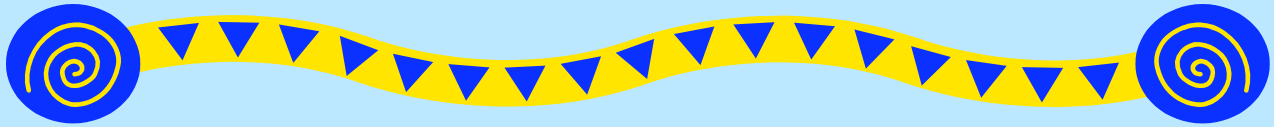

Early Mathematics & Mathematics Disabilities

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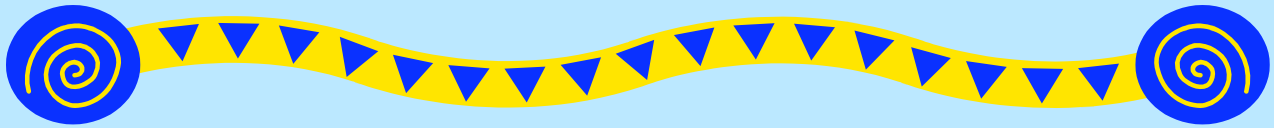
Gersten, R., & Chard, D. (1999). Number sense: Rethinking arithmetic instruction for students with mathematical disabilities. *The Journal of Special Education, 33,* 18-28.

Jordan, N. C., & Hanich, L. B. (2000). Mathematical thinking in second-grade children with different forms of LD. *Journal of Learning Disabilities, 33*.

Robinson, C. S., Menchetti, B. M., & Torgesen, J. K. (2002). Toward a two-factor theory of one type of mathematics disabilities. *Learning Disabilities Research, 17,* 81-89.

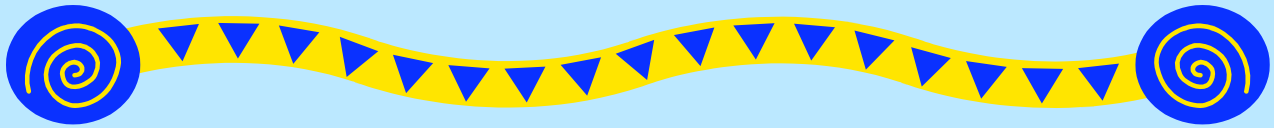


1. Gersten & Chard: Theoretical paper

Definition of number sense: "Refers to a child's fluidity and flexibility with numbers, the sense of what numbers mean, and an ability to perform mental mathematics and to look at the world and make comparisons."

Examples of number sense: conceptual understanding of number size (8 is greater than 5; 15 is further away from 8 than 11)

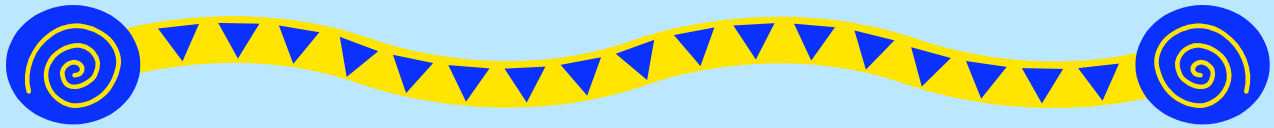
Informal development: Number sense is informally acquired prior to formal school & is a necessary condition for learning formal arithmetic.It can be mediated by parents & siblings informally when talking about quantities



Importance of number sense: Authors suggest that simultaneous teaching of number sense activities with increased number fact automaticity could be important for reducing mathematics difficulties

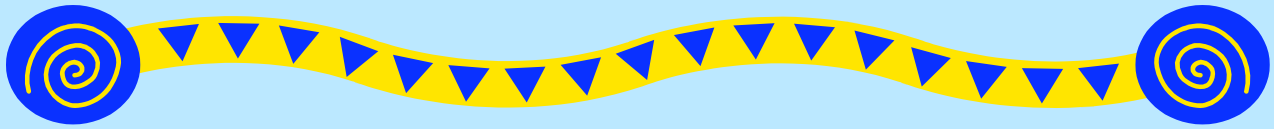
Comparisons drawn to phonological awareness & reading:

- Beginning mathematics instruction should focus on the development of number sense.
- The best approach for teaching number sense has yet to be empirically validated although some studies show promise.
- Number sense may be necessary but not sufficient for developing problem solving skills (many other components are needed).



