Essentials about reading problems: causes and effective treatments

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For more, see grapholearn.info and comprehensiongame.info

Norman Geschwind Memorial Lecture at the 2024 IDA Conference on October 26, 2024, in Dallas, USA

Content

- Fast track info to those who do not have time to read all
- Challenges related to summarizing knowledge about reading problems
- A summary of key results of the Jyväskylä Longitudinal study of Dyslexia
- Update of our understanding on how to categorize reading problems
- Sensitization to 2 key points: 1. goal of reading 2. how reading is acquired
- Practical guidelines of how to identify children who need preventive help
- Prevention of problems associated with learning **basic reading skills**
- Prevention of problems related to reaching the **goal of reading, full literacy**
- Conclusions: the future of training all children to acquire full literacy

The main facts to be attended at the end

- Nobel prize winners of Economics 2024 did not dive deep enough into the problems of poor countries; how these could develop their institutions if they don't know what, why, and how they could do it.

- Also, why point to problems if there is no solution to eliminate these?

- We have an explanation of why poor nations are poor, and we know how to eliminate the problems:

  1. The most essential single reason for the country's poor status is its people's lack of knowledge
  2. The main reason for the lack of knowledge is insufficient schooling, insufficient to build infra
  3. Insufficient schooling results from a lack of exciting reading material to reach goals of reading
  4. many learn to sound text accurately, but few can read enough to learn to comprehend text
  5. without reading comprehension, learning from schoolbooks is highly compromised
  6. the knowledge children learn in school is not sufficient for them to become productive citizens
  7. thus, people fail to invent needs of & means for the development of their institutions
  8. the core problem, lack of reading comprehension, **is <u>realistically</u>** solvable via new technology
  9. full literacy can be learned using our training tools built to run on Android phones families' own
  10. These work in most languages (via AI) and also provide access to all written information via AI

One hour's lecture can not tell all the necessary facts about reading

- A typical lecture summarizing our key results of >300 publications takes >20 hours

- By visiting Comprehensiongame.info one finds the most recent summaries

- We had to be able to correct the unoptimalities of reading research
  - Earlier the most ambitious researchers of human problems preferred experimental research
  - Opening causes of problems was preferred, not only listing problems, which increase the misery
  - Dyslexia is exciting problem of the mind for experimental researchers today due to new technology
  - It is realistic to try to find ways how to find effective interventions to thus find causes
  - Today such approach to dyslexia is are not common but preferred by my teams
  - Most dyslexia-related research is compromised due to the use of un-optimal concept of dyslexia
- We have to know how to train children to reach **full literacy, ie. to learn by reading**
- Realistically affected children can be trained in school learning to be better than classmates
- The efficiency of such training can/have been documented **by using experimental research**
- Training has to be such that the helped children can avoid lifelong unwanted consequences
- The correct and urgently needed way of training has **to help preventively**
- This is possible because **now we know who needs prevention,** as I will show
- And only **dynamic assessment** can be recommended because **it also helps all the time**

Early identification of children in need of help – results from – the <u>Jyväskylä Longitudinal study of Dyslexia (JLD)</u>
An intensive follow-up of children at familial risk for dyslexia from birth to adulthood

