THE UNSTABLE DEVELOPMENT OF MATHEMATICS LEARNING
DISABILITIES AND CORRELATED CONSTRAINTS: IMPLICATIONS FOR
IDENTIFICATION

A Thesis in
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by
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The mathematical developmental trajectory for students with mathematics learning disabilities (MLD) is unstable. Some students with MLD may maintain this disability throughout elementary school and even into secondary school, but some may be not identified as MLD later in their school life. The concept of correlated constraints will be used to describe this unstable phenomenon. This concept suggests that behavioral development involves the interaction of multiple factors working together as a dynamic system. This dynamic system could be a possible explanation for the unstable development of MLD. In this thesis, first, the developmental trajectory of students with MLD is outlined. Second, several possible factors affecting the math performance of students with MLD are discussed. Third, the connection between correlated constraints and the unstable development of MLD will be explained. Forth, possible improvements to the present identification system will be discussed.
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Chapter 1

Introduction

About 6-7% of the school-age population is under the risk of mathematics learning disabilities (MLD) (Fuchs & Fuchs, 2003) while reading disabilities (RD) range from 5-10%. Yet MLD has not had as much focus directed to them as RD for systematic studies (Fuchs & Fuchs, 2003), despite being very important for success after school. For example, it has been found that mathematics capability is the main factor affecting full time employment, income, and work productivity (Rivera-Batiz, 1992). Furthermore, even when reading abilities have been controlled, lower mathematics abilities increases an individual’s likelihood of unemployment and decreases the likelihood of promotion if employed (Parsons & Bynner, 1997). Because of its importance to both the individual and society, more attention should be directed to investigating factors contributing to MLD.

Problematic Definition

To date, there is still no universal etiology for MLD. Mazzocco and Myers (2003) have clearly stated that “No core deficit has been identified for MD [MLD] …. In the field of MD, work toward establishing a consensus definition is in its early stages.” (p. 219). Therefore, most empirical research has used a standard operational definition of a specified cutoff score on a standardized math assessment instrument to define their samples. This kind of definition may present a problem. That is which specific cutoff score should be used. Hanushek, Kain, and Rivkin (2002) have pointed out that “this category [learning disability] encompasses a continuum of learning conditions where it is difficult to describe and to apply precise cutoffs in evaluation and
assessment” (p. 586). Therefore, if selecting a more stringent cutoff score, there will be a problem of Type I errors (false negative). On the other hand, if selecting a more lenient cutoff, Type II errors (false positive) will emerge (Chong & Siegel, 2008). Unfortunately, most studies rather suffer these risks when it comes to characterizing the children who fit in their category of “children with learning disabilities (LD). The vague definition has blurred the results of various research. Different research projects adopt different definitions, so the results vary widely.

**The Complex Nature of Mathematics**

While the problematic definition in the field of MLD presents issues to be resolved, the complex nature of math has also aggravated this field. Theoretically, mathematics can be subdivided into four main domains: study of quantity, structure, space, and change (e.g., counting, algebra, geometry, and analysis). The requirements to master each domain are very different. Let us take geometry and counting as an example. Geometry may require more visual-spatial ability than counting but counting may require more linguistic ability and basic number sense than geometry. Students with MLD can have deficits in one or all of the many mathematical domains or in one or a set of individual competencies within each domain (Geary, 2004). If it is actually as Geary (2004) said, this complex nature has made the search for the core deficit of MLD harder and complicates research in the field.

**Available Studies and Asking Further Questions**

Although research in the field of MLD was influenced by such obstacles mentioned above, previous research articles are no doubt critical and helpful in increasing our understanding of MLD. Prior researchers’ investigations have created a lot of knowledge about MLD. For
example it has shown that several different factors have been consistently linked to poor math
achievement, such as reading-related, memory, visuospatial skills, and/or executive skills
(Mazzocco & Myers, 2003). Also there have been several longitudinal studies investigating the
developmental trajectory of students with MLD and showing an unstable pattern over time (e.g.,
Aunola, Leskinen, Lerkkanen, & Nurmi, 2004; Bodovski & Farkas, 2007; Jordan, Kaplan, &
Hanich, 2002; Morgan, Farkas, & Wu, 2009; Shalev, Manor, Auerbach, & Gross-Tsur, 1998;
Shalev, Manor, & Gross-Tsur, 2005). After a preliminary review of literatures, several factors are
found to influence the mathematical developmental trajectory for students with MLD. These
factors could be classified into cognitive, environmental and behavioral domains. Normally, each
domain could influence students’ mathematical developmental trajectory separately. However,
from a developmental science perspective, these domains could also influence each other and
form a dynamic system of correlated constraints. Under this dynamic system of correlated
constraints, the different developmental factors could influence each other bidirectionally
(Magnusson & Cairns, 1996). Also from this concept of correlated constraints, if primarily
positive factors make up the whole developmental system, correlated constraints protect against
the development of bad influences. Conversely, if negative factors make up the whole
developmental system, correlated constraints will decrease the effects of positive influences and
prevent the positive change in the student (Farmer & Farmer, 2001).

When the concept of correlated constraints applies to the development of MLD, it could
be a plausible explanation for the unstable development of students with MLD. If so, a possible
implication to focus effort on the present identification system could be addressed. In order to
achieve this result, this literature review is designed around the following questions. First, what
do the developmental trajectories for children with MLD look like? Second, what are some
common cognitive, environmental, and behavioral characteristics that children with MLD may
exhibit? Third what does the concept of correlated constraints in the developmental science tell us
and what is its implication on the development of MLD? Finally, under this implication, what complementary efforts are needed for the present identification system in MLD? By understanding the above questions, a complementary effort for a more holistic system in identification could be made. Therefore, by investigating these questions, I can expect to increase the instructional knowledge in this field.
Chapter 2

Mathematics Developmental Trajectory

Recently, researchers have highlighted the importance of examining achievement trajectories over time. Because understanding children’s growth rate is fundamental to understanding learning and learning difficulties. Longitudinal investigation is the main way to understand such growth trajectory. However, few studies have examined mathematics difficulties from a longitudinal developmental perspective (Jordan et al, 2002). The following sections will address the early development of mathematics knowledge, developmental trajectory for MLD, and their empirical evidence.

