two parts of the hypothesis are not adequately tested. Hypothesis one stated that children match symmetry better than asymmetry, and that children match words better than non-words respectively, but these are not confirmed in matching test.

To conclude, the present study involves stimuli from real life, and the results further substantiate previous findings about symmetry. Symmetrical elements together with previous experience facilitate memory. The two hypotheses stating that symmetry is remembered better than asymmetry, and words are remembered better than non-words is confirmed in the memory test. However, the matching test is not difficult enough to differentiate performance with difference stimuli, and the hypotheses cannot confirmed. Results suggest that symmetry facilitates memory for Chinese characters in young children. It provides a foundation for study two to examine symmetry perception in children with mental retardation.

STUDY TWO: CHILDREN WITH MENTAL RETARDATION

Limited by their intellectual abilities, children with mental retardation experience learning difficulties. Learning is a cognitive process, which involves different components before learning occurs and changes in individuals can be observed. A vast amount of research has been conducted in the area of learning applied to children with mental retardation. Most theorists concentrated their efforts on one aspect of learning, such as attention or memory. However learning in children with mental retardation is affected by selective attention, organization of learning materials for storage, and deficient memory and recall (Ross, 1976). No single component can explain and solve the problems. Research about teaching children with special needs has always aimed at designing teaching programs for each individual according to their characteristics. Teaching children with suitable materials enhances their performance and arouses interest. Experimental work showed that symmetry enhances the performance of children with mental retardation in cognitive tasks (Carlin & Soraci, 1993; Caruso & Detterman, 1983; House, 1966).

Study one of the present research showed that symmetry aided memory in children with average intelligence. According to the "developmental position", Zigler (1966, 1969) suggested that although children with mental retardation learn at a slower rate and can reach a lower level of achievement, they do develop through the same stages as children with average intelligence. The present study examines the application of "developmental position" to see whether children with mental retardation can benefit from the perceptual advantage of symmetry as do children with average intelligence.

To examine whether symmetry facilitates learning Chinese characters in children with mental retardation, matching and memory tests were used to evaluate learning in children. Matching and memory tasks involve discrimination, recognition, and memory which are important abilities in learning Chinese characters. The purposes of the present study are: 1) to examine whether children with mental retardation benefit from perceptual advantages of symmetry as do children with average intelligence; 2) to test the applicability of the "developmental position in visual perception in children with mental retardation. Two hypotheses are tested in the present study, they are 1) symmetrical stimuli (including words and non-words) are matched and memorized significantly better than asymmetrical stimuli in children with mental retardation; 2) Words are matched and memorized significantly better than non-words in children with mental retardation.

Methodology

Participants

30 children with mental retardation aged from 81 to 162 months (mean: 115.3; DS: 17.7) participated in the present study. They attend special schools for children with mental retardation, and live at home. Children with mental retardation were assessed as mild grade mental retardation with no known etiologies before their school placement.

Stimuli

The same sets if stimuli were used in the matching and memory tests as for the normal children. There were twelve plates of stimuli with three characters printed on each. In each plate, both symmetrical and asymmetrical characters were included to simulate reading in real life. In symmetrical plates, there were more symmetrical characters than asymmetrical, i.e., two symmetrical and one asymmetrical, and vice versa in asymmetrical plates. All possible combinations of symmetrical and asymmetrical stimuli were used, i.e., AAS, ASA, SAA, SSA, SAS, and AAS (A= asymmetry and S = symmetry). The number of symmetrical and asymmetrical was equal. The same real Chinese characters chosen were characters which are commonly found in textbooks used in nursery and special school in Hong Kong; the same pseudo characters were also used as control characters.

Procedure

Matching Test. The procedure was the same as in study one. The examiner put a plate which consist of three characters on the table, and then three characters were given to the children to match with those on the table.

Memory Test. A plate of three characters is laid on table in each trial. Children were asked to remember the three characters with, including the appearance and positions, within a maximum time limit of ten seconds. They were given the same three characters and were required to reproduce the characters in the same orientation and positions.

Results

Matching Test

Performance with symmetry was better than with asymmetry. Results showed that mean scores of symmetrical words (SW) were higher than for asymmetrical words (AW), and symmetrical non-words (ANW) were higher than for asymmetrical non-words (ANW). Children matched words better than non-words. Mean scores of SW and AW were higher than SNW and ANW respectively. Mean scores showed that children had the best performance with symmetrical words, which were all correctly matched (Table 4).

Table 4

Mean Scores of Matching Test in Children with Mental Retardation (N=30)

	Mean (SD)	
	Symmetry	Asymmetry
Word	3 (--)	2.93 (0.25)
Non-word	2.97 (0.18)	2.8 (0.48)

Note: Maximum score = 3

2-way ANOVA repeated measures were computed with matching scores in children with mental retardation. Main effect was significantly different, children matched symmetry better than asymmetry, $F (1, 29) = 5.057$, $p < .05$. However, no significant difference was found between words and non-words, $F (1, 29) = 2.377$,

$p > .05$. No significant interaction was found between the two factors, $F(1, 29) = 1.29$ (n.s.)

Memory Test

Mean scores showed that children remembered symmetrical words and non-words better than asymmetrical. SW and SNW were remembered better than AW and ANW respectively. Children obtained the highest mean scores with symmetrical words. Moreover, children remember words better than non-words. Performances with SW and AW were better than SNW and ANW respectively (Table 5).

The memory performance in children with mental retardation was analyzed by 2-way ANOVA repeated measures. Main effects were significant, children remembered symmetry better than asymmetry, $F(1, 29) = 21.712$, $p < .001$. Words were remembered significantly better than non-words, $F(1, 29) = 13.767$, $p < .01$. Interaction between the two factors was not significant, $F(1, 29) = 0$ (n.s.)

Table 5

Mean Scores of Memory Test in Children with Mental Retardation (N=30)

	Mean (SD)	
	Symmetry	Asymmetry
Word	2.17 (0.83)	1.6 (1.07)
Non-word	1.73 (0.83)	1.17 (0.91)

Note: Maximum score = 3

Discussion

Results indicated that children with mental retardation develop along the same path as children with average intelligence according to the "developmental position" (Zigler, 1966, 1969). Although children with mental retardation are limited in intellectual abilities, they benefit by perceptual advantages related to symmetry as in children with average intelligence. Results in memory tests and observation during the tests also suggested that children with mental retardation applied strategies for remembering words similar to children with average intelligence. Some children with mental retardation verbalized the word stimuli and rehearsed it to themselves during the memory test.

