Level of Mathematics Abilities of Mild Autism Children On The McCarthy Scales of Children’s Abilities

Fonny Hutagalung\textsuperscript{a}, Zulkifli Md Isa\textsuperscript{b}, Noor Aishah Rosli\textsuperscript{c}, Chew Fong Peng\textsuperscript{d}, Rushdan AR\textsuperscript{e}

\textsuperscript{a,b,c,d}Faculty of Education, University of Malaya, Kuala Lumpur, Malaysia
\textsuperscript{e}Faculty of Applied Social Sciences, Open University Malaysia (OUM), Malaysia

\textbf{ABSTRACT}

The objective of this study is to determine the level of mathematics abilities among mild autism children in Klang Valley, Malaysia. A total of ten autistic children aged 5 to 7 years old were selected as respondents. Purposive sampling was used using McCarthy Scales of Children’s Abilities (MSCA) to measure the level of cognitive abilities of the children. This instrument consist of three scales; Verbal, Perceptual-Performance and Quantitative. Overall results shows the level of mathematics abilities of mild autism child is at moderate level. However, result also show that there were a significant difference in Verbal, Perceptual Performance and Quantitative Scales.
Introduction

The word cognitive pertains to the mind and how it works (Charlesworth, 2000). It refers both to what the child knows and how the child thinks. Cognition is the term used to describe the mental activity through which human beings, acquire, remember and learn to use knowledge (Hetherington, Parke, Gauvain & Locke, 2006). Cognitive development is about how we process our thinking, which includes reasoning, memory, problem solving, perception, and decision making from early childhood to adolescence. It is about how young children make sense of their world through the interaction of genetic and learned factors such as biological, environment, experiential, social and motivational (Hetherington, Parke, Gauvain & Locke, 2006). It refers to changes in our mind and thinking that may take place over time.

Berk (2000) defines cognition as “the inner processes and products of the mind that lead to “knowing”. It includes all mental activity such as remembering, symbolizing, categorizing, problem solving, creating, fantasying and even dreaming. Cognitive development refers to the development of the child’s thinking and reasoning abilities. Siti Hawa Munji and Ma’rof Redzuan (2005) believe that development of cognitive ability in children is the process of enhancing thinking capability, knowledge and intellect of children.

Mathematics is a discipline or knowledge domain, an abstract system or representation with meaning that are absolute. It is a social and cultural perspective for discovering and thinking about mathematical knowledge and applying it to fulfill the purposes of our everyday lives. When we think of mathematics we usually think of it as a formal abstract system involving rules and requirements for accuracy and precision. However we also apply mathematical concepts in situations arising from our everyday activities such as swimming, netball or dance.

Autism is one of five developmental disabilities of childhood included under the umbrella term Pervasive Developmental Disorder (American Psychological Association, 2000). The five subtypes of PDD are autistic disorder, Asperger disorder, Rett’s disorder, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified (William, 2003). Autism and Pervasive Developmental Disorder (PDD) are developmental disabilities that share many of the same characteristics. Usually evident by age 3, autism is neurological disorders that affect a child’s abilities to communicate, understand language, play and relate to others. Autistic Spectrum Disorder (ASD) is a type of neurodevelopmental disorder affecting the mental, emotion, learning and memory of a person (McCary et al., 2012).

In the diagnostic manual used to classify disabilities, the DSM-IV-TR (American Psychiatric Association, 2000), “autistic disorder” is listed as a category under the heading of Pervasive Developmental Disorders. A diagnostic of autistic disorder is made when an individual displays 6 or more of 12 symptoms listed across three major areas: social interaction, communication and behaviour. When children display similar behaviours but do not meet the criteria for autistic disorder, they
may receive a diagnosis of Pervasive Developmental Disorders. Growing evidences have shown that environmental and epigenetic factors could contribute towards autism incidence (Persico & Bourgeron, 2006), which include possible causal factors such as genetic mutations (Freitag, 2007) and various environmental agents that would cause birth defects (Arndt, Stodgell, & Rodier, 2005).

Autistic disorder is one of the disabilities specifically defined in the Individuals with Disabilities Education Act (IDEA), the federal legislation under which children and youth with disabilities receive special education and related services. Due to the similarity of behaviours associated with autism and PDD, use of the term pervasive developmental disorder has caused some confusion among parents and professionals. Children with mild autism do not have general language delay, and many have average or even above average intelligence. (William, 2003). However, the treatment and educational needs are similar for both diagnoses. Intensive, behaviourally based early intervention has helped some children with autism learn communication, language and social skills that have enabled them to succeed in general education classroom (Jacobson, Mulick, & Green, 1998).