Early Development of Mathematics Knowledge

There are a number of components needed for a child to perform mathematics properly, such as basic knowledge of numbers, memory for arithmetical facts, understanding of mathematical concepts, and the ability to follow procedures (Dowker, 1998). Some components or sub-components begin to develop well before formal education starts (e.g. describing absolute size, part-whole relations, and protoquantitative reasoning schemas). These earlier understandings mainly come from informal instructional interactions with parents, siblings, or others (e.g. teaching children to use any object to learn counting, teaching children the meaning of “third”) (Baroody, Lai, & Mix, 2006). From the viewpoint of developmental stage theories, it is this early learned knowledge that provides the foundation for mastering more complex mathematics skills and procedures. For example, Entwisle and Alexander (1990) stated, “Mathematics is a hierarchically arranged subject, with each step drawing upon skills laid down in the preceding
steps….” (p. 454). More specifically, several components (e.x., Fig. 1) were found foundationally important for children to develop numerical competence and to solve future complex arithmetical problems adequately (Desoete & Grégoire, 2006; Fuson et al, 1997; Sowder, 1992).

Fig. 1. Theoretical framework integrating several components of mathematical problem solving. From Desoete and Grégoire, 2006.

Despite the explanation of developmental stage theories, environmental factors such as family factors and systematical instruction can also affect children’s development (Entwisle & Alexander, 1990). Family factors could be parents’ expectation, education, and socioeconomic status (SES). Factors like these could affect a child’s early math concepts, so low skills of preschool children are related significantly to negative family factors (Entwisle & Alexander, 1990). On the other hand, systematical instruction begins after formal school education. Under systematical instruction, home-environment-disadvantaged children who show low math skills prior to beginning school may begin to catch up to their higher level peers (Morgan et al., 2009).

The above finding (developmental stage theory and environmental factors) creates an interactive influence on the mathematics development, so the development trajectory becomes increasingly complicated. Hence, as Bodovski and Farkas (2007) stated, “There is no
consensus … about whether children who start school with low levels of knowledge improve, remain ... or fall even further behind their peers over time” (p. 116). However, there are still some researchers devoting themselves to discover the contributors of MLD development, and research like this has provided a lot of references to understand the possible trajectory and factors affecting it. Broadly, there are two types of research trying to discover MLD development. The first type of research work, which is more popular, tries to compare the different developmental trajectories between children with MLD and their peers without disabilities (e.x., Aunola et al., 2004; Bodovski & Farkas, 2007; Jordan et al., 2002; Morgan et al., 2009). The second type of research work tries to discover the persistence of MLD by comparing the development of students with MLD themselves (e.x., Shalev et al., 1998; Shalev et al., 2005). Both of the two types of research have produced a lot of results. In the following sections, the results of both types of research will be discussed.

First Type of Research: Two Different Models for Developmental Trajectory for Children with MLD

Because of the viewpoint of developmental stage theories and environmental factors on mathematics learning, there are two contrasting viewpoints to the developmental trajectory by comparing children with MLD to their peers without disabilities (Aunola et al., 2004). The first one may be characterized as a cumulative growth model. In this model, they think children’s knowledge and skills gradually accumulate as time goes by. Children who start with a higher level in math refine their skills and knowledge more than those who start with poorer skills. Such a cumulative pattern would manifest itself in a high stable rate, so individual differences in math performance will increase over time, presenting a fan out spread (Aunola et al., 2004). In this model, the initial level of performance predicts positive subsequent growth in performance
(Aunola et al., 2004). Therefore, there will be an increasing gap between “high” and “low” skilled students, and finally students with early onset of mathematics disabilities or difficulties may continue to demonstrate MLD as they move through adult life (Bodovski & Farkas, 2007; Morgan et al., 2009).

The second view may be characterized as a lag model (Aunola et al., 2004). Under this model, children who enter school with a lower level of mathematics knowledge increase their math performance more rapidly than those who have a higher level (Jordan et al., 2002). As a consequence, children with a lower level finally catch up with those who originally have a higher level (Aunola et al., 2004). Such decrease in the individual gap may be due to three possibilities. The first possibility is the regression to the mean (Phillips, Norris, Osmond, Maynard, 2002), although this has only been found on reading. The second possibility could be the systematical instruction in school (Morgan et al., 2009). For example, the environmentally deprived children with low math knowledge begin to receive formal mathematics education, and this systematic instruction helps them to overcome their previous disadvantages. The third possibility could be there are instructional or testing ceiling effects (Jordan et al., 2002). That is, there may be an increasing difficulty of targeted knowledge to be learned which makes students with high achievement somehow slow down their rates. Thus, children who experience early onset of MLD may catch up to their peers.

**Second Type of Research: Unstable Development among Children with MLD**

Instead of comparing math developmental trajectory of students with MLD to their peers without disabilities, some researchers try to investigate the math developmental trajectory of students with MLD longitudinally. They try to identify the persistence of MLD over time (e.x., Shalev et al., 1998; Shalev et al., 2005). In the research of Shalev et al. (1998), they identified
children with MLD by using IQ-Achievement discrepancy model at fourth grade. After a three year longitudinal study, they found about half (47%, 57 of 123) of the students were reclassified as having persistent MLD. In the other research (Shalev et al., 2005), they identified children with MLD by using the same method when the children were at fifth grade. From their six years tracing, they found 40% (42 of 104) of the students originally identified as MLD remained classified as MLD. From these findings, we could find the persistence of MLD in elementary school is very unstable. Their finding means over 50% of children originally identified as MLD will recover from this disability in elementary school (although they also showed this group of students will still perform poorly in mathematics). This unstable persistence could also be found from other research findings. For example, in the work of Silver, Pennett, Black, Fair, and Balise (1999), they found only 50% of their 9- to 13-year-old participants with MLD retained that diagnosis at a 19-month follow-up. Furthermore, in the work of Mazzocco and Myers (2003), they also found a similar unstable persistence pattern (63%, 22 of 35) like Shalev et al. (1998), Shalev et al. (2005), and Silver et al. (1999).

From both types of research on MLD development, we could find math development among the children with MLD is variable and unstable. This has a very important implication to our present screening system for MLD to prevent the waste of resources in this area. Therefore, further questions about what common factors produce this kind of variable and unstable development need to be discussed. In the following chapters (Ch3, Ch4, & Ch5), common factors in cognitive, environmental, and behavioral domains which affect math performance of students with MLD over time will be respectively provided and discussed. In chapter 6, the developmental science perspective and one of its core concepts, correlated constraints, will be defined and applied to the development of MLD. Finally, in Ch 7, an implication from Ch6 for possible prevention and intervention system will be addressed.
Chapter 3

Cognitive Factors

In the beginning of chapter 2, we have discussed reasons that have complicated children’s mathematics development. One of the reasons is from the developmental stage theories, people think early learned knowledge is very important to provide the foundation for mastering more complex mathematics skills and procedures. This viewpoint could be plausibly connected with cognitive factors of children. For example, if young children have a problem with some cognitive functions, he or she may experience a hard time at the beginning of learning when compared to other children, thus causing hardship when progressing to deeper knowledge. Moreover, for children with MLD, it has been shown that they have demonstrated lower performance on most or all the cognition measures (Geary, Hoard, Byrd-Craven, Nugent, & Numtee, 2007). This finding supports my hypothesized connection which will be discussed in CH6. Therefore, from literature reviews, some common cognitive factors such as counting ability, working memory, attention deficit, inhibitory control, and metacognitive knowledge will be addressed in the following section to see their implications on math development of children with MLD.