Results suggested that perceptual advantages associated with symmetry are robust, and may facilitate learning Chinese characters in children with mental retardation. Performance with symmetry was significantly better than asymmetry in both matching and memory tests. The present results further confirmed previous experimental work about symmetry perception in children with mental retardation (Carlin, & Soraci, 1993; Caruso, & Detterman, 1983; House, 1966; Soraci, et. al, 1990). The hypothesis stating that symmetry is matched and remembered better than asymmetry is supported with the performance in both matching and memory tests.

Although limited by deficient memory, results suggested that children with mental retardation also benefited from previous experience with word stimuli. Performance with words was significantly better than non-words in the memory test. The hypotheses stating that words are remembered better than non-word was confirmed in the memory test. However, better performance with words versus non-words was only significant in the memory test. Perceptual skills involved and characteristics of the stimuli help to explain the results. In the matching test, children only need to discriminate between different stimuli and no memory is required. Therefore, previous experience with stimuli may have little effect on performance. However, in the memory test, children were required to remember the stimuli; recognition and memory was required. Pervious experience may enhance children's performance in the memory test.. Moreover, verbalization of words allows children to apply strategy to enhance their memory, which contributes a difference in memory performance with both words and non-words.

Learning in children with mental retardation may be limited by their deficient memory (e.g. Ellis, 1970), selective attention (Zeaman & House 1963, 1979; Fisher & Zeaman, 1973), but they can still benefit by the perceptual advantage associated with symmetry. The characteristics of stimuli may have a striking effect on the perception of children with mental retardation, as visual perception is an important process in learning which affects the data input (learning material) for further cognitive processing. Moreover, children with mental retardation are able to attend to fewer dimensions of stimuli at the same time than normal children (Whiteley et. al., 1987). The results suggested that symmetry can be perceived easily and facilitates memory in children with mental retardation, and teaching them to focus on the symmetry of stimuli may help them to learn.

To conclude, children with mental retardation appear to develop in a same way as children with average intelligence, they can benefit from the perceptual advantage of symmetry. Children with mental retardation matched and memorized symmetry better than asymmetry, i.e. the hypothesis was confirmed. Children with mental retardation also applied strategies in memory tasks, and previous experience and verbalization with word stimuli contributed to the superior performance with words in memory test. This study examined the visual perception of symmetry in children with mental retardation to further support the "developmental position".

STUDY THREE: CHILDREN WITH DOWN SYNDROME

Down syndrome is an organic disorder where an extra chromosome is present in the twenty-first pair. Down syndrome is associated with mental retardation ranging from mild to severe level. Affected by an organic defect, cognitive developmental of children with Down syndrome may be different from children with mental retardation of unknown etiology (Zigler & Hodapp, 1986).

According to the two-group approach in the "developmental position", children with mental retardation can be divided into two main groups. One of the groups includes individuals with mental retardation associated with an organic defect in which a clear etiology can be found. The other group includes individuals with a cultural-familial retardation for which no clear organic etiologies can be found. Associated with different cognitive development, children with Down syndrome may accordingly experience learning difficulties different from other children with mental retardation.

In the previous study, it was found that symmetry facilitates children with mental retardation in remembering Chinese characters. This study examines the perception of symmetry in children with Down syndrome to see whether it is similar to children with mental retardation of unknown etiology in the previous study. Moreover, past research showed that in cognitive tasks, children with mental retardation tend to reproduce symmetrical patterns in their response, and are attracted to symmetrical patterns (Stratford, 1979). The present study can further test the hypothesis that children with

Down syndrome are attracted to symmetry or can benefit from symmetrical perceptual advantages.

Matching and memory tests were used to test children's learning performance, as abilities involving matching and memory, such as discrimination, recognition, and memory are considered important in learning Chinese characters. This study was conducted with the objective to further examine previous findings that children with Down syndrome are attracted to symmetrical patterns. To achieve the objective, two hypotheses are tested, they are: 1) Symmetrical stimuli (including words and non-words) are matched and memorized significantly better than asymmetrical stimuli in children with Down syndrome; 2) Words are matched and memorized significantly better than non-words in children with Down syndrome.

Methodology

Participants

30 children with Down syndrome aged from 88 to 209 months (mean: 141.1; SD: 39.8) participated in the present study. Their mental age derived from the Goodenough-Harris Drawing Test (Harris, 1963) ranged from 53 to 89 months (mean: 70.9; SD: 10.4). Children with Down syndrome are identified with an extra chromosome at the twenty-first pair, and were assessed as mild grade mental retardation before their school placement. All the children attend special schools for children with mental retardation, and live at home.

Stimuli

The same two sets of stimuli are used in the matching and the memory test. Each plate, both symmetrical and asymmetrical characters are included to simulate reading in real life. In symmetrical plates, there are more symmetrical characters than asymmetrical, i.e. two symmetrical and one asymmetrical, vice versa in asymmetrical plates. All possible combination of symmetrical and asymmetrical stimuli is exhausted, i.e. AAS, ASA, SAA, SSA, SAS, and ASS (A = asymmetry and S = symmetry). Number of symmetrical and asymmetrical stimuli was equal. As previously, real Chinese characters chosen were characters which are commonly found in textbooks used in nursery and special school in Hong Kong; pseudo characters were designed to look like real Chinese as control characters.

Procedure

Matching Test. Children are asked to discriminate and match three characters each trial. Children responded by placing the matched characters below the stimuli. Procedures were the same as in previous study.

Memory Test. Children were asked to remember three characters each trial. After children indicated that they could remember all the characters, the plate was be covered. Children were required to reproduce the characters in exactly the same orientation and positions they had just seen.

Results

Matching Test

Mean scores showed that the matching performance between symmetry and asymmetry was similar. AW was matched slightly better than SW, and SNW and ANW were matched with the same mean scores. Performance with words was better than non-words. Children matched SW and AW better than SNW and ANW respectively (Table 6).

Performance in matching test was analyzed by 2-way ANOVA repeated measures. The main effect from words versus was significant. Children matched words better than non-words, $F(1, 29) = 5.563$, $p < .05$. However symmetry did not affect the matching performance in children with Down syndrome; this main effect was not significant, $F(1, 29) = 0.088$ (n.s). There was no significant interaction effect, $F(1, 29) = 0.088$ (n.s.).