JLD 1994-

with Timo Ahonen, Mikko Aro, Kenneth Eklund, Jane Erskine, Tomi Guttorm, Leena Holopainen, Jarmo Hämäläinen, Ritva Ketonen, Marja-Leena Laakso, Seija Leinonen, Paavo Leppänen, Matti Leiwo, Marja-Kristiina Lerkkanen, Kaisa Lohvansuu, Paula Lyytinen, Anna-Maija Oksanen, Kurt Muller, Anna-Maija Poikkeus, Anne Puolakanaho, Ulla Richardson, Paula Salmi, Asko Tolvanen, Minna Torppa, Helena Viholainen
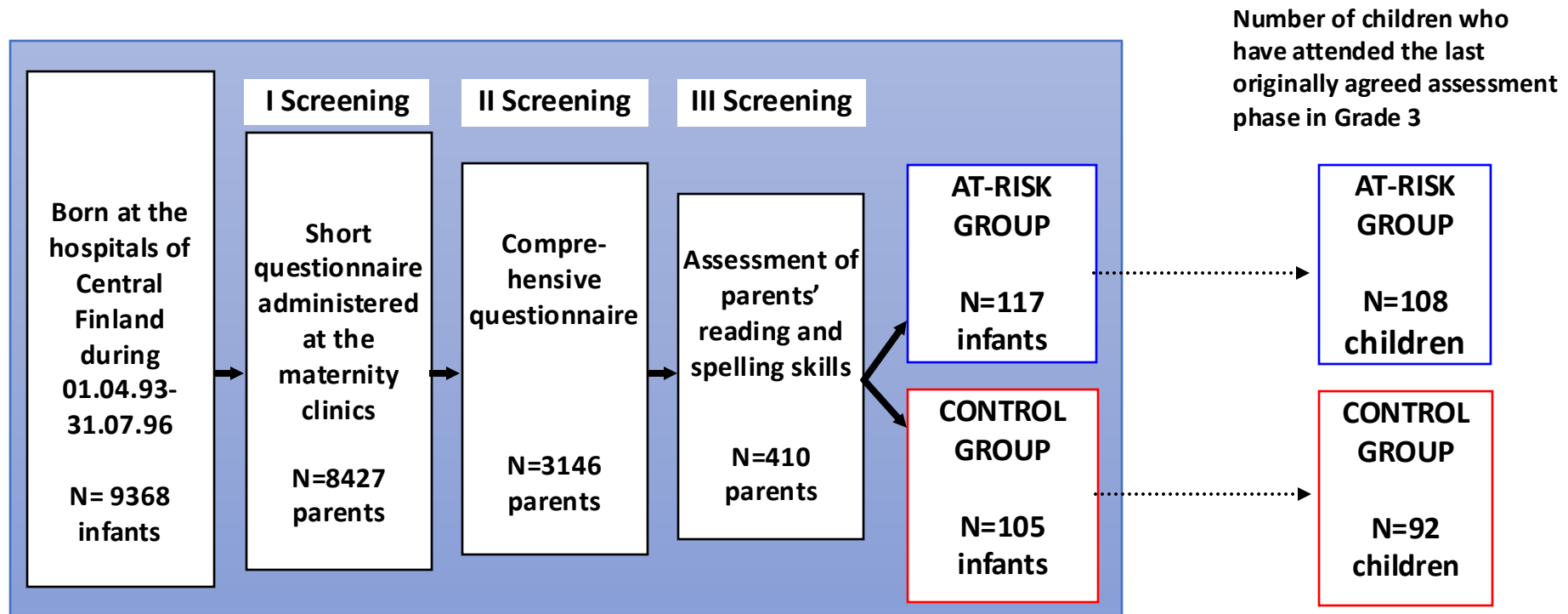
The goals of the JLD

to identify

- children in need of prevention of reading problems

- precursors (causes?) of dyslexia

- predictors of compromised acquisition of reading skills

- developmental paths leading different acquisition routes

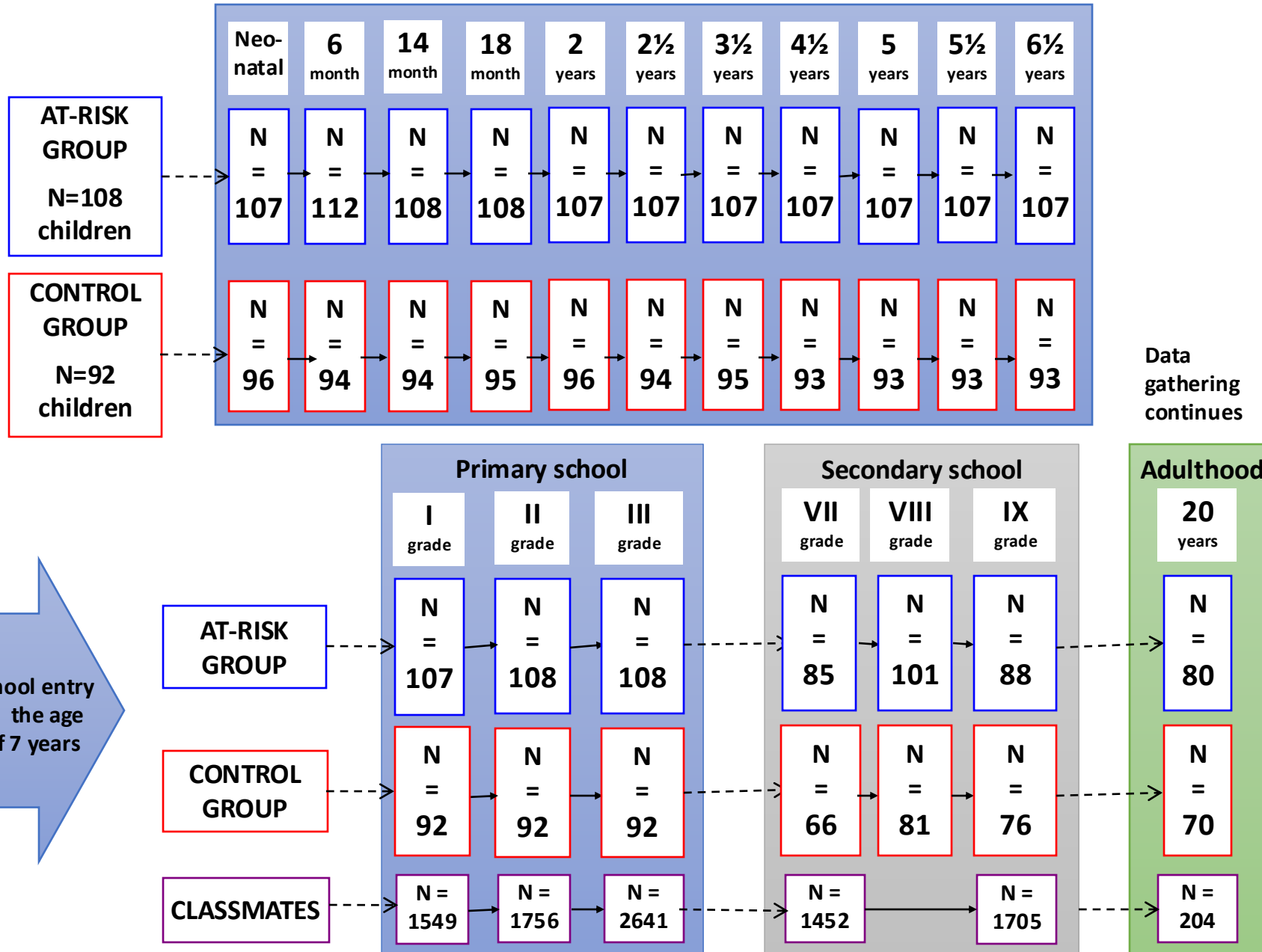The last step: designing preventive practices