Counting Ability

Counting ability is the ability for children to understand how to count objects and understand the knowledge of the order of numbers (Geary, 1993). The basic concept includes Gelman and Gallistel’s (1978) five implicit principles: (a) one-to-one correspondence (one and only one word tag is assigned to each counted object), (b) stable order (the order of the word tags must be invariant across counted sets), (c) cardinality (the value of the final word tag represents
the quantity of items in the set), (d) abstraction (objects of any kind can be collected together and counted), and (e) order irrelevance (items within a given set can be tagged in any sequence) (Geary et al., 2007). It has been shown that children with math-related disabilities have problems related to their basic counting abilities regardless of their IQ or reading status (Aunola et al., 2004; Geary, Hoard, & Hamson, 1999; Ohlsson & Rees, 1991). Two possible reasons can explain why counting is an important antecedent for future math skills. The first possible reason is that familiarization of basic counting can lead to automatic use of math-related knowledge and thus allows extra attention resources to be devoted to more complex math problem solving and procedures (Gersten & Chard, 1999). The other possible reason is familiarization of basic counting can involve not only the automation of fact retrieval but also the accuracy of fact retrieval (Aunola et al., 2004; Siegler, 1986; Geary et al., 2007). For example, when children have a lot of successful experience in using basic counting knowledge, they gradually gain confidence in their accurate answers on the retrieval of solutions instead of counting, but when children repeatedly make counting errors, it has been found their incorrect solving methods may be repeated over time and thus incorrect answers will continue to be associated with some specific problems. This deficit of basic factor retrieval, which was caused by poor counting ability, can be stable and persistent (Chong & Siegel, 2008). In the longitudinal research of Chong and Siegel (2008), they found children with fact fluency deficits at grade 2 showed the same deficit through grade 5 and the gap in this ability remained the same with their peers through grade 5 too. This finding is also in agreement with findings in other literature (Geary, Brown, & Samaranayake, 1991; Jordan et al., 2002; Jordan, Hanich, & Kaplan, 2003a, 2003b). So if the counting ability cannot be remedied, further math problems may become very serious and sustained.
**Working Memory**

Working memory is the ability to retain a mental representation of information in short-term memory while simultaneously processing other incoming information. Under the tripartite view (Swanson & Sáez, 2003), working memory is composed of a central executive controlling system which interacts with two sets of subsidiary storage systems: the speech-based phonological loop and the visual-spatial sketch pad. The phonological loop stores the temporary verbal information for a short duration by the process of subvocal articulation. The visual-spatial sketch pad stores the visual-spatial information for a short period of time, and plays the key role in generating and manipulating mental images. Finally, the central executive component’s function is to coordinate with these two subsidiary memory systems, which includes the control of encoding and retrieval strategies, attention switching during manipulation of material held in the verbal and visual-spatial systems, and long-term memory information retrieval (Swanson & Sáez, 2003). Although the relationship between working memory and mathematics is not fully understood, it has been well established that children with learning disabilities do not perform as well as their peers on working memory tasks (McLean & Hitch, 1999; Siegel & Ryan, 1989; Swanson, 1993). From the tripartite view of working memory, it is suggested that MLD seems to be involved with poor function of the phonological loop in working memory. For example, when children count, low performance on the representation and articulation of number words and the associated procedural competencies has been documented (Geary, 2004; Geary et al., 2007). However, some researchers have also confirmed that MLD also involves poor function in the visual-spatial sketch pad (Berg, 2008; Geary et al, 2007; Krajewski & Schneider, 2009). For example, Krajewski and Schneider (2009) have shown that children at around 3 years of age need to develop the quantity to number word linkage. The quantity to number word linkage is thought to have a close relationship with visual-spatial working memory. Similarly, Ansari, Donlan,
Thomas, Ewing, Peen, and Karmiloff-Smith (2003) have shown that individual differences in visual-spatial working memory in children around 3 years old become especially important when children must grasp the cardinality understanding at this developmental level. Therefore it is possible that children with MLD may show deficits in both.

Another interesting evidence of working memory is that Passolunghi and Siegel (2001) tried to discover the effects of numerical working memory and verbal working memory on MLD. They suggested that Children with MLD are not restricted to only numerical working memory tasks but also verbal working memory tasks. For example, by comparing two groups of students (poor math problem solvers and good math problem solvers) on four different working memory tasks (three tasks are verbal working memory tasks and one is numerical working memory task), they found there are significant differences between the two groups on all four tasks even when two groups’ verbal intelligence and reading comprehension ability are controlled. This result supports the idea that children with MLD are affected greatly by poor general working memory.

**Attention Deficit**

In the last paragraph how working memory functions has been discussed. Also, it has been mentioned that basically the central executive system controls “attention” switching among the verbal and visual-spatial systems. Although their focus is on RD, Swanson and Sáez (2003) have further suggested that executive processing deficits for participants with learning disabilities could result in three outcomes: (1) poor performance on complex divided attention tasks, (2) weak monitoring ability, as exhibited in the failure to suppress (inhibit) irrelevant information, and (3) poor performance across verbal and visual-spatial tasks that require concurrent storage and processing. From the first outcome, it seems that poor attention control could disrupt the
execution of mathematical procedures, so in the next paragraph the relationship between MLD and attention ability will be discussed.

Although the relationship between attention problems and MLD are very scarce, recent research studies have shown that attention problems have a strong relationship with MLD (Fuchs et al., 2006; Gross-Tsur, Manor, & Shalev, 1996; Lindsay, Tomazic, Levine, & Accardo, 2001; Shalev, Auerbach, Gross-Tsur, 1995). For example, in the work of Fuchs et al (2006), they found that attention could predict significantly 3 aspects of mathematics performance (arithmetic, arithmetic, computation, and arithmetic word problem), and pointed out that a teacher rating scale of attentive behavior could predict the development of first-grade skills with arithmetic word problems. Also, children with Attention Deficit Hyperactivity Disorder (ADHD) have been found to perform poorly mathematically (Capano, Minden, Chen, Schachar, & Ickowicz, 2008; Mayes, Calhoun, & Crowell, 2000).