Autism occurs in approximately 5 to 15 per 10,000 births. These disorders are four times more common in boys than girls. The causes of autism and PDD are unknown. Currently, researchers are investigating areas such as neurological damage and biochemical imbalance in the brain. (Akshoomoff, 2000; Mauk, Reber, & Batshaw, 1997). These disorders are not caused by psychological factors. Although there is no treatment to cure autism, studies support that early diagnosis of autism followed by early intervention programme (EIP), especially behaviour modification, would help to increase the child’s cognitive level (Dawson et al., 2010).

Children with autism vary widely in abilities, intelligence, and behaviours. Some do not speak; others have limited language that often includes repeated phrases or conversations. Those with more advanced language skills tend to use a small range of topics and have difficulty with abstract concepts. Repetitive play skills, a limited range of interests, and impaired social skills are generally evident as well. Characteristics of mild autism include poor communication and social skills, repetitive and stereotyped behaviours, intense interest or preoccupation in a typical things or pats of things (Barnhill et al. 2000).

Early diagnosis and appropriate educational programs are very important to children with autism. Educational programs for children with autism focus on improving communication, social, academic, behavioural and daily living skills. Behaviour and communication problems that interfere with learning sometimes require the assistance of a knowledge professional in the autism field who develops and helps to implement a plan that can be carried out at home and school.

Intelligence tests are most helpful when they are used to determine specific skills, abilities and knowledge that a child either has or does not have. When such
information combined with other evaluation data, it can be directly applied to school programming. The studies reveal that the teachers usually are not aware of which cognitive ability they are evaluating with the questions they ask, which deepen/take root low order cognitive abilities in the students (Ayvacı & Türkdoğan, 2010; Çalışkan, 2011; Çepni, 2003; Gray, 1978; S. Karamustafaoğlu, M. Karamustafaoğlu, Bacanak, & Değirmenci, 2011; Vendlinski, Nagashima, & Herman, 2007). Intelligence test can yield valuable information about children’s ability to process information. In order to learn, every person must take in, make sense of, store and retrieve information from memory in an efficient and accurate way. A thorough interpretation of an intelligence test can yield information about how effectively a child processes and retrieves information. Most individually administered intelligence test can determine at least to some degree a child’s ability to attend, process information quickly, distinguish relevant from less relevant details, put events in sequence and retrieve words from memory.

Cognitive test is an assessment that measure the test taker’s mental capabilities such as general mental ability test, intelligence test, and academic skills test (Sandra, 2007). Intelligence testing is one of the most debated issues in special education (Ronald, 2006). Current psychological and educational research is limited by the lack of means for the accurate and reliable assessment of the cognitive ability of the autism population. The ability to forecast school achievement would be of acknowledged value, but, to date, there has been little success in this area. There is also the problem of distinguishing between a mild autism, brain damage, mental retardation, and specific learning disabilities on the basis of psychological testing. It is difficult to ascertain which aspects of these major pathologies are present and how much they contribute to the overall profile. Individual intelligence testing, until recently, has been a crucial, even mandatory component in the formal assessment process (Ronald, 2006).

There is a need for standardized tests of cognitive ability for the mild autism children in order to know in fact whether a child is doing well or badly with respect to his own group and with respect to his normal peers. With this knowledge, one could investigate the possible causes for failure and give remedial help in the needed direction. Most individual tests of intellectual performance assess both verbal and nonverbal reasoning (James, 2008). Because of the low primary visibility of social defects and because the mild autism are often suspected of being mentally retarded, unmotivated, or inattentive, the general public has not exhibited great interest in the socially handicapped. The assessment of intellectual functioning of the mild autism children is demonstrably difficult but absolutely necessary in order to plan individualized, meaningful, and effective mediational programs. Educational assessment data are used to plan the Individual Education Plan (James, 2008).

There is much disagreement among authors concerning which type of intelligence test should be used to assess the mild autism child. At the present time, there are
so few intelligence tests which have been standardized on the mild autism, that it complicates the picture even further. Some researchers reasoned that to obtain an accurate I.Q, both a performance and a verbal scale should be administered and the evaluation must always include an assessment of communicative skills (Berg, 1970; Graham and Sapiro, 1953).

It is of great importance to many educators of the mild autism, that test scores of mild autism children be compared with those of the normal kids since education’s ultimate aim is to prepare the child to fit adequately (both educationally and socially) into a conducive environment. There are other educators who believe that the important question is not how the autism child ranks in comparison to his autism peer but how he ranks in comparison to other autism children. Both objectives appear to be reasonable and certainly both should be investigated in order to devise educational guidelines for each individual mild autism child.