Tracing earlier mathematics research: Studies from cognitive development & instructional research are unraveling a deeper understanding of students' choice of mathematical strategies; Verbalizations of strategy use and extensive practice have proven beneficial in student learning

Early mathematics instruction: Highly specific instructional practices for students lacking early numeracy experiences or for students with LD

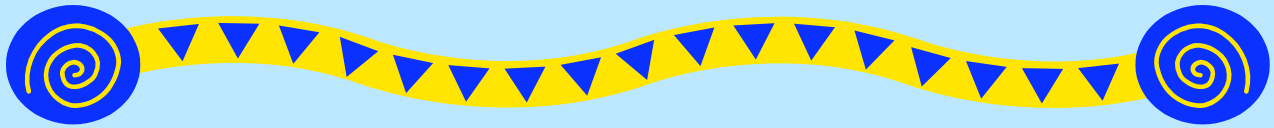


2. Jordan & Hanich: empirical investigation

Context: Normal development of mathematical cognition shows prior to formal training children internalize basic counting principles & procedures, add & subtract in a variety of contexts, solve simple story problems, and use strategies to solve basic number facts.

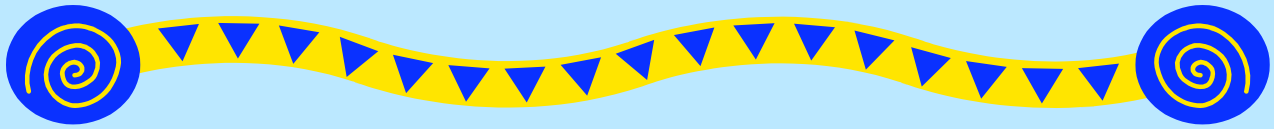
Students with MD show difficulties in 2 areas: retrieval of number facts & ability to solve story problems (change, equalize, combine, & compare problem types)

Purpose of study: examine performance of children with different patterns of academic achievement on tasks related to the teaching of mathematics



- Participants:
  - 10 in MD & normal reading ach.
  - 10 in MD/RD
  - 9 in RD only
  - 20 in NA (matched sample)

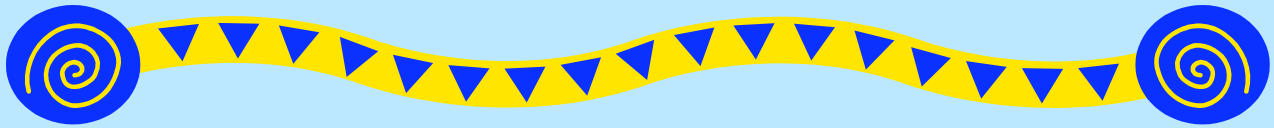
- Typical mathematics instruction in all classrooms consisted of 45-60 minutes daily using textbook, direct instruction in facts, story problems, and multi-digit calculation; range of problem solving strategies using manipulatives



Materials & Procedures: each child given series of tasks to assess thinking for four areas: number facts, story problems, place value, and written calculation.

Results: Children with MD/RD performed significantly worse than NA children in most areas; children with MD only performed worse than NA children only on complex story problems & written calculation; no significant differences found between RD only and NA on any tasks

Findings suggest: MD/RD subgroup is distinct from MD only subgroup where MD/RD have pervasive deficiencies in mathematical thinking and MD only have more specific deficits in problem solving

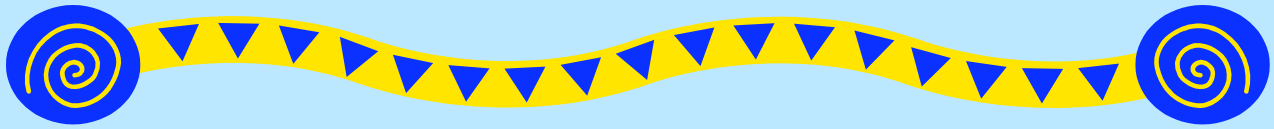


Characteristics of children with mathematics difficulties (MD):

- Deficits related to mastery or fast retrieval of arithmetic facts
- Speed of processing numerical information
- Could more successfully represent problems and use verbal counting methods in untimed conditions

Characteristics of children with MD & RD:

- Deficits related to problem solving & arithmetic fact mastery
- Perform worse than normally achieving on untimed & timed tasks
- Inaccurately represent problems & make numerous counting mistakes



3. Robinson, Menchetti, & Torgesen: Theoretical paper

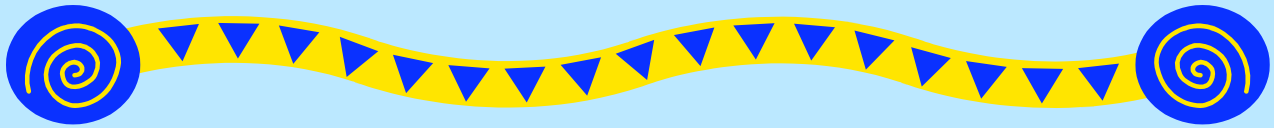
Context: Complete theory of LD must contain 4 levels of explanation - used to discuss reading disabilities; no similar theory in mathematics as comprehensive as theory of phonologically based reading disabilities