For children with MLD having poor attention abilities, my hypothesis is that their poor working memories decay their attention abilities. This hypothesis is similar to the finding in RD (Swanson and Sáez, 2003). It seems that their poor working memories will consume much of their attention resources and result in their poor performance on mathematics. For example, in a word problem, children need to read the problem while simultaneously filtering key information to figure out the proper solution (a form of general working memory). Under this heavy working memory task, because children with MLD have been proven to have poor working memory, this task will consume much of their attention resources on the right choice of information and thus result in mistakes in following steps. On the other hand, for children with ADHD performing poorly mathematically, a possible explanation is that some mathematics problems need some level of attention ability to maintain the previous information to perform them. For example, counting attention is very important for children to remember their previous counting number for the next correct number. That is why finger-counting has been shown to be an effective strategy for
children to understand where they are for counting. The other explanation is the general symptoms of children with ADHD may reflect their poor reading and mathematics performance. For example, they can not focus well on the teacher’s instruction.

Inhibitory Control

Inhibitory control means the ability to control and ignore (inhibit) irrelevant information. It is thought to be an important component for math problem solving. For example, think about what it will be like if you were to ask a child to solve an addition problem, but this student was distracted by an irrelevant word in this problem and was confused into using multiplication. As this example shows, it has been proven that students with MLD are greatly affected by inhibitory control. For example, Passolunghi and Siegel (2001) found poor problem solvers make a higher number of intrusion errors than good problem solvers while asking them to recall the last words or digits in a series of working memory tasks requiring inhibition of irrelevant information. Also, they found that errors increase among poor problem solvers while the items demanding working memory tasks became higher. This result confirmed two things. First, the inhibitory control is highly correlated with students with MLD. Second, their research supports that MLD individuals may suffer from poor working memory and this poor working memory is highly related to the failure of an inhibitory mechanism while processing the information.

However, we should ask whether a student with MLD is related to their poor metacognitive knowledge. For example, in the research of Passolunghi and Siegel (2001), they found that the two groups of their participants did not differ in the recalling of to-be-remembered words or digits when they are stressed or elaborated on by the examiners. However, when asking students to supply the last information heard in the task, the poor problem group made more errors because of the stressed information. It seems that students with MLD lack a strategy to
select or to retrieve relative information. The next section will discuss how metacognitive knowledge relates to mathematics performance.

**Metacognitive Knowledge**

Metacognitive knowledge refers to the understanding and knowledge of one’s own cognitive processes or anything related to them. Specifically, when solving a novel problem, students need to plan their own way to approach this task, monitor comprehension, and evaluate progress towards the completion of the task. These are skills that are metacognitive in their nature. It has been shown that metacognitive knowledge is highly related to mathematics performance, especially in the students’ beginning level of mathematics (Aunola et al., 2004). There are two possible important explanations for this. The first one is that metacognitive ability may reflect overall cognitive ability, which has been proved to be very important for mathematics performance (Swanson, 1990). The second possible explanation is that metacognitive knowledge may enable learners to adjust themselves appropriately to varying problem-solving tasks, demands and contexts, thereby demonstrating their importance in any variety of learning processes (Swanson, 1990). For example, it has been noted that metacognition plays an important role in accelerating the transferring of mathematics problem solving, that is, how students apply knowledge, skills, and strategies to a novel problem (Fuchs & Fuchs, 2003). Also, in one research study by Swanson (1990), he randomized students into four groups, 2 (high-low aptitude) x 2(high-low metacognitive ability), he found that high-metacognitive students outperformed their low-metacognitive peers in mathematics problem solving, regardless of their aptitude level (aptitude level here means their general academic performance). According to Swanson, higher metacognitive ability groups tended to use more hypothetico-deductive (if-then propositions) and evaluation (check the adequacy of a hypothesis) strategies than the lower metacognitive groups.
Therefore, high metacognitive knowledge can lead to more efficient knowledge processing and compensate the overall ability in any task at hand.
Chapter 4

Environmental Factors

It has been shown that children with MLD demonstrate different environmental situations like socioeconomic status (SES), and parent involvement from their peers without disabilities (Jordan et al., 2002; Jimerson, Egeland, & Teo, 1999). Furthermore, children from disadvantaged backgrounds tend to fall further behind as they pass through the elementary years (Entwisle & Alexander, 1992). It seems that besides cognitive factors, environment can also lead to different achievement for children. Therefore, it is important for us to address not only the cognitive aspects but also the environmental factors for students with MLD. In the following paragraphs, some common environmental factors that contribute to children with MLD will be presented and explained.

Socioeconomic Status (SES)

The definition of SES is different from research to research. For example, the definition could be income, occupation, or education of parents. Many researchers have demonstrated that SES is one of the most important explanations in educational outcomes. For example, Egeland and Aber (1991) had shown that failure to learn basic skills and to achieve academically is a problem of a poverty background. With regard to mathematics achievement, SES had also been shown to be critical for children not only in early elementary school but also in middle school. For example, in the 20 year longitudinal study of high risk children (N = 174), Jimerson and his colleagues (1990) examined the deflection of mathematics achievement from their samples’ predicted achievement score across time, based on their regression line (from first to sixth grade
and first grade to age 16 years). They also examine the five predictor variables (years of special education, child behavior, parent involvement, home environment, and socioeconomic status) to account for the deflection. From their hierarchical multiple regression analyses on examining the relative contributions of the predictor variables for sixth grade residual scores, they found SES (Grade 1-3) contributed significantly to the deflection in mathematics achievement in sixth grade. Furthermore, from the post hoc analyses to examine potential differences in predicting the group of upward deflection in contrast to those of downward deflection, they found SES in upward and downward deflection groups significantly correlated with their math achievement. Specifically, SES is the only one variable that could account for both upward and downward deflection in math. One thing that is needed to pay attention to in the work of Jirmerson et al. (1999) is that SES only achieved a significant relationship with math, not with reading for both upward and downward groups. Comparing this situation to mathematics achievement, one possible hypothesis is that mathematics education is not emphasized in the Head Start program. That is, perhaps too much time is dedicated to the Head Start program for students in poverty for reading but not math. This may be one of the directions that policy makers should consider for low SES students to help them gain better math achievement.