Earlier we designed GraphoGame (sold to a firm) training-sounding text

Now: **Comprehension Game** + **Tale Reader** training children to full literacy

SCREENING OF THE FAMILIES FOR CHOOSING PARTICIPANTS FOR THE STUDY

Born at the hospitals of Central Finland during 01.04.93-31.07.96

N= 9368 infants

I Screening

Short questionnaire administered at the maternity clinics

N=8427 parents

II Screening

Compre-hensive questionnaire

N=3146 parents

III Screening

Assessment of parents' reading and spelling skills

N=410 parents

AT-RISK GROUP

N=117 infants

CONTROL GROUP

N=105 infants

Number of children who have attended the last originally agreed assessment phase in Grade 3

AT-RISK GROUP

N=108 children

CONTROL GROUP

N=92 children

PHASES OF ASSESSMENTS

	Neo-natal	6 month	14 month	18 month	2 years	2½ years	3½ years	4½ years	5 years	5½ years	6½ years
AT-RISK GROUP N=108 children	N = 107	N = 112	N = 108	N = 108	N = 107	N = 107	N = 107	N = 107	N = 107	N = 107	N = 107
CONTROL GROUP N=92 children	N = 96	N = 94	N = 94	N = 95	N = 96	N = 94	N = 95	N = 93	N = 93	N = 93	N = 93

Data gathering continues

School entry at the age of 7 years

	Primary school			Secondary school			Adulthood
	I grade	II grade	III grade	VII grade	VIII grade	IX grade	20 years
AT-RISK GROUP	N = 107	N = 108	N = 108	N = 85	N = 101	N = 88	N = 80
CONTROL GROUP	N = 92	N = 92	N = 92	N = 66	N = 81	N = 76	N = 70
CLASSMATES	N = 1549	N = 1756	N = 2641	N = 1452	N = 1705		N = 204