The I.Q. score obtained on an intelligence test standardized on a mild autism child. This score is too often interpreted as a measure of the child's intellectual capacity rather than how he is functioning in comparison to normal peers. However, scores on individual subtests when properly interpreted may give an indication of deficit areas which cannot be accounted for by the mild autism and therefore may suggest a more in depth evaluation or a change in the educational goals or settings. The subtest scores should be carefully examined and given emphasis in the interpretation of results and remedial suggestions for the mild autism child. Although there is already strong indication of possible learning problems, additional data are gathered to describe student’s strength and weaknesses (James, 2008).

In studying almost every characteristic (construct, structure, function or process) of development, developmental scientists consider both norms and individual differences. Norms represent average outcome on some characteristic; normative development is the pattern over time that is typical or average (Bornstein, 2011). The high order cognitive skills, such as logical thinking and critical thinking, are the basic skills for daily life, apart from the academic achievements in the schools (Gürol, 2011; Marshall and Horton, 2011; McCormack, 2009).

Objective

The purpose of this research was to investigate the test performance on the McCarthy Scales of Children’s Abilities of mild autism children focusing on mathematical abilities. Based on previous research involving other similar instruments and knowledge of how language contributes to test performance, it is believed that a specific hypothesis concerning test performance of the mild autism on each of the six MSCA Scales could be formulated.
It was hypothesized that there would be a significant difference on the Scaled Index scores of the Verbal, Quantitative, General Cognitive, and Perceptual-Performance of this test.

**Methodology**

**McCarthy Scales of Children’s Abilities (MSCA)**

The McCarthy Scales of Children’s Abilities (MSCA) is a recently developed test of mental abilities which appears to have significant potential for both clinical and research use. The MSCA was developed and published in 1970 by Dr. Dorothea McCarthy, an expert in the areas of child development and assessment techniques.

McCarthy was aware of the importance of a child’s early years and the critical role they played in a child’s cognitive development. She was convinced that cognitive differences among children could be measured not only at an early age but along several dimensions, McCarthy’s awareness of the limitations of traditional psychometric instruments in the assessment of the preschool child provided the initial impetus for the development of a new instrument.

The MSCA is an individually administered series of six Scales (Verbal, Perceptual Performance, Quantitative, General Cognitive, Memory, and Motor) containing eighteen subtests: fifteen which assess cognitive ability, including two which also assess motor coordination; and three which are non-cognitive and measure gross motor coordination.

For each of the six Scales, a child’s raw score is converted to a scaled score (called an Index) according to chronological age. The General Cognitive Index (GCI) has a mean of 100 with a standard deviation of 16 which corresponds to the mean and standard deviations of several other psychological instruments. The mean scaled scores of the remaining five Scales have been arbitrarily adjusted to 50 with a standard deviation of 10.

The General Cognitive Index (GCI) which is merely the sealed score of the General Cognitive Scale, is presented as an index of the child’s functioning at a given point in time. It is not meant to be interpreted as immutable for any particular child but is considered to reflect any genetic or environmental factors. Rather the GGI represents the child’s ability to integrate his accumulated learnings and adapt them to the tasks of the MSCA. The child’s GCI is of maximum usefulness when viewed in the context of his Indexes on the other five Scales. It is the child’s profile of scores, rather than any one particular score, that indicates his overall behavioural and developmental maturity in the cognitive and motor domains, as well as his specific strengths and weaknesses.

**Table 1: Classification of the General Cognitive Index**

<table>
<thead>
<tr>
<th>General Cognitive Index</th>
<th>Achievement Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>130</td>
<td>Very Outstanding</td>
</tr>
<tr>
<td>120-129</td>
<td>Outstanding</td>
</tr>
<tr>
<td>110-119</td>
<td>Intelligent</td>
</tr>
<tr>
<td>90-109</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Participants

The subjects for this study were selected from a population of children enrolled in Klang Valley, Malaysia, school system selection criteria for the mild autism population (N=10) was as follows:

1. All subjects were enrolled within the public school system with the mild autism receiving intensive management to help compensate for the effects of the social skills problem.

2. Ages seven, plus or minus six months. The following criteria was determined by available school or medical records and the subjective opinion of the school personnel.

3. I.Q. within normal limits.

4. No severe emotional or behavioral problems.

5. No other significant sensory or physical impairment, with corrected vision within normal limits.

6. Due to the limited population, no attempt was made to control for the socioeconomic status of the hearing impaired population nor was any attempt made to approximate the normal distribution according to sex.

The control group of ten "normal" hearing subjects were subject matched as closely as possible to the experimental group, utilizing the above criteria with the I.Q. of the normal children being within the normal range of plus or minus one standard deviation from the mean on whatever test was used within the school system. If no test results were available, a teacher's subjective judgment was accepted. Since a limited number of children were available to fulfil the mild autism population criteria, each control individual was matched as closely as possible to the experimental subjects on socioeconomic levels based on the father's (or mother's) employment utilizing only two SES levels; high, (professional, technical, managerial, clerical, sales, skilled) and low (semiskilled, and unskilled).