Table 6

Mean Scores of Matching Test in Children with Down Syndrome (N = 30)

	Mean (SD)	
	Symmetry	Asymmetry
Word	2.97 (0.18)	3 (0.00)
Non-word	2.77 (0.43)	2.77 (0.68)

Note: Maximum score = 3

Memory Test

The results in the memory test were similar to those in the matching test. Mean scores indicated no significant difference in performance with symmetry and asymmetry. Children with Down syndrome remembered words better than non-wrods. Mean scores indicated that both SW and AW were remembered better than SNW and ANW respectively (see Table 7).

2-way repeated measures were computed with memory performance in children with Down syndrome. Children remembered words significantly better than non-words. Results showed a significant main effect with words, $F(1, 29) = 7.829$, $p < .01$. As in the matching test, children remembered symmetrical and asymmetrical stimuli eqaully well without significant difference, $F(1, 29) = 0.092$ (n.s.); and there was no significant interaction effect, $F(1, 29) = 0.19$ (n.s).

Table 7

Mean Scores of Memory Test in Children with Down Syndrome (N = 30)

	Mean (SD)	
	Symmetry	Asymmetry
Word	1.6 (0.86)	1.63 (0.96)
Non-word	1.23 (1.01)	1.13 (0.86)

Note: Maximum score = 3

Discussion

Results showed that the performance of children with Down syndrome did not appear to benefit by the perceptual advantages associated with symmetry in children with mental retardation as in the previous study, instead their performance was more affected by their previous experience with stimuli. Children matched and remembered symmetry and asymmetry equally well, but their performance with words was significantly better than non-words in both the matching and memory test ($p<.05$; $p<.01$). Results showed that children with Down syndrome were more affected by previous experience with stimuli than a symmetrical perceptual advantage.

The present findings seem to contradict previous findings in the literature that children with Down syndrome are attracted to symmetry (Stratford, 1979). Stratford reported that children are more likely to a reproduce symmetrical response even when there is no equivalent symmetry in the questions, however, the finding is supported by casual observation. In fact, the nature of the stimuli may affect performances. In Stratford's study, the stimuli were patterns made of squares, however, the symmetrical stimuli in the present study are real characters. Previous experience with words did facilitate performance, and verbalization of real characters may also help children to remember symmetrical characters (Grindley, & Townsend, 1973). The difference between the nature of stimuli contributes to the different findings.

Moreover, in the present study, many of the children with Down syndrome are mature in terms of chronological age. This suggested that they might have had frequent experience with the word stimuli, either in daily life or school. Mean scores in the matching test showed that all the asymmetrical words were matched correctly, and only a few mistakes were made with symmetrical non-words. Their knowledge and previous experience helps to explain their better performance with words than non-words. These factors favouring performance with words may override the perceptual advantage of symmetry in children with Down syndrome, and help to explain the inconsistent findings with previous experimental work.

To conclude, the results support the hypothesis that children with Down syndrome are more affected by previous experience, and performance with words is significantly better than non-words regardless of symmetry or asymmetry. However, performance with symmetry was not significantly different from asymmetry in either matching or memory tests. The results suggest that the cognitive development of children with metal retardation associated with this organic defect is different from children with other types of mental retardation.

STUDY FOUR: COMPARSION BETWEEN THREE GROUPS OF CHILDREN

Every child is unique. With different genetic make-up and intellectual abilities, each child develops differently. Children with average intelligence, mental retardation of unknown etiology, and Down syndrome are equipped with different genetic endowment and accordingly their cognitive development will be different. "Developmental position" is one of the two main schools of thought in cognitive development of children with mental retardation. According to the "similar sequence hypothesis" of the "development position" (Zigler, 1966, 1969), cognitive development of children with mental retardation of unknown etiology (cultural-familiar mental retardation) follows the same path as normally developing children. Hypothesis 4 predicts that children with and without metal retardation of matched mental age may be expected to have similar performances in cognitive tasks. Researchers subscribing to the position suggest that the similar sequence hypothesis applies to children with mental retardation of unknown etiology (Zigler & Hodapp, 1986). Further research aimed at extending the similar development sequence hypothesis to children with mental retardation associated with an organic defect is on-going (Zigler & Hodapp, 1997). This study compared the perception of symmetry in children of average intelligence, with mental retardation, and Down syndrome, and examined whether similar development patterns can be extended to children with mental retardation with a clear etiology.

Children with Down syndrome can be identified as trisomy 21, with a cognitive structure different from children with mental retardation of unknown etiology. As it is etiologically homogeneous and is detectable at birth, Down syndrome may be the best form of mental retardation to study (Cicchetti & Pogge-Hesse, 1982). In order ot extend the "developmental position" to children with mental rtardation associated with clear etiology, the preformance in children with Down syndrome should be similar to that in children with average intelligence.

Previous research shows that symmetry facilitates performance in cognitive tasks. Research about symmetry has been conducted involving different populations, such as individuals with average intelligence (e.g. Bornstein, et. al, 1981; Howe, 1980), with mental retardation (Carlin, & Soraci, 1993; Caruso, & Detterman, 1983; House, 1966; Soraci, et. al, 1990), or with Down syndrome (Straford, 1979). Although involving different stimuli or cognitive tasks, results of research suggests a consistent finding that symmetry is salient in human perception and provokes perceptual advantages. Studies one to three in the present research examined symmetry perception in children with average intelligence, mental retardation, and Down syndrome respectively, however, the results indicated that the three groups of children were affected by different variables associated with different performances with symmetrical patterns.

The present study compared the performance of cognitive tasks in these three groups of children. The objective of the study was to compare performance of symmetry perception in the three groups of children. The results may reveal differences in cognitive development in the three groups, and further test whether the "developmental position" can be applied to children with mental retardation of a clear etiology. Two hypothesis were tested: 1) With matched mental age, children with average intelligence have a similar performance to children with mental retardation in matching and memory; 2) with matched mental age, children with Down syndrome perform similarly to children with average intelligence in matching and memory tests.

Methodology

The data analyzed in this study are derives from the first three studies reported here.