Three age-specific bottlenecks which anticipate problems associated with learning to read
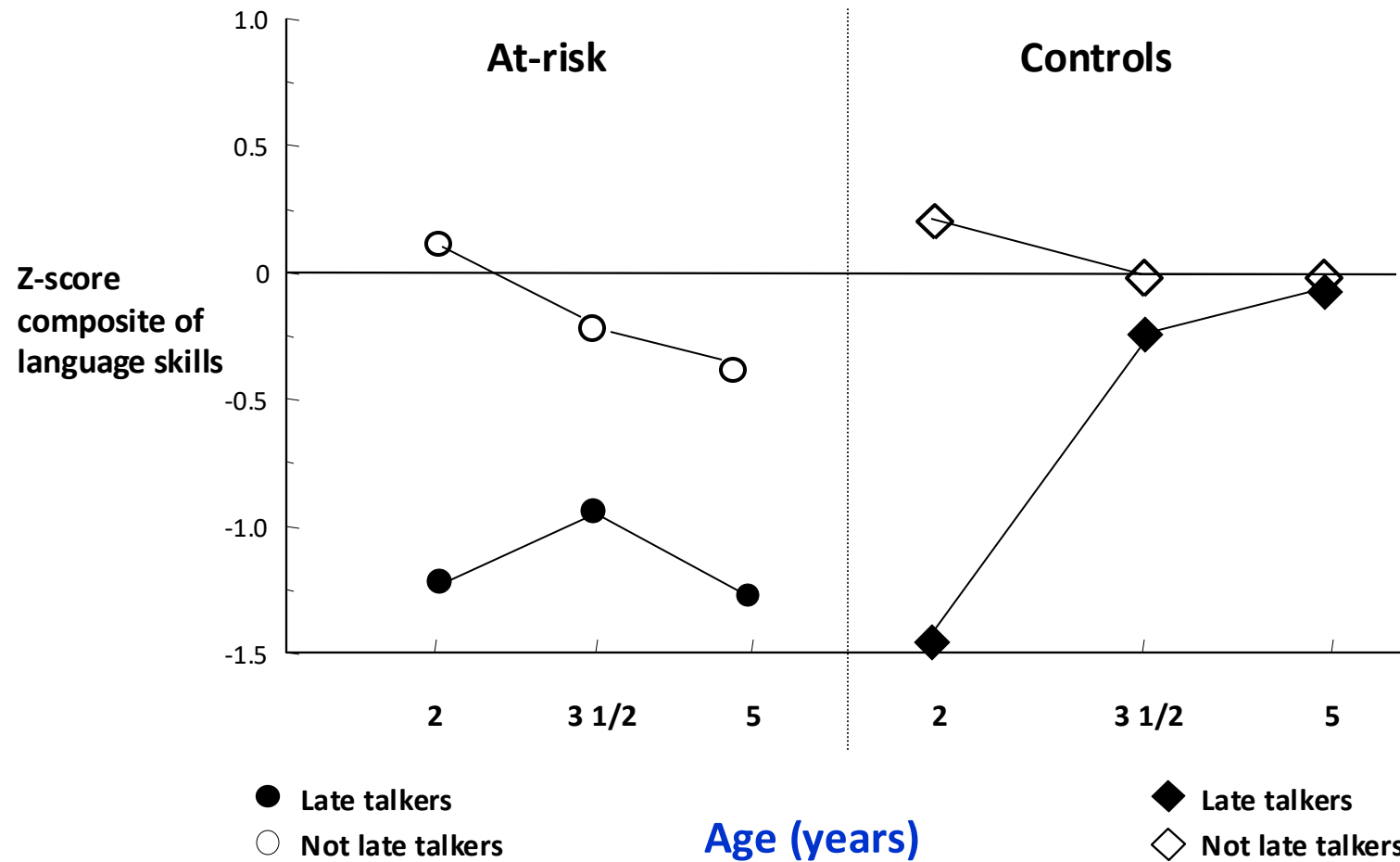
Children at **familial risk** for dyslexia ending up facing dyslexia
As shown during the 2.grade providing predictive information
at age of
3-5 days after birth > auditory insensitivity
**2-3 years > late oneset of receptive & expressive speech**
5 to 6 years > difficulties in storing letter names

Newborn ERPs (at the age of 3-5 days) to tone frequency change between 2. Gr. typical readers and children at familial risk of ending up facing dyslexia

MMN-paradigm
Standard   Deviant

— Dev 1100Hz, 12 %, SOA 425 ms
— Std 1000Hz

Control typical readers (TRC, N=25)

At-risk children ending to dyslexia (RDFR, N=8)