**Home Environment**

Home environment basically means either cognitive, emotional, or socioemotional support for children in a family. Each dimension includes a lot of sub-components. Right now Home Inventory is considered to be the most reliable measurement of home environment. There are mainly 8 subscales to measure the home environment. They are: (1) Parental Responsivity, (2) Encouragement of Maturity, (3) Emotional Climate, (4) Provision of Materials and Experiences, (5) Active Involvement of Parents, (6) Family Participation with Child, (7) Paternal Involvement,
and (8) Physical Environment (see Bradley, Caldwell, & Rock, 1988, for more information). Quite a lot of evidence has suggested that home environment may have strong effects on the mathematics skills of children (Crane, 1996; Entwisle & Alexander, 1992; Jirmerson, et al., 1999; Siegel 1984). For instance, Crane (1996) examined home environment, SES, and maternal cognitive test scores on mathematics development by using data from the National Longitudinal Survey of Youth (NLSY). From this study, he found each variable had a significant independent effect on mathematics; and home environment had the largest effect on mathematics even when SES and maternal cognitive test scores were controlled. His results suggested that one standard deviation increase in the adopted HOME scales could result a three-fifth standard deviation rise in children’s mathematics scores. Also, he found home cognitive stimulation had a slightly larger effect than emotional support in both earlier and later years, and home environment mattered more when children were younger. This is consistent with the previous psychological theory that children are affected most by early environment. Moreover, he found the effect of SES on children’s mathematics score was indirectly operated through home environment. For instance, about 1/2 the effect of family income and 1/3 the effect of household size was attenuated by controlling for home environment. This finding could be explained that SES would be related to children’s mathematics scores directly and indirectly, through its effect on home environment. From the result, we can understand home environment could affect children’s mathematics performance a lot even when the SES is controlled. Therefore, programs that train parents with MLD children to improve both intellectual and emotional support should be emphasized to facilitate children’s mathematics performance. Especially, programs that attempt to raise children’s cognitive skills by teaching parenting skills to their children should be developed.
The type of instruction could affect student’s academics achievement. For example, during 1968 to 1977, the Project Follow Through has compared different teaching models and has shown us different teaching models could have different effects on students’ academic achievements. It is also true in the area of mathematics. For example, Sowder, Philipp, Arsmrong, and Schappelle (1998) indicated that poor mathematics instruction and teachers’ limited knowledge could affect students’ mathematics achievement. So the topic of what is the most effective form of instruction on mathematics is very important. However, this is a very complex question to answer due to the complex instructional environment in schools. For example, the National Research Council (2001) pointed out that effective instruction relies on the interactions among teachers and students around the content. That is, the teachers’ backgrounds, students’ characteristics, school culture, the mathematical topics, and the instructional materials being used all could be factors to be discussed. Fortunately, in the area of special education, there has been some progress concerning this question (National Mathematics Advisory Panel [NMAP], 2008). In their final report, the NMAP examined 26 high-quality research studies, mostly using randomized control designs. They found a very united opinion on the effectiveness of explicit instruction for students with MLD from those 26 studies especially on the area of computation, word problem and solving problems that require the application of mathematics to novel situations. This explicit method of instruction features teachers specific explaining, step by step demonstrating, careful sequencing of problems, allowing students many opportunities to ask and answer questions, think aloud and frequent feedback.

Although their finding of the effectiveness of explicit instruction on MLD, from the recommendation of NMAP (2008), they suggest this kind of instruction should not be the only mathematics instruction these students could receive since, from their meta-analysis, this
instruction is only effective in the area of computation, word problem and solving problems that require the application of mathematics to novel situations. Specifically, they suggest teachers should dedicate some time to make sure that students possess the foundational skills and conceptual knowledge necessary for understanding mathematics while incorporating some explicit instruction on a regular basis.

**Social/ Family Expectation and Gender**

Gender is always a controversial aspect when discussing mathematics development. Some researchers claimed that boys were more likely to display better mathematics skills than girls (Aunola et al., 2004; Jordan, Kaplan, Oláh, & Locuniak, 2006). Some indicated the sex difference between young children on standardized measures of mathematics were minimal or even nonexistent (Lachance & Mazzocco, 2005). I suspect this unclear result may be due to the indirect effect of gender on children’s mathematics performance. That is, the social and parental expectations may mediate the effect of gender on the performance of mathematics. One indirect support of my suspicion is the finding of a large influence from parental expectation. For example, Entwisle and Alexander (1990) have found significant effects of parents’ expectations on mathematics achievement on their children’s scores on the quantitative section of the California Achievement Test in the first and second grade. Further, Tsui (2005) found that higher mathematics performance of Chinese eighth grade students than that of American eighth grade students is partly due to parents’ expectation on children’s mathematics scores. He found the relationship between parental expectation and mathematics scores is stronger for Chinese students than for American students. Also, normally in our society, people have expected male students to perform better on mathematics. Therefore, from both of the indirect supports (1. large effect of parental expectation on children’s’ mathematics performance, and 2. normal society’s viewpoint
on male) it is possible that gender is mediated by this effect. In the future, we need to investigate further about social and parental mathematics expectations on different genders, and how this may affect their mathematics performance.
Chapter 5