Participants

Three groups of 30 each children participated in the present study. They were children with average intelligence, with mental retardation, and Down syndrome. Children with average intelligence attend normal nurseries. The children with mental retardation and with Down syndrome attended special school and lived at home. The chronological and mental ages of the three groups of children are summarized in Table 8.

Stimuli

Similar sets of stimuli were used in the matching and the memory test. There are twelve plates of stimuli with three characters printed on each. In each plate, both symmetrical and asymmetrical characters are included to simulate reading in real life. In symmetrical plates, there are more symmetrical characters than asymmetrical, i.e. two symmetrical and one asymmetrical, vice versa in asymmetrical plates. All possible combination of symmetrical and asymmetrical stimuli is exhausted, i.e. AAS, ASA, SAA, SSA, SAS, and ASS (A = asymmetry and S = symmetry). Number of symmetry and asymmetry are equal. Real Chinese characters chosen are characters which are commonly found in textbooks used in nursery and special school in Hong Kong; pseudo characters are designed to look like real Chinese as control characters.

Table 8

Demographic Data of Three Groups of Children (Children with Average Intelligence, Children with Mental Retardation, and Children with Down Syndrome)

	Children		
	Average Intelligence	Mental Retardation	Down Syndrome
Chronological age			
Minimum	43	81	88
Maximum	77	162	209
Mean	65.2	115.3	141.1
SD	9.6	17.7	39.8
Mental age			
Minimum	90	56	53
Maximum	151	107	89
Mean	111.4	74.2	70.9
SD	15.3	12.4	10.4

Note: Numbers are reported in months

Procedure

Matching Test. Children required matching three characters on the table each time. They response by placing the matched characters below the stimuli.

Memory Test. Children were asked to pay attention and remember the three characters, including the appearance and positions. All the characters will then be covered. Children and asked them to reproduce the characters

Results

Matching Test

Table 9 summarizes performance of three groups of children in matching test. 2-way ANOVA repeated measures were used to compare matching performance between children with mental retardation (MR) and average intelligence (AI), and between children with mental retardation (MR) and Down syndrome (DS). Mental age of children is a covariate with the other two variables. The results showed that the performance of MR and AI children was not significantly different $F(1, 29) = 0.159$, $p > .05$. Performance of children with DS and AI was also not significantly different, $F(1, 29) = 0.196$, $p > .05$

Memory Test

Comparison of memory performance of three groups of children is shown in Table 10. 3-way ANOVA repeated measures were also used to analyze performance between different groups of children. Again mental age was covariate with other two variables. The results showed that performance between MR and AI children was not significantly different, $F(1, 29) = 0.008$, $p > .05$. Performance between DS and AI children was also not significantly different, $F(1, 29) = 0.542$, $p > .05$.

Table 9

Comparisons of Performance in Matching Test between Three Groups of Children

		Mean Scores (SD)	
		Symmetry	Asymmetry
Word	Average Intelligence	3 (--)	3 (--)
	Mental Retardation	3 (--)	2.93 (0.25)
	Down Syndrome	2.97 (0.18)	3 (--)
Non-word	Average Intelligence	2.97 (0.18)	3 (--)
	Mental Retardation	2.97 (0.83)	2.8 (0.48)
	Down Syndrome	2.77 (0.43)	2.77 (0.68)

Note: Maximum scores = 3

Table 10

Comparisons of Performance in Memory Test between Three Groups of Children

		Mean Scores (SD)	
		Symmetry	Asymmetry
Word	Average Intelligence	2.23 (0.73)	2.13 (0.94)
	Mental Retardation	2.17 (0.83)	1.6 (1.07)
	Down Syndrome	1.6 (0.86)	1.63 (0.96)
Non-word	Average Intelligence	2.13 (0.97)	1.53 (1.01)
	Mental Retardation	1.73 (0.83)	1.17 (0.91)
	Down Syndrome	1.23 (1.01)	1.13 (0.86)

Note: Maximum scores = 3

Discussion

The present research examined matching and memory of symmetry in three groups of children. The performance of children with mental retardation and Down syndrome was not as good as for children with average intelligence in terms of mean scores, especially in the memory test. However, comparisons between their performance in both matching and memory tests show that children with mental retardation are similar to children with average intelligence, and the performance of children with Down syndrome is similar to children with average intelligence. Results generally is consistent with the "developmental position" that children with mental retardation develop along the same path as children with average intelligence, although children with mental retardation may develop at a slower rate and may only attain a lower level of achievement.

Patterns found in the mean scores gives further evidence to support the "developmental position" which states that children with metal retardation develop along the same path as children with average intelligence. Comparisons between performances of children with average intelligence and mental retardation are summarized in Tables 9 and 10. Results in the memory test especially showed that the two groups of children gave a similar pattern of performance. The mean score was highest with symmetrical words, and lowest with asymmetrical non-words. The performance with symmetrical non-words and asymmetrical words was similar. Results suggest that children with both mental retardation and average intelligence can benefit from a symmetrical perceptual advantage and previous experience. Therefore, with a symmetrical perceptual advantage and previous experience, the performance with symmetrical words was the best. However, associated with neither advantage, performance with asymmetrical non-words was the worst. The results indicate that even though children are different in intellectual abilities or mental age they perform in a similar pattern of performance, and this supports the "developmental position" in cognitive development of children with mental retardation.

Results of this study support the hypothesis that children with Down syndrome and children with average intelligence perform similarly in matching and memory tests. However, the results of studies one and three show that the two groups of children were affected by the variables of symmetry or words to different extent. Children with average intelligence were affected by symmetry configuration in perceptual tasks, and performance with symmetrical patterns was better; whereas children with Down syndrome were relatively more affected by their previous experience with stimuli and their performance with word was better regardless of symmetry or asymmetry. However, comparisons between the two groups of children showed that their performance was not significantly different. This further supports extending the "development position" to children with mental retardation associated with clear etiology.

To conclude, the present study examined visual perception of symmetry consistent with the "development position" of cognitive development of children with mental retardation. Comparisons of performances of the three groups of children generally supported or was at least consistent with the "developmental position". Children with mental retardation did have similar patterns of performance as normally developed children. And similar performances between children with Down syndrome and with average intelligence further suggest that the similar sequence development can be extended to children with mental retardation of a clear etiology, such as children with Down syndrome.