1. Behavioral component- observable learning or performance problem

2. Identification of deficient cognitive processes - underlie behavioral manifestation of the disorder

3. Weaknesses in central nervous system functioning - cause identified cognitive processes to operate ineffectively

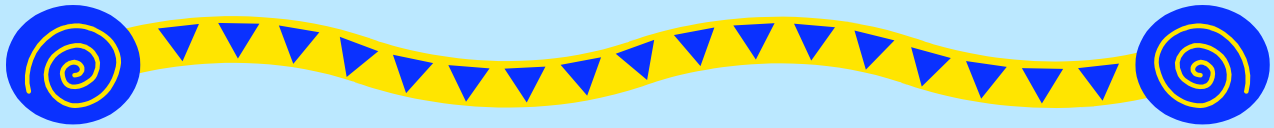
4. Etiology of the disability - cause of neurobiological weaknesses



Purpose of article: propose a theoretical explanation of the difficulties in acquiring fluent knowledge of number facts

- Difficulty retrieving number facts due to poor representation of numbers in long-term memory on at least 2 dimensions:
  1. Phonologically - representation of phonological features of spoken numbers may be less distinct than in NA
  2. Semantically - representation of meaningful aspects of numbers
     & number system may be less well developed than NA

- Dual weakness in stimulus representation at cognitive level - core Characteristic of many students with math disabilities



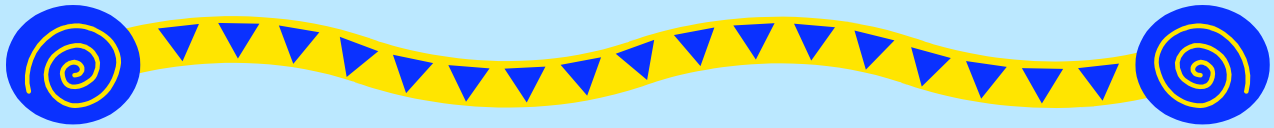
Reasons for focusing on number facts:

1. Weak recall of number facts often cited as one of most common characteristics

2. Foundational skill in many areas of math instruction

3. Fluency with number facts makes it easier to solve more complex problems

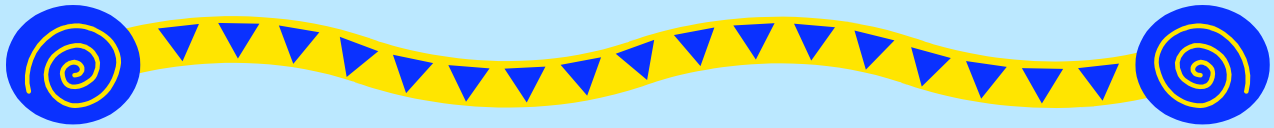
4. Number fact instruction occurs early in school years so red flag can be noticed earlier



Two-factor theory might result from either weaknesses in phonological processing (phonological component)or weakly developed number sense (semantic component)

- Phonological component: auditory features associated with individual numbers and with number facts in entirety are weakly connected and encoded so student seeking to retrieve fact from memory has a less distinct memory representation from which to draw.

- Number sense component: weakness in encoding facts for later retrieval is meaning based rather than phonologically based. Numbers themselves and numbers in relation to each other within a fact are less meaningful when attempting to memorize the facts. Appear to be random to the student.



Implications for research:

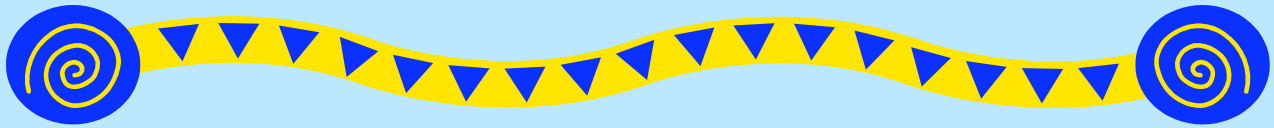
Intervention:

- Early intervention is needed to stimulate number sense.
- Use estimation to help develop number sense and meaning.

Research: Three types of studies to verify or disconfirm the Two-factor theory:

1. Simple, concurrent correlations (using measures of phonological processing and number sense and number facts)
2. Longitudinal
3. Intervention (focus on improving phonemic representations)

No evidence that training in phonemic awareness involving number Stimuli improves representations; need proper control conditions and treatment validity



Themes:

- There is a need to conduct research on the predictors of early mathematics failure.

- Number sense is a construct that warrants further examination.

- Researchers tend to draw parallels between early reading and early mathematics difficulties (e.g., PA).

- Intervention research is needed on those skills in the early grades that can prevent mathematics failure.