Emotional/Behavioral Factors

Several studies on general learning disabilities, especially on reading achievement, have found a relationship between low achievement and behavioral problems (Hinshaw, 1992; Morgan, Farkas, Tufis, & Sperling 2008). Although the causality between them is not yet fully understood, the relationship between academic achievement and emotional/behavioral problems is very strong both in magnitude and occurrence. For example, in the study of Morgan et al. (2008), after statistically controlling for potential confound, they found approached problems out of five types of behaviors (approached problems, self-control problems, interpersonal problems, externalizing problems and, and internalizing problems) elevated the possibility of learning disabilities. The odd ratio was a high 3.07, which means children with poor approached problems (low task-focused behavior) in first grade will be 3.07 times higher than children without approached problems to become poor readers in third grade. Conversely, they also found poor readers in the first grade will be 2.17, 1.33, 1.39, and 1.66 times higher than normal readers to show approached problems, self-control problems, externalizing problem, and internalizing problems respectively. This strong relationship makes it plausible to speculate this kind of relationship in the field of mathematics. For example, in chapter 3, it has been mentioned that poor attention shows a decent relationship in mathematics performance, although I defined attention into the cognitive domain. In addition to this, although the research studies related to this topic are scarce in MLD, an important issue about “mathematics anxiety” is gaining increasing focus in this area. The first concern of mathematics anxiety began from the work of Richardson and Suinn (1972). From their work they defined mathematics anxiety as “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary
life and academic situations” (p. 551). From previous works, it has been shown that math anxiety could not only affect students’ math performance (Ashcraft & Kirk, 2001), but would also invoke some behavioral problems such as worrisome thoughts, and avoidance behavior (Hembree, 1990; Richardson & Woolfolk, 1980). According to these findings, special attention should be focused on children with MLD, because it seems that children with MLD are the most possible victims from mathematics anxiety. Furthermore, this special attention of the relationship should be increased due to the finding that the mathematics anxiety could disrupt individual’s function of working memories and then negatively affect their math performance (Ashcraft & Kirk, 2001; Hopko, Ashcraft, Gute, Ruggiero, & Lewis, 1998). From this finding and our previous discussion of working memory in MLD, it is possible that there should be a relationship between MLD and mathematics anxiety mediated by the function of working memory. However, no research study investigated the causal relationship among MLD, working memory, and mathematics anxiety. But the relationship between MLD and mathematics anxiety is supported by the work of Dowker (2005). From her work, she clearly suggested math anxiety and related problems such as depression or psychosomatic disorders produce negative effects on children with MLD. Also, one study I found investigated the causal relationship between calculation ability, self-reported evaluation of mathematics, and math anxiety in 140 primary school children between the end of first grade and the middle of third grade. In this study the result showed there was no causal effect of calculation ability and math anxiety on each other, which contradicted the previous finding of Dowker (Krinzinger, Kaufmann & Willmes, 2009). They explained this null causal effect between calculation and math anxiety should be due to methodological issues such as the choice of measures for math anxiety. From their further explanations, first, it could be the cognitive level of anxiety may not be the most suitable aspect of math anxiety to be examined for children in such young ages. Instead, the physiological reactions such as high pulse or avoidance behavior concerning calculations might be more suitable measures for that age. Second, they think it might
be the phrasing of the questions in the measure poses difficulties for young children. Although this finding produced no significant result of the causal effect on calculation ability and mathematics anxiety, this study presented an important issue in this field and stressed the need for more appropriate instruments to assess math anxiety during early primary school years, the time when math anxiety most likely first emerges.

Finally, if the suitable measurement of math anxiety during early primary school years is developed, we still need to investigate the causal relationship among MLD, working memory, and mathematics anxiety. It seems like one possible explanation from my causal-relationship hypotheses could lead to the occurrence of pseudo MLD, which may be the one reason for the unstable developmental trajectory of MLD. The following is my hypothesis. By following four causal model hypotheses between RD and behavioral problems from Hinshaw (1992) and Morgan et al. (2008) (1. “common cause” variables in both reading and behavior, 2. reading problems lead to behavioral problems, 3. behavioral problems lead to reading problems, and 4. reading and behavioral problems cause each other), three possible explanations for the casual relationship between MLD, working memory, and mathematics anxiety were also developed here. First, it could be the mathematics anxiety derived from MLD decreases the function of students’ working memory. Second, it could be the poor working memory derived from mathematics anxiety leads to poor performance and causes the MLD. Third, both 1st and 2nd explanations are true and may have bidirectional interference on each other. If the second and third explanations are correct, then there will be a possibility for the occurrence of pseudo MLD, because this low working memory is derived from mathematics anxiety, not from MLD itself. For instance, the math performance for children at the beginning of education is affected by poor family environment. If this low performance at beginning of formal education caused the beginning of mathematics anxiety without proper intervention, low function of working memory will occur to cause pseudo MLD. This situation will evolve into a vicious circle then lead those children to
have true MLD. However if proper intervention occurs, those normal students with pseudo MLD will catch up with their peers and their low working memories will improve due to the decreasing mathematics anxiety. In sum, proper measurement of math anxiety for children in early school and further investigation of this topic need to be developed to verify the truth of the matter.
Chapter 6

Developmental Science Perspective: Correlated Constraints

Developmental science is a fairly new metatheoretical framework for guidance of interdisciplinary research to investigate individuals’ behavioral and psychological phenomena (Cairns, 2000). This framework stresses a cross-scientific perspective and the importance of including a wide range of factors for investigating various forms of individual development. For the approach issue, unlike the old holistic approach, the developmental science has enriched the original holistic approach into a solid theoretical foundation for planning, implementing, and interpreting empirical research on specific problems (Magnusson, 2000). Four main sources have contributed to the methodological tools and research strategies of developmental science: cognitive research, neuroscience, modern model for dynamic complex process, and longitudinal research (Magnusson). For the cross-scientific issue, contemporary contributions to this synthesis have included fields of social development, cognitive development, social ecology, developmental psychobiology and ethology, holistic approaches, developmental systems, life course analysis, developmental contextualism, and developmental psychopathology (Farmer & Farmer, 2001).

From the developmental science perspective, an individual functions as an open organism interacting with the outside environment and the development of that individual is built from this dynamic interaction of the systems existing both within and beyond that individual (Magnusson, 1998). Therefore, the behavioral patterns of individuals could only be understood when we investigate how their internal (e.g., cognitive, emotional, endocrine, morphological, neurobiological, perceptual, physiological) and external (e.g., family, peer group, neighborhood, culture) subsystems work together (Magnusson & Cairns, 1996). Because both of these factors
work bidirectionally to influence each other, understanding outcomes is a complex procedure and requires investigating multiple factors, across multiple levels (gene, cytoplasm, cell, organ, organ system, organism, behavior, environment) in relation to issues of timing, but understanding these complex relations can provide a better understanding of human behavior than the ordinary variable-oriented research, in which one usually targets to a specific area and studies the linear relations between operating factors (Bergman, Cairns, Nilsson, & Nystedt, 2000). It does not mean that the standard variable-oriented research is misplaced or without its value, since it has contribute a lot of information for the beginning understanding of human development (Bergman, Cairns, Nilsson, & Nystedt, 2000), but this kind of research method has its limitation to understanding the interaction of factors. As what Bergman et al. (2000) stated, “Important interactions may be completed missed…. These interactions may not even be captured by the accumulation of studies of specific aspects undertaken in this way [variable-oriented research]” (p.4). Therefore, if we want to understand the holistic pattern of development in MLD, we need to further rely on this developmental science framework. A discussion of how to apply this metatheoretical framework to the development of MLD is out of the scope of this article, but one of the concepts, correlated constraints, in developmental science could be used to explain the unstable math development in children with MLD.