CHAPTER IX

DISCUSSION

1. General Discussion

The present research examined symmetry perception with stimuli from real life to substantiate research findings established in Western cultures. Generally, the research validates findings that symmetry is better perceived than asymmetry. Children with average intelligence and with mental retardation have a better performance with symmetrical stimuli. However, results showed that children with Down syndrome are more affected by previous experience with stimuli regardless of symmetry or asymmetry, and their performance is not significantly different from normally developing children. The study generally supports the perceptual advantage of symmetry over asymmetry.

Results also give evident consistent with the "developmental position" that the cognitive development sequence of children with mental retardation is similar to that of normally developed children. Children with average intelligence benefit from a symmetrical perceptual advantage, and the findings can be further extended to children with mental retardation. Results show that children with mental retardation attained a similar pattern of performance to normally developed children in the visual perception of symmetry. Both groups of children benefit from a symmetrical perception advantage, although the performance of children with mental retardation was not as good as children with average intelligence in terms of mean scores. Casual observation also suggested that children with mental retardation applied strategies in memory tasks similar to normally developing children. Their performance in cognitive tasks suggests that the cognitive development of children with mental retardation follows the same sequence as normally developing children.

The results also suggest the "development position" can be extended to children with mental retardation of clear etiology. Although the results revealed that children with Down syndrome do not benefit significantly from symmetry as do the other two groups of children, their performance in matching and memory was not significantly different from normally developing children. Children who participated in the present study were of different intellectual abilities, and were affected by different factors (e.g., symmetry, previous experience) in cognitive tasks to differing extents, however, overall their performances were not significantly different from one another. The present research examined visual perception of symmetry, giving further evidence to validate the "developmental position", and supporting its extension to children with mental retardation associated with Down syndrome.

The present research also indicated areas worthy of attention in further research. The matching task in the present research may be too easy for children to have sufficient differentiating power. Matching requires visual discrimination, which is an intact ability in children with average intelligence. Therefore, children performed equally well with all stimuli regardless of symmetry or asymmetry. Moreover, the research suggested the nature of stimuli also affects performance in cognitive tasks. Stimuli in the present study are Chinese characters, and verbalization and previous experience with the stimuli enhances the performance of children with word stimuli.

In brief, the symmetry of Chinese characters did facilitate cognitive performance in children. Findings give further support to previous research about symmetry, and give further support to the "developmental position" that the cognitive development of children with mental retardation is similar to that of children with average intelligence. The present research also suggested an extension of the similar development sequence hypothesis to children with mental retardation caused by an organic defect.

2. Limitations of the Study and Direction for Further Research

This research also indicates areas worthy of attention in further research.

The matching task was too easy for children to differentiate their performance between symmetry and asymmetry. Further research examining symmetrical perception could be improved by designing a more difficult task involving different cognitive abilities. Matching tasks require visual discrimination, which is an intact ability in children with average intelligence. The results showed ceiling effects with matching performances in children with average intelligence. Children with average intelligence matched all the stimuli correctly regardless of symmetry, asymmetry, word, or non-word. Moreover, matching and memory tasks in the present study only examine part of the cognitive abilities required in reading and writing. Designing tasks involving more cognitive abilities in further research investigating symmetry perception could allow application of findings to reading and writing to ease children's learning problems.

Matching level of previous experience with stimuli and chronological age of participants may further validate findings in the present study. Results show that previous experience with words affects children's performance. For example, children with Down syndrome are more affected by previous experience than by a symmetrical perceptual advantage. It is suggested that chronological age of children accounts for these results. As children with Down syndrome in the present study are mature in terms of chronological age, and are senior form students in school, they have had frequent experience with words in both life and schools. As the two factors mentioned affect performance in cognitive tasks, matching previous knowledge with stimuli or the chronological age of participants in further study about symmetry, using stimuli from real life, is suggested. Further research aimed at examining how previous experience affects learning, and interacts with stimuli configuration in contributing differences in learning in children, may also be fruitful.

CHAPTER X

CONCLUSION

Previous research was conducted with stimuli designed by the researchers, and very few studies were conducted with stimuli from life, hence the present research was conducted with stimuli from life to further substantiate Western findings about symmetry. The study simulated the reading situation in life and suggested that the perceptual advantage of symmetry may apply to learning Chinese characters. In a real reading situation, texts are not composed either of symmetrical or asymmetrical characters, but will include both. Considering this fact, the design of the present research put both symmetry and asymmetry together. The Results showed that children gave a better performance in trials with more symmetrical elements, and further validate previous findings about symmetry.

The results suggest that symmetrical elements in reading texts facilitate memory, and may ease learning problems in children. As mentioned, the structure of Chinese characters makes a heavy memory loading to beginners, which makes learning Chinese characters a difficult task, especially for young children. Many of the Chinese characters are symmetrically structured or contain symmetrical elements. Results suggest that symmetry in Chinese characters facilitate performance in cognitive tasks. Teaching young children with symmetrical Chinese characters may facilitate learning. It is suggested that including more symmetrical characters in teaching materials for young children, might facilitate learning, and ease learning problems in learning Chinese characters, though it is impossible to avoid asymmetrical characters in texts. To begin with materials which children find easier may help to foster an interest toward learning in children.

Symmetry also facilitates reading in children with mental retardation. Limited by their intellectual abilities, children with mental retardation may encounter more difficulties than normally developed children in learning to read and write. On the other hand, as the performance of a cognitive task in children with mental retardation is affected by motivational factors (Zigler & Balla, 1982; Sigler & Burack, 1989; Zigler & Hodapp, 1997), for example, they have a lower expectation of success (e.g., MacMillan & Knopf, 1971), are more likely to depend on others to solve problems (e.g., MacMillan & Wright, 1974), and have lower self images (Zigler, Balla, Watson, 1972). This research showed that as the symmetrical perceptual advantage is robust in children with mental retardation; teaching them with materials which they find easier may arouse their learning motivation. Moreover, children with mental retardation are more likely to selectively focus their attention, and are only able to attend to fewer dimensions at the same time (Whiteley, Zaparniuk, & Asmundson, 1987); teaching them to focus on the symmetry of Chinese characters may facilitate learning.