Quiet sleep

Leppänen et al., Cortex , 2010, 46, 1362 -137 6

Development of language skills among late talkers of the risk and control groups

Lyytinen P. et al., J. of Speech, Language & Hearing Research, 2001

PISA READING PERFORMANCE (at age: 15y) and Late talking at the age of 2.5y

PISA reading outcome, z-score
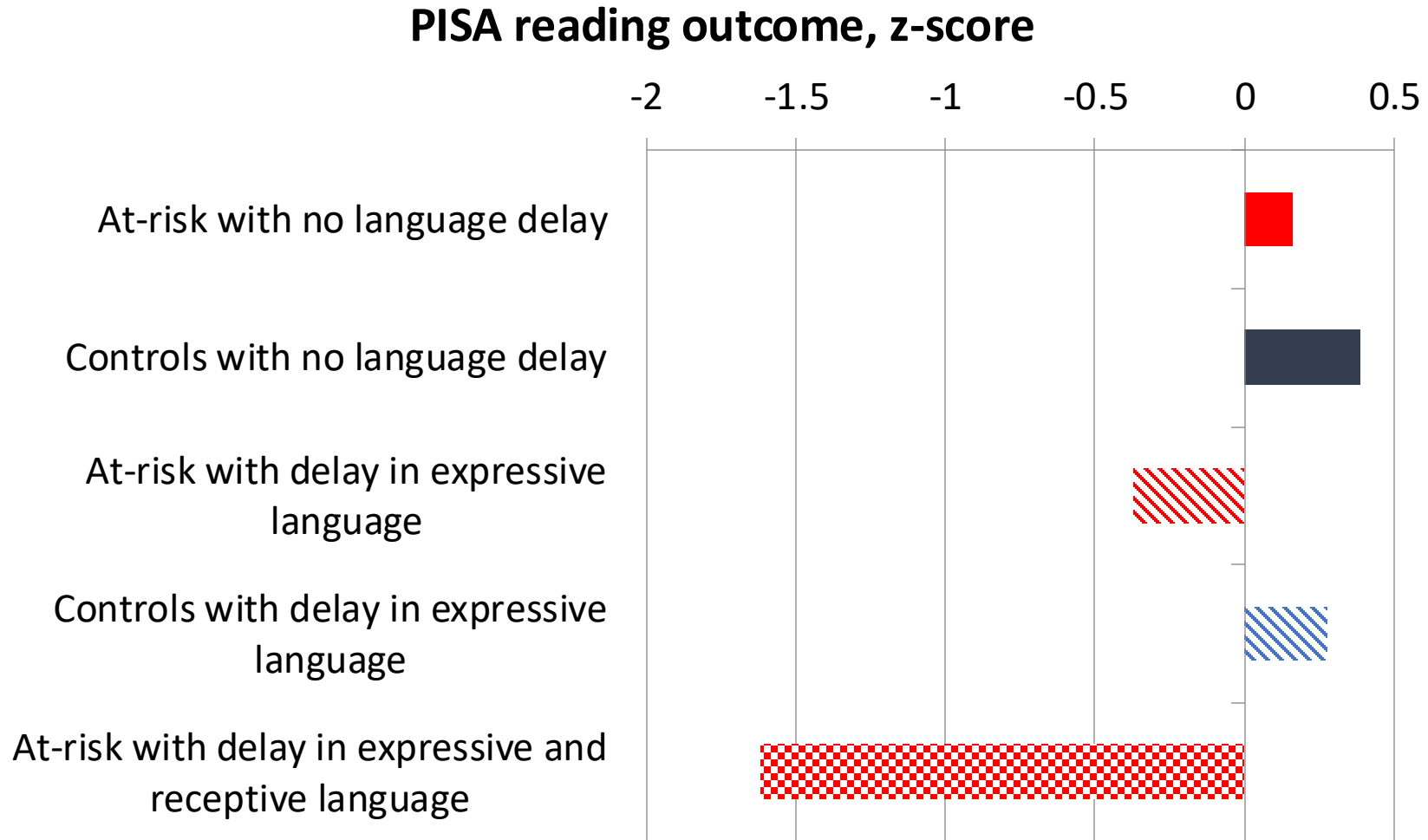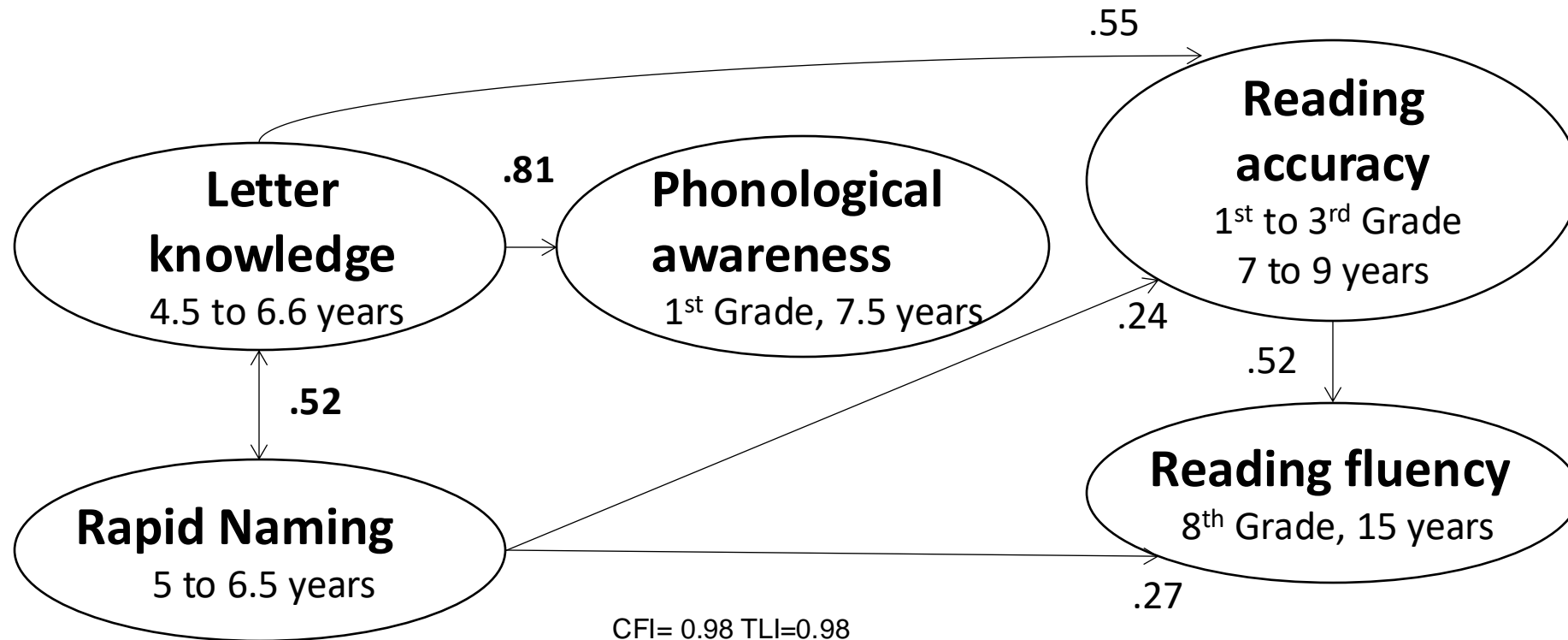