**Correlated Constraints**

The focus of this article so far has been on the individual factors in the development of MLD. However, as what Bergman et al. (2000) have said, this kind of variable-oriented research finding has its limitation on our understanding in the development of MLD. From the developmental science perspective, an individual functions as an organism interacting with the outside environment and the development of that individual is built from this dynamic interaction.
of the systems existing both within and beyond that individual (Magnusson, 1998). By applying this perspective to MLD, internal factors (factors in cognitive and emotional domain) and external factors (factors in the environmental domain) could bidirectionally interact with each other and form a dynamic system for the development of MLD. However, people may wonder if the situation is so, then a slight adjustment in one of the factors could produce something like the butterfly effect in chaos theory and if so the individual’s development will become far too unstable to investigate. In fact, it is true and agreeable that nature is full of sudden transformations and divergences, but there is a psychological lawfulness and mathematical order to be found in any analysis of transformations themselves (Magnusson & Cairns, 1996). The concept of correlated constraints could be used to explain this lawfulness and order. From their explanation, the concept of correlated constraints is a network of associations between social, environmental, and biological forces. Because of such mutual influences, the developmental factors tend to become a correlated system of constraints that promote stability in development (Magnusson & Cairns, 1996). Putting it more clearly, when primarily positive factors (e.g., academic success, supportive relationship from parents, sufficient resources from school or home) make up the whole developmental system, correlated constraints protect against the development of behavior problems. That is, even when risks are introduced into the system, positive factors constrain other negative influences and decrease the likelihood of negative outcomes. On the other hand, correlated constraints can have a deleterious outcome if the main system is mainly constructed by negative factors (poor task engagement, low SES, academic difficulties) because a system composed of negative correlated risks is likely to promote increasingly problematic patterns of adjustment and sustain behavioral difficulties from childhood into adulthood (Magnusson & Cairns, 1996). When this concept is adopted into the development of MLD, a student could have cognitive, environmental or behavioral factors (both good and bad) to positively or negatively affect their mathematics performance. If primarily positive factors make
up the whole developmental system, correlated constraints protect against the development of MLD. However, for the student with MLD, their correlated constraints have more negative factors than their peers without disabilities (maybe not in all three domains, but maybe in one or two domains). Therefore, if a teacher focused on only one factor in a specific domain for intervention (e.g. academic intervention for student’s counting ability), the correlated constraints of other negative factors may prevent this positive effort and make this intervention short lived.

The Correlated Constraints and Multiple Risk Factors of MLD

In the research of Shalev et al. (1998) and Shalev et al. (2005), they found over 50% of children who were originally identified as MLD but not identified as MLD years later. From the concept of correlated constraints, four possible explanations could be considered for this unstable phenomenon. Because of the wide usage of discrepancy model as the identification tool, inside my explanation, I first classify students with MLD into two categories, true MLD and pseudo MLD. For true MLD, students may show most of their problems in their cognitive domain. Although they may have problems in other domains but their cognitive deficits are the main factors (Also, it conforms to the definition of specific learning disability in IDEA 2004). For pseudo MLD, students may be misidentified as MLD because of their poor math performance from environmental or emotional factors. The cognitive problems are not the main reason causing MLD.

First Possible Explanation:

Those with true MLD may have more deficits in only the cognitive domain but not in environmental and emotional domains. When considering most schools only focus on the
cognitive aspects of intervention (e.g., counting abilities, attention, inhibitory control or metacognitive abilities), these students get rid of the identification of MLD (although they still performed poorly on mathematics) because most of their negative factors in their correlated constraints are intervened and focused on by schools. However, this situation could be an exception if the cognitive problems of the students are too severe. If the cognitive problems are too severe, the effect of intervention may have its limit and those with severe problems will remain in the category of MLD. Further, that is also why the result of Shalev et al. (2005) shows the persistence of MLD was associated with the severity of the dyscalculia in fifth grade ($p<0.05$), lower IQ ($p<0.01$), and inattention ($p<0.01$).

**Second Possible Explanation:**

It may be that those with true MLD also have problems in the environmental and emotional domains. If the schools and teachers only focus efforts on the cognitive interventions but neglect other negative factors such as their low home environment, SES or mathematics anxiety, from the concept of correlated constraints, these efforts will be short lived and other negative factors in the developmental system will correlate with each other to constrain these positive factors. This kind of situation will help the persistence of MLD.

**Third Possible Explanation:**

For those with pseudo MLD, if the school identifies their problems are mostly from the environmental and emotional domains, then instead of giving them only academic interventions, schools and teachers also help them environmentally and emotionally, these who were originally identified with MLD may recover years later. Then the persistence of MLD will not occur.
Fourth Possible Explanation:

For those with pseudo MLD, if the school misunderstands their poor performance is from their cognitive side and only focus on academic interventions, from the concept of correlated constraints, this intervention will be short lived and other negative factors in the developmental system will correlate with each other to constrain the positive efforts. If so, the students will keep having poor performance in mathematics, so the persistence of (pseudo) MLD will happen.

These four possible explanations under the concept of correlated constraints give me some implications on the present identification system. The next chapter will be to focus on how to compensate the present identification system.
**Chapter 7**

**Implication**

**Possible Technique to Complement the Present Identification System**

The most popular identification for students with MLD right now is IQ-Achievement Discrepancy model. However, IQ-ACH discrepancy has been criticized for its poor capacity for early identification and IQ-ACH discrepancies have been discredited on additional conceptual and methodological grounds (Fuchs, Compton, Fuchs, Paulsen, Bryant, & Hamlett, 2005). The above problems could also be reflected in some research studies. For example, in the works of both Shalev et al. (1998) and Shalev et al. (2005), they both use IQ-ACH discrepancy as their screening tool, but both their works show the unstable persistence of MLD. When inspecting the nature of MLD, it is easy to understand why there is an unstable development of MLD. For example, first, Mazzocco and Myers (2003) have clearly stated that “No core deficit has been identified for MD [MLD] …. In the field of MD, work toward establishing a consensus definition is in its early stages.” (p. 219). Second, Hanushek, Kain,and Rivkin (2002) have pointed out that “this category [LD] encompasses a continuum of learning conditions where it is difficult to describe and to apply precise cutoffs in evaluation and assessment” (p. 586). Finally, by corresponding to the first and second, Fuchs et al. (2005) further stated, “Because MD is a ‘soft’ disability, for which no discernable physical markers exist, there is no way to determine ‘true’ disability” (p. 507). But it is not just enough to understand “why”. We need to contribute this “why” on the present practice in this field.