Different performance patterns in matching and memory tests may indicate that children with different intellectual abilities learn in a different way, and may accordingly encounter different types of learning problems. Although evidence supporting the "developmental position" suggested that children with mental retardation developed along the same sequence as normal children, different groups of children are affected by different factors to a different extent. In Hong Kong, some children with mental retardation receive education in normal nurseries together with children of average intelligence. Teachers in those nurseries need to cater for different needs of children at the same time, and to have more understanding of a child's learning characteristics may help them to teach more effectively. This study provides some details on cognitive development of children with mental retardation, and provides information about learning symmetrical Chinese characters for teachers' reference and guidance.

Appendix 1

Instructions of the Goodenough-Harris Drawing Test (English Version)

"I am going to ask you to make three pictures for me today. We will make them one at a time. On this page I want you to make a picture of a man. Make the very best picture that you can; take your time and work very carefully. I want to see whether the boys and girls in ______________ schools can do as well as those in other schools. Try very hard, and see what good picture you can make. Be sure to make the whole man, not just his head and shoulders."

"This time I want you to make a picture of a woman. Make the very best picture that you can; take your time and work very carefully. Be sure to make the whole woman, not just her head and shoulders." (Note: with very young children it may be appropriate to say: ... "picture of a woman, a mommy")

"This picture is to be someone you know very well, so it should be the best of all. I want each of you to make a picture of yourself – your whole self – not just your face. Perhaps you don't know it but many of the greatest artists liked to make their own portraits, and these are often among their best and most famous pictures. So take care and make this last one the very best of the three."

Appendix 2

Instructions of the Drawing a Man Test (Translated Chinese Version)

我想你畫三幅圖畫，每一次畫一幅。第一幅圖畫，我想你畫一個男人(爸爸)。盡量比心機，慢慢畫，畫靚D睇下學校裏面男仔抑或女仔畫得靚D。好！宜家開始畫睇下你畫得靚唔靚，記住要畫晒成個人，唔好只係畫個頭或者個膊頭。

畫完後，我想你畫一個女人(媽媽)。今次都要比心機，慢慢畫，畫到最靚。記住要畫晒成個人，唔好只係畫個頭或者個膊頭。

最後一幅圖畫，要畫一個你好熟悉的人。這一幅一定會係三幅裏面最靚既。我想你畫自己比我睇下，要畫晒成個人，唔好只畫個樣。可能你唔知道，有好多出名畫家都鍾意畫自己，而通常都會係佢地畫得最靚最出名的一幅畫。好啦家！你都開始比心機畫啦！

Appendix 3

Instructions of the Matching Test (English Version)

"I am going to play a game with you. As you can see, I will place three characters on table each time. Then I will give you three cards, try your best to find out cards look exactly the same as those on the table, and out the matched one under each character on the table. This is a competition between you and your classmate to see who can match more characters correctly. At the end of the game, a present will be given to children who have try their best in the game. Do you understand, if yes let's start the game."

Appendix 4

Instructions of the Matching Test (Chinese Version)

我同你玩一個遊戲。首先，我會每次放三張咭在桌上，然後比三張一樣的咭比你。你就找張同桌上一樣的咭，放在咭下面。呢個係一個比賽，睇下你同你 D 同學邊個玩得叻 D。遊戲玩完後，我會送一份禮物比最有心機玩既小朋友。明白點玩嗎? 我地開始玩啦！

Appendix 5

Instructions of the Memory Test (English Version)

"I am going to play another game with you. As in the game we've play before, I will place three characters on table each time. This time you need to pay attention and try to remember all the three characters. After a while, I will cover the characters, and give you the same three characters. All you need to do is to arrange the three characters on hand to make them appear what you just seen. I want to see whether you or your classmate can do better in the game. At last a present will also be given to children who try their best in the game."

Appendix 6

Instructions of the Memory Test (Chinese Version)

我宜家同你玩另一個遊戲呢個遊戲同之前既差唔多。同樣我會每次放三張咭在桌上，今次你要留心睇試下記住呢三張咭，等一陣我會拿走三張咭，跟住我會比三張一模一樣的咭你，你就要把三張咭擺成同你剛剛見到的一樣，方向位置都要一樣。呢個遊戲要看看你同你 D 同學邊個玩得叻 D。遊戲玩完後，我會送一份禮物比最有心機玩既小朋友。明白點玩嗎? 我地開始玩啦！

Appendix 7

Pilot Study: Information Sheet for Parents (English Version)

INFORMATION SHEET

An Exploratory Study on Learning Chinese Symmetrical Characters in Children

This is an exploratory study on learning behavior in Chinese children. The result obtained in this study will provide information for further research.

If you consent, children will be required to complete a task individually including drawing three pictures of their father, mother, and themselves, and are required to match and memorize some Chinese characters presented by researchers. Their performance will be recorded and analyzed. All the information will be kept strictly confidential. After giving consent, you or your child is free to withdraw from the study, and can stop participating in the study at any time, with no penalty.

The Chief Supervisor of this study is Dr. Alice Chang Lai, Associate Professor of Department of Health Sciences, Hong Kong Polytechnic University (Tel. No. 2766-6314). The Co-Supervisor of this study is Prof. Ida M. Martinson, Chair Professor of Department of Health Sciences, Hong Kong Polytechnic University (Tel. No. 2766-6385). The researcher is Ms. Vanessa Lau Wai Yin, Department of Health Sciences, Hong Kong Polytechnic University (Tel. No. 2766-6313). For any subsequent inquiry of this study, please free contact Ms Lau.

Thank you for your cooperation!

Sincerely,

Vanessa W. Y. Lau (Miss)
Postgraduate research student
The Hong Kong Polytechnic University

Appendix 8

Pilot Study: Information Sheet for Parents (Chinese Version)

敬啓者:

我是香港理工大學醫療科學系的碩士研究學生，現誠意邀請貴子女參與一項名爲『兒童認知及學習方法』的研究初探。此研究目的在探討香港兒童的認知發展及學習情況。研究結果將有助日後進行研究參考之用。

此研究會以圖畫及字咭配對的形式在學校進行，須時大約三十分鐘。研究絕對不會對兒童或家長造成任何心理損害。家長及兒童均保留權利，可隨時退出研究。

此項研究極需要家長及兒童的合作方可順利完成。我們極希望能得到貴家長及子女的協助，敬希貴家長填妥附上之同意書交回學校。貴家長如有任何問題，歡迎向學校查詢或致電香港理工大學黎程正家博士或研究員劉慧然聯絡，電話：27666313 / 6314，多謝你們幫忙。

此致

貴家長

香港理工大學醫療科學系

____

碩士研究學生

劉慧然謹啓

一九九七年　月　日

Appendix 9

Pilot Study: Parent Consent Form (English Version)

CONSENT FORM

I, ____________________ and my child ________________________ are willing to participate in this study, "An exploratory study on the learning symmetrical Chinese characters in children".