Parental release forms allowing a child to be tested were obtained by the principal in each school. Assurance was given by the examiner that if the test's situation proved to be distressing to any child, testing would be discontinued and another subject sought.

Procedure

Each child was individually administered the McCarthy Scales of Children’s Abilities according to the standardized administration procedures as outlined by McCarthy (1970) MSCA manual. Each test was given by the tester, who is
experienced in the administration of intelligence tests and in the administration of the MSCA. Total confidentiality of the child’s name and test results was maintained and the individual names were converted to numbers for all analytical purposes. Individual test results were made available only to those authorized school personnel who requested them.

Upon completion of testing, each subject’s performance on the McCarthy Scales of Children’s Abilities was scored according to standard scoring procedures as described by McCarthy (1970). These raw scores were converted to Scale Indexes according to the child’s chronological age and a profile was plotted.

Findings

The data for this study consisted of the scores obtained by a group of ten mild autism children and a matched group of ten normal children on the six Scales of the McCarthy Scales of Children’s Abilities. This investigation was undertaken in order to compare the performance of a group of mild autism children with the performance of a matched group of normal subjects on a relatively new test of mental abilities, the McCarthy Scales of Children Abilities. It was hypothesized that mild autism children would differ significantly from normal children on the Verbal (V), Quantitative (Q), Performance-Perception (PP), and General Cognitive Index (GCI) Scales of the MSCA.

Table 2: Distribution of the Mean Scale Index MSCA for normal children

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal</td>
<td>64.590</td>
</tr>
<tr>
<td>Performance-Perception</td>
<td>54.000</td>
</tr>
<tr>
<td>Quantitative</td>
<td>48.737</td>
</tr>
<tr>
<td><strong>General Cognitive</strong></td>
<td><strong>93.35</strong> (Moderate level)</td>
</tr>
</tbody>
</table>

*Mean score index of scale is the same as the level of cognitive ability moderate according to the same chronological age.

Table 3: Distribution of the Mean Scale Index MSCA for mild autism children

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal</td>
<td>22.300</td>
</tr>
<tr>
<td>Performance-Perception</td>
<td>35.800</td>
</tr>
<tr>
<td>Quantitative</td>
<td>34.200</td>
</tr>
<tr>
<td><strong>General Cognitive</strong></td>
<td><strong>92.30</strong> (Moderate level)</td>
</tr>
</tbody>
</table>

*Mean score index of scale is the same as the level of cognitive ability moderate according to the same chronological age.

Discussion

This study aimed at understanding the pattern of cognitive functioning in young children with mild autism as compared to typically developing children. Consistent with past studies, results showed a trend of weaker language comprehension, language expression and speed of processing in young children
with mild autism as compared to typically developing children. The results of this study will hopefully not only be a beginning in the investigation of the use of the MSCA for mild autism children but have also provided a number of findings worthy of further investigation. Variations in test results of the mild autism children in this sample have been noted in conjunction with the severity of autism, sex of the child, SES, educational placement, and modified test administration all of which need further in-depth verification and replication with larger samples. Analysis of raw scores, item analysis, and possible test profiles, and curriculum planning also appear to be prime areas for further study. Reasons for the unexpected differences between the autism and normal groups on the Motor and Perceptual Performance Scales should be explored. The use of the MSCA as a possible means for detection of other problems overlaying the hearing loss warrants further investigation. Finally, it appears that the McCarthy Scales of Children’s Abilities shows promise in the area of assessment of the mild autism population, particularly since it is a test designed for use in the early years which are critical to a child’s cognitive development. The wide variety of tasks on the MSCA sample language, numerical concepts, motor coordination

To rule out gross retardation and to provide for early intervention and appropriate remedial steps, this testing should be done as early in the child’s life as is possible, the period of his greatest plasticity. Follow-up testing would also be a necessity in order to measure progress and to further delineate deficit areas for that particular mild autism child planning for the intellectual growth of children is dependent on the knowledge of children’s cognitive development. Children need chances to learn in ways that are active and that provide opportunities to learn in ways that suit their individual techniques for organizing and remembering information. The different stages of child development have implications for planning a curriculum for young children. The teachers are also not aware of whether their teaching practices contribute to the development of students’ cognitive ability or not (Newcomb & Trefz, 2005). Teachers need to think about children’s physical activities and cognitive requirements of different tasks when they select learning experiences. They also need to plan activities that will help children develop social skills. Their isolation causes them to remain inexperienced in a world of comparably savvy children and can make adolescence an endless maze (Friedlander, 2009, p.141-142).

References
Berk, Laura E. Child Development. 5th ed. (2000). Boston: Allyn and Bacon