Lyytinen, et al. 2015 Current Developmental Disorders Reports, 2, 4, 330-338.

The JLD-follow-up from birth to school age of reading-related development
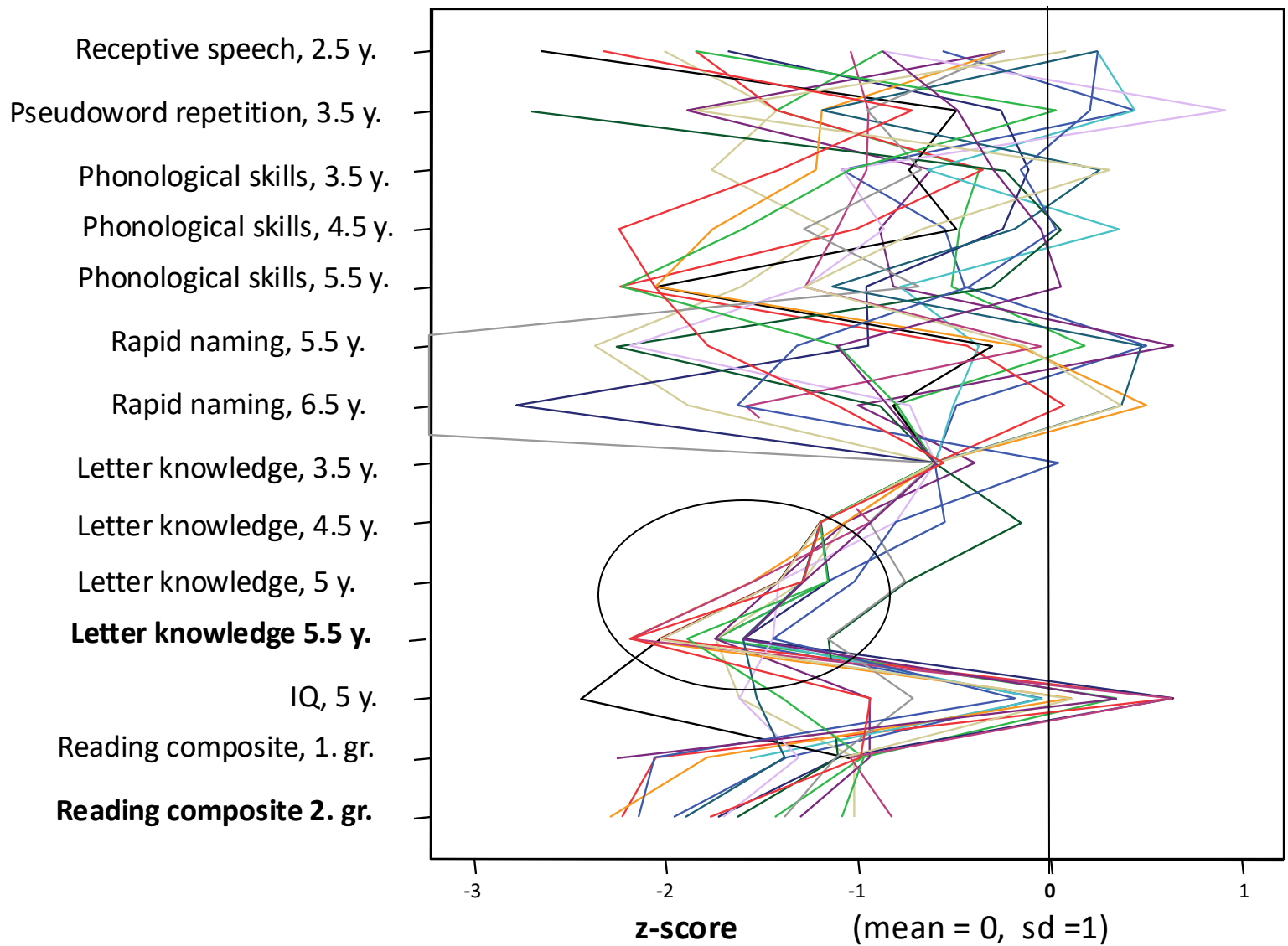
Lyytinen, et al. Scandinavian.J.of Psychology, 2009.