I understand that my child will be asked to draw some pictures and complete matching and memory tasks. We have been assured that information obtained will be used for research purposes only. It will remain confidential and will be destroyed at the completion of the research study. We understand that we are still free to withdraw or stop participating the study at any time, with no penalty.

____
Signature of the parent

____
Signature of the researcher

____
Contact phone number

____
Date

Appendix 10

Pilot Study: Parent Consent Form (Chinese Version)

家長同意書

本人 ______________________________ (* 同意 / 不同意)

子 / 女 ____
接受「兒童認知及學習方法」測試研究初探。本人明白這項研究的目的是作學術用途，本人及兒童的姓名因此將得保密。

本人獲得保証，測試研究內容將不會引致兒童心理損害。在測試期間，兒童一旦對訪問內容感到不舒服，本人保留子女不參與的權利,並且有權利隨時退出此項活動。

家長簽名 : ______________________________

聯絡電話 : ______________________________

研究員簽名: ______________________________

日期 : ________年________月________日

(* 請刪去不適合的選擇)

*******多謝你的幫忙*******

Appendix 11

Record Sheet and Stimuli Tested in the Pilot Study

姓名 : ____________________ 性別 : ____________________

年齡 : ____________________ 開始時間 : ____________________

出生日期 : ____________________ 完結時間 : ____________________

測試日期 : ____________________ 研究員 : ____________________

配對測試

1	上	七	土
2	[illegible]	[illegible]	[illegible]
3	巨	田	目
4	[illegible]	[illegible]	[illegible]
5	[illegible]	至	[illegible]
6	二	卜	十
7	木	不	才
8	[illegible]	X	丅
9	丰	朩	丩
10	[illegible]	[illegible]	[illegible]
11	生	立	五
12	古	占	石

記憶測試

1	上	七	土
2	[illegible]	[illegible]	[illegible]
3	巨	田	目
4	[illegible]	[illegible]	[illegible]
5	[illegible]	至	[illegible]
6	二	卜	十
7	木	不	才
8	[illegible]	X	丅
9	丰	朩	丩
10	[illegible]	[illegible]	[illegible]
11	生	立	五
12	古	占	石

Appendix 12

Studies One to Four: Information Sheet for Parents (English Version)

INFORMATION SHEET

Learning Symmetrical Chinese Characters in Cantonese-speaking Children: A Comparative Study

This study is to examine the learning behavior of normal children, children with Down syndrome and children with mental retardation in Chinese context. The result obtained in the present study will give teachers and professionals a better understanding of learning behavior of the above mentioned three groups of children. And the information obtained may help in designing teaching methods to capitalize strength and remedy weaknesses of children.

If you consent, children will be required to complete a task individually including drawing three pictures of their father, mother, and themselves, and are required to match and memorize some Chinese characters presented by researchers. Their performance will be recorded and analyzed. All the information will be kept strictly confidential. After giving consent, you or your child is free to withdraw from the study, and can stop participating in the study at any time, with no penalty.

The Chief Supervisor of this study is Dr. Alice Chang Lai, Associate Professor of Department of Health Sciences, Hong Kong Polytechnic University (Tel. No. 2766-6314). The Co-Supervisor of this study is Prof. Ida M. Martinson, Chair Professor of Department of Health Sciences, Hong Kong Polytechnic University (Tel. No. 2766-6385). The researcher is Ms. Vanessa Lau Wai Yin, Department of Health Sciences, Hong Kong Polytechnic University (Tel. No. 2766-6313). For any subsequent inquiry of this study, please free contact Ms Lau.

Thank you for your cooperation!

Sincerely,

Vanessa W. Y. Lau (Miss)
Postgraduate research student
The Hong Kong Polytechnic University

Appendix 13

Studies One to Four: Information Sheet for Parents (Chinese Version)

敬啓者:

我是香港理工大學醫療科學系的碩士研究學生，現誠意邀請貴子女參與一項名爲『兒童認知及學習方法』的研究。此研究目的在探討香港兒童的認知發展及學習情況。研究結果將有助老師及專業人員在教導兒童時作參考之用。

此研究會以圖畫及字咭配對的形式在學校進行，須時大約三十分鐘。研究絕對不會對兒童或家長造成任何心理損害。家長及兒童均保留權利，可隨時退出研究。

此項研究極需要家長及兒童的合作方可順利完成。我們極希望能得到 貴家長及子女的協助，敬希 貴家長塡妥附上之同意書交回學校。 貴家長如有任何問題，歡迎向學校查詢或致電香港理工大學黎程正家博士或研究員劉慧然聯絡，電話：27666313 / 6314，多謝你們幫忙。

此致

貴家長

香港理工大學醫療科學系

____

碩士研究學生

劉慧然謹啓

一九九七年　月　日

Appendix 14

Studies One to Four: Parents Consent Form (English Version)

CONSENT FORM

I, ____________________, and my child ________________________ are willing to participate in this study, "Learning Symmetrical Chinese Characters in Cantonese-speaking Children: A Comparative Study"

I understand that my child will be asked to draw some pictures and complete matching and memory tasks. We have been assured that information obtained will be used for research purposes only. It will remain confidential and will be destroyed at the completion of the research study. We understand that we are still free to withdraw or stop participating the study at any time, with no penalty.