From the literature reviews in this thesis, first, I found the developmental trajectory of MLD is very unstable. Over 50% of early identified children with MLD could be out of this
category year later and these children will still perform poorly in mathematics. Second, I found there are multiple factors that could contribute or associate with MLD. These factors can be categorized into cognitive, environmental, and emotional domains. Finally, I found there is a concept, correlated constraints, in the developmental science. This concept has been used to describe the individuals’ behavioral and functioning development recently. When applying this concept to discuss the relationship between multiple factors of MLD and the persistence of MLD, four possible explanations for this unstable development in MLD was developed. When further connecting this explanation to the present identification tool, I think if there is a more holistic identification system, the more persistent and severe type of MLD could be identified more accurately. Therefore, my suggestion of a new identification system should be able to focus on two directions. 1. How to more accurately identify very severe MLD. 2. How to address the multiple risk factors that cause MLD. Recently, there are two practices that could be used together for these specific purposes. The first one is responsiveness-to-intervention (RTI) and the second is the “wrap around” system.

**RTI: Problem Solving Model**

RTI is the most front-running alternative for IQ-Achievement discrepancy model now (Fuchs, Mock, Morgan, & Young, 2003). The premise is that students are identified as MLD when their response to educational intervention is dramatically inferior to that of peers. Under this premise, children who respond poorly to otherwise effective interventions have a disability that requires specialized treatment to affect the schooling outcomes associated with successful adulthood. Basically and usually there are three tiers in RTI as the process of identification. This three tiers system—universal, selective, and indicated—could be also treated as a prevention system. Under the descriptions of Fuchs et al. (2003), in the first tier, all the students are provided...
with “generally effective” instruction by their classroom teacher and their progress is monitored. In the second tier, those who do not respond to the intervention at the first tier get something else or something more from their teacher or someone else and again, their progress is monitored. Finally, those who still do not respond from the second tier either qualify for special education or for special education evaluation.

Among different proposed types of RTI, the problem solving model will be the focus of this thesis because the underlying idea in this model is more in concord to the developmental science. From the perspective of the problem solving model, no prior intervention is particularly effective to a specific student characteristic (e.g., disability label), nor will a given intervention be effective for all students of a particular group, no matter how exclusively this group may be conceived (Fuchs, et al., 2003). The most effective intervention of a targeted student is based on the collective information gathered through a four-stage process which contains problem identification, problem analysis, plan implementation, and problem evaluation (Fuchs et al., 2003) in each tier. For more detailed information about the four-stages process, you could read the work of Fuchs et al. (2003). By using the four-stage process in the three tiers model of RTI, the work of prevention, intervention, and finally identification could all be taken into account.

The Idea of “Wrap Around” Service

Basically, “wrap around” service means the different agencies (community, school, and family) work together to deliver different kinds of supports for targeted individuals. Under this service, a multidisciplinary team (regular classroom teacher, special education teacher, applied behavior analyst, family consultant, school consultant) will work together to intervene different risk factors of children. The most important element to run this idea is the need of an integrated service delivery structure. However, for the integrated service delivery structure, we don’t need to
worry or spend extra effort to “reinvent the wheel”. For the past two decades, enormous effort has been dedicated across the nation to develop systems of care or wraparound services (Farmer, Farmer, Estell & Hutchins, 2007). This research has also shown promising results. For further information, please read the work of Farmer et al. (2007).

A Possible Comprehensive Prevention Framework

The inspiration of this work is from the study of Farmer et al. (2007). They focused mainly on the behavioral aspect. They used the concept of correlated constraints to guide the institute of Medicine’s intervention framework and the public health model. Here, I will extend their work by using the concept of correlated constraints to guide the problem-solving model for the preventive identification of MLD. Using this technique, I hope this new model could accurately identify very severe MLD and address the problem of multiple factors in MLD.

Three points emerge from the perspective by using this concept to guide the problem-solving model. First, the focus of each tier in RTI must be on how the general context affects the adaptation of all students. Second, once children are found suffering from difficulty, it is necessary to understand those children’s organization of the developmental system during the second and third tiers. That is, whether the child’s developmental system organized around positive or negative constraints (Farmer et al., 2007). Third, during the second and third tiers of RTI, how different interventions could be brought together to either prevent or promote the reorganization of the developmental systems of youths who experience problems.

These three points complement the functions of the original problem-solving model and make each individual tier more comprehensive. For example, if putting the concept of correlated constraints into the first tier of the problem solving model, in addition to providing generally effective instruction and monitoring their progress by the classroom teacher, the multidisciplinary
team should also identify some critical classroom environment that could promote academic
performance and provide this information to the teacher. For example, what kind of teacher’s
behavior, classroom setting, routing, and activities are helpful to students. In the second tier,
besides giving more individualized instruction academically, the multidisciplinary team should
also focus on preventing the negative reorganization of the developmental systems for children
who have one or two difficulties but who otherwise experience a system of positive constraints.
For example, the team also needs to prevent the disruptive behaviors (mathematical anxiety) that
may emerge from academic failure; also they need to understand those students’ home
environment to help their parents support students’ academic activities. In the third tier of the
problem-solving model, in addition to providing very specialized academic intervention, the
multidisciplinary team should also center on promoting the positive reorganization of the
developmental systems for children who experience a system of negative constraints. For
example, the multidisciplinary team should examine the interaction of various problematic factors,
identify how different factors support or sustain each other, and finally develop a set of
individualized interventions that could fit with each other well to promote the reorganization of
positive constraints. Further, ongoing assessments should be conducted to determine how
different problem factors and interventions affect each other (As an intervention prompts change
in one factor, how does it affect other factors and interventions) (Farmer et al., 2007).

**Conclusion:**

What I am proposing here is not a new model that could replace original RTI but a way to
make original systems more comprehensive. What I add into the original problem solving model
are the concepts of correlated constraints and integrated service delivery structure in “wrap
around” concept. By following the steps as described in the previous paragraphs, I think the
multiple risk issues in MLD could be addressed during identification. For example, by putting the multidisciplinary teamwork into each tier, we could help not only students’ academic problem but also their underlying environmental and emotional problems. Further, through this framework, a more accurate way to identify the most persistent type MLD could be found. For example, through these three tiers preventive identification, those who do not respond to any intervention in the previous two tiers could probably be the most persistent and server MLD. Because this work is pioneering, there are some details that need to be discussed and investigated for this topic. First, what kind of measurement could be used for students’ math performance? Second, how can practitioners gauge students’ response to intervention? Third, several experimental works need to be run to investigate the effectiveness and practicability of this new idea. The first two detailed questions have been addressed in the Fuchs et al. (2005) and they already identified several promising possibilities. In the future, further efforts could build on their finding in this new problem solving model. In sum, by discussing these details, the efforts to complement the present RTI model could be achieved.
Reference