Individual profiles of the **predictors** of the JLD **children whose reading acquisition was most severely compromised**

Predicting reading accuracy and fluency

Letter knowledge
4.5 to 6.6 years

Phonological awareness
1st Grade, 7.5 years

Reading accuracy
1st to 3rd Grade
7 to 9 years

Rapid Naming
5 to 6.5 years

Reading fluency
8th Grade, 15 years

.55

.81

.52

.24

.52

.27

R^2=49.5%

CFI= 0.98 TLI=0.98

RMSEA=.043, SRMR=.036

chi= 112.063 (df=82), p=.004

N=200

What can we learn from the picture shown?

1. Reading problem is the most common **learning** problem (not primarily phonological)
2. Due to complex English writing, we have failed to understand it as a learning problem
3. **Learning to read=storing connections between spoken and written language**
4. Self-evident in consistent writings (=in all but English among alphabetic writings)
5. Thus, we can say problems in reading acquisition are problems of **association learning**
6. In consistent writing, learning to read=to store connections of phonemes and letters
7. If names of letters are given appropriately, learning the names is enough
8. Variation in knowing the names of letters explains variation of phonological awareness
9. Here we have all we need to prevent problems of learning **basic reading skills**

Categories of problems in reaching the goal of reading

- Dyslexia is often defined as a brain-related or genetic problem
  - Brain may contribute in affecting reading acquisition, but it is not the whole story
  - Associating dyslexia with the brain is irrelevant if it does not show effective treatment
  - All difficulties related to acquisition of **basic reading skill** have common features=
    - THE CONNECTIONS BETWEEN SPOKEN TO WRITTEN LANGUAGE HAD TO BE STORED
    - THE LEVEL OF THE TRANSPARENCY OF WRITING AFFECTS WHICH ARE THE OPTIMAL UNITS FOR THAT
    - Thus, **dyslexia can be PREVENTED,** the problem is only in defining effective treatments
- **The goal of reading is,** however, **mediation of the meaning of texts (obs. PISA)**
  Today the comprehension of written language tends to be a most demanding problem
  Solution - after basic reading skills have been acquired one has only start reading
  PISA results are going down globally - world has changed=**interest in reading has fallen**
  In the developing world, many children fail to learn to comprehend texts due to a lack of exciting reading material – and this results that also adults left without full literacy
  It is enough if children comprehend text enough for comprehending schoolbooks
  For that, children in the developing world need help that is now available (as shown later)

How to reach the goal of reading, reading comprehenson (RC)

- Learners of transparent writing (such as Spanish) need not attend to meaning of words for learning to read because any pronounceable can be sounded accurately
- Learners of readers of English need to take the meaning of the word into attention
- Thus, readers of English have fewer problems in RC than readers of e.g. Spanish
- Reached the goal of reading requires taking the next step to acquire RC
- Only children who have acquired **full literacy (with RC) can learn** efficiently via reading
- Who masters full literacy (FL) comprehends whole stories, not words or sentences only
- The natural cure for reaching FL comes from reading outside school (ie. leisure reading)
- World has changed, especially boys read less today and face problems to learn in school
- Learning FL, (ie.good PISAscore), need support from **home literacy environment (HLE)**
- A good HLE=availability of interesting books for reading, parental models of reading etc.
- Via good HLE children start reading leisure texts and can acquire full literacy=optimal RC
- **But few reach optimal RC without learning good enough reading strategies**

What are good reading strategies?