____

Signature of the parent

____

Signature of the researcher

____

Contact phone number

____

Date

Appendix 15

Study One to Four: Parent Consent Form (Chinese Version)

家長同意書

本人 ______________________________ (* 同意 / 不同意)

子 / 女 ____

接受「兒童認知及學習方法」測試研究。本人明白這項研究的目的是作學術用途，本人及兒童的姓名因此將得保密。

本人獲得保証，測試研究內容將不會引致兒童心理損害。在測試期間，兒童一旦對訪問內容感到不舒服，本人保留子女不參與的權利,並且有權利隨時退出此項活動。

家長簽名 : ______________________________

聯絡電話 : ______________________________

研究員簽名: ______________________________

日期 : ________年________月________日

(* 請刪去不適合的選擇)

*******多謝你的幫忙*******

Appendix 16

Recore Sheet and Stimuli Used in Study One to Four

測試記錄表

姓名: ______________________ 性別: __________

出生日期: ______________________ 年級: __________

學校: ______________________________________

測試日期: ____________________________________

測試結果

Drawing Test

Drawing a Man Drawing a Woman Drawing Him- / Her- self Total Score Average Score	

Matching Test

Symmetry		Asymmetry	
Word		Non-word	

Memory Test

Symmetry		Asymmetry	
Word		Non-word	

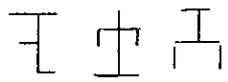
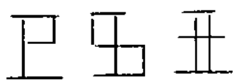
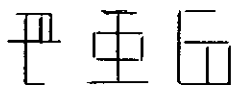
Appendix 16

Record Sheet and Stimuli Used in Studies One to Four

Matching Test (Word Stimuli)

	Plate	R1	R2	R3	Score
1	木 七 工				
2	山 中 刀				
3	天 牛 市				
4	未 石 牙				
5	五 正 出				
6	巴 亞 巨				

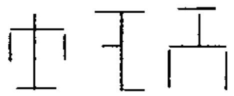
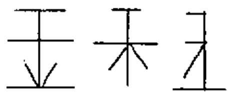
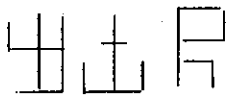
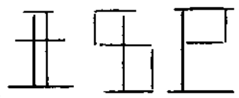
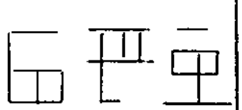
Matching Test (Non-word Stimuli)

	Plate	R1	R2	R3	Score
1					
2					
3					
4					
5					
6					

Memory Test (Word Stimuli)

	Plate	R1	R2	R3	Score
1	七 木 工				
2	刀 山 中				
3	市 天 牛				
4	石 未 牙				
5	出 正 五				
6	巨 巴 亞				

Memory Test (Non-word Stimuli)

	Plate	R1	R2	R3	Score
1					
2					
3					
4					
5					
6					

Appendix 17

Scoring Sheet of Goodenough-Harris Drawing-A-Man Test

Short Scoring Guide *

MAN POINT SCALE

1. Head present
2. Neck present
3. Neck, two dimensions
4. Eyes present
5. Eye detail: brow or lashes
6. Eye detail: pupil
7. Eye detail: proportion
8. Eye detail: glance
9. Nose present
10. Nose, two dimensions
11. Mouth present
12. Lips, two dimensions
13. Both nose and lips in two dimensions
14. Both chin and forehead shown
15. Projection of chin shown; chin clearly differentiated from lower lip
16. Line of jaw indicated
17. Bridge of nose
18. Hair I
19. Hair II
20. Hair III
21. Hair IV
22. Ears present
23. Ears present: proportion and position
24. Fingers present
25. Correct number of fingers shown
26. Detail of fingers correct
27. Opposition of thumb shown
28. Hands present
29. Wrist or ankle shown
30. Arms present
31. Shoulders I
32. Shoulders II
33. Arms at side or engaged in activity
34. Elbow joint shown
35. Legs present
36. Hip I (crotch)
37. Hip II
38. Knee joint shown
39. Feet I: any indication
40. Feet II: proportion
41. Feet III: heel
42. Feet IV: perspective
43. Feet V: detail
44. Attachment of arms and legs I
45. Attachment of arms and legs II
46. Trunk present
47. Trunk in proportion, two dimensions
48. Proportion: head I
49. Proportion: head II
50. Proportion: face
51. Proportion: arms I
52. Proportion: arms II
53. Proportion: legs
54. Proportion: limbs in two dimensions
55. Clothing I
56. Clothing II
57. Clothing III
58. Clothing IV
59. Clothing V
60. Profile I
61. Profile II
62. Full face
63. Motor coordination: lines
64. Motor coordination: junctures
65. Superior motor coordination
66. Directed lines and form: head outline
67. Directed lines and form: trunk outline
68. Directed lines and form: arms and legs
69. Directed lines and form: facial features
70. "Sketching" technique
71. "Modeling" technique
72. Arm movement
73. Leg movement

* For use only after the scoring requirements have been mastered.

Appendix 18

Scoring Sheet of Goodenough-Harris Drawing-A-Woman Test

WOMAN POINT SCALE

1. Head present
2. Neck present
3. Neck, two dimensions
4. Eyes present
5. Eye detail: brow or lashes
6. Eye detail: pupil
7. Eye detail: proportion
8. Cheeks
9. Nose present
10. Nose, two dimensions
11. Bridge of nose
12. Nostrils shown
13. Mouth present
14. Lips, two dimensions
15. "Cosmetic lips"
16. Both nose and lips in two dimensions(10,14)
17. Both chin and forehead shown
18. Line of jaw indicated
19. Hair I
20. Hair II
21. Hair III
22. Hair IV
23. Necklace or earrings
24. Arms present
25. Shoulders
26. Arms at side (or engaged in activity or behind back)
27. Elbow joint shown
28. Fingers present
29. Correct number of fingers shown
30. Detail of fingers correct
31. Opposition of thumb shown
32. Hands present
33. Legs present
34. Hip
35. Feet I: any indication
36. Feet II: proportion
37. Feet III: detail
38. Shoe I: "feminine"
39. Shoe II: style
40. Placement of feet appropriate to figure
41. Attachment of arms and legs I
42. Attachment of arms and legs II
43. Clothing indicated
44. Sleeve I
45. Sleeve II
46. Neckline I
47. Neckline II: collar
48. Waist I
49. Waist II
50. Skirt "modeled" to indicate pleats or draping
51. No transparencies in the figure
52. Garb feminine
53. Garb complete, without incongruities
54. Garb a definite "type"
55. Trunk present
56. Trunk in proportion, two dimensions
57. Head-trunk proportion
58. Head: proportion
59. Limbs: proportion
60. Arms in proportion to trunk
61. Location of waist
62. Dress area
63. Motor coordination: junctures
64. Motor coordination: lines
65. Superior motor coordination
66. Directed lines and form: head outline
67. Directed lines and form: breast
68. Directed lines and form: hip contour
69. Directed lines and form: arms taper
70. Directed lines and form: calf of leg
71. Directed lines and form: facial features

* For use only after the scoring requirements have been mastered.

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