- The starting point is to become an **active reader**
- Active reader searches answers to the question(s) of the title of the text
- Not all words are equal, not even all sentences
- The key information is often in a few sentences of the whole long story
- The most important task of an efficient reader is to find the key information
- Working memory fails to do its task if one fails to find the key information
- Optimal reading instruction focuses on that from the beginning
- E.g. African children without any access to leisure texts need help for that
- Children in the **developed** world need it if they are not reading outside of school
- They mostly learn sounding text but do not comprehend it to acquire full literacy
- Fully literate children have easier time in school, lower stress and fast learning

How can one train reading comprehension to reach full literacy (FL)?

Children who are not interested in reading leisure texts need special support

The two kinds of digital applicationa which can open ways to FL and to learning via reading are

1. **Tale Reader (TR)** application for children to be used before school age when children are interested in listening reading of exciting stories

2. **Comprehension Game (CG)** for children who already can sound text accurately

Both are needed by more and more learners also in the developed world

TR can help children of poor countries who have no opportunity to read leisure texts

TR trains basic reading skills+reading comprehension applying statistical & associative learning

CG is designed for children who can sound out text well enough for starting to learn via reading

GraphoGame (I developed earlier) trains sounding texts but is not enough for learning in school

The PISA results have fallen in countries where children have used GraphoGame

Possibly teachers have anticipated that accurate oral sounding of texts is enough

It was enough earlier but the **world has changed: children do no more read** leisure texts

Thus GraphoGame users can learn RC if they start reading or use e.g. CG.

Main features of the games, TR and CG

Both are open to be used in whatever language/writing system by locals

Implementation guidelines + training (also via game) is provided

Everything can be learned by reading from comprehensiongame.info

Different versions **will become available soon** for separately e.g.
- families
- teachers
- anyone wanting to elevate one's reading efficiency

o Everyone can elevate one's reading efficiency using optimal reading strategies

- All relevant information can be read from the **comprehensiongame.info**
- Skim News section: "Unlocking.." there and update of the present ppts
- These pages are also full of other helpful information about literacy acquisition
- You can find there e.g., most of my earlier presentations and publication list

Most important features and benefits of the ComprehensionGame (CG)

- The main goals and means of the Comprehensiongame:
- 1. it trains readers to comprehend written language=**reach the goal of reading**
- 2. train the reading strategies, including **critical reading** (important today)
- 3. most important: it allows children to learn from all written knowledge
  - This happens via applying in a most beneficial way artificial intelligence (AI)
    - All knowledge picked e.g. from the schoolbooks is automatically checked and extended using AI
    - A good example is how rural illiterate Zambians were instructed to guarantee their food security
    - The plan is to extend the use of AI as soon a new applicable property of AI is found
    - Today, an important application of AI is to make the tool usable in languages AI "masters"
    - Human brain has to check the content and be an alternative "definer" of the key knowledge
- 4. learning results are stored at the individual level for those

  who have the rights to use it for following learning e.g. in school
- 5. CG uses **dynamic assessment**, ie. **all training focuses on not-yet learned content**

The most important features of the TaleReader (TR) application

- TR is for children who **like listening to exciting stories read to them** what TR does
- TR is designed first of all for children of poor countries who have no exciting reading material to reach the goal of reading in a natural way, and reading instruction is poor
- It may also be helpful to children in the developed world where home language environment tends to be poor if the public early education guides children to use it
- Such an experience trains by opening statistical and associative learning opportunities
- When statistical learning fails to work, stories applying for associative learning help
- These stories introduce connections between spoken and written directly
- Empirical data reveal that TR application keeps children interested long enough
- TR will be available soon to families who self-generate stories using their language
- For poor countries, we plan to make readily available stories (readily syncronized)
- TR can be used to "teach" children knowledge created in an age-appropriate way
- **The central "secret" of TR is that it synchronizes spoken and written for learning**

Please consider asking us to tailor digital treatment alternatives for the children you are responsible for helping.
> for that, please answer the questions we have written for you

* Find a recent summary of central results of the JLD (open access):

https://link.springer.com/article/10.1007/s40474-015-0067-1

- You can easily find my reading-related publications from the pages shown below

    or by using e.g. scholar.google.com – most published in open-access forums

- Ask for reprint(s): **heikki.j.lyytinen@jyu.fi**

- For info on how the GraphoGame (I designed earlier) works for helping children **globally, see grapholearn.info**

- **Note that GraphoGame trains only the basic reading skills!**

- **See this in all-time updating form and more: comprehensiongame.info**

- **Take the survey!**