Typical and atypical learning of literacy and how to support learners who are in need of help for reaching full literacy (FL)

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The goals of this presentation

1. to document that we know enough about learning of literacy for starting to apply research results for helping learners in need

2. to show how we can support all children to reach the goal of reading, ie. full literacy(FL) - independent of learning difficulties

3. any adult can help her/his children everywhere by following accurately guidelines resulting from the research which I will summarize in this presentation, and which are described in detail in publications available soon from www.comprehensiongame.com Please, find this presentation there, too

This story is based on my >50 years of research – Storyline:

My steps taken for becoming able to support children globally to acquire Full Literacy:

a. using years for studying the ***basic mechanisms of learning (association learning)***

b. focussing on understanding learning difficulties for 40 years from which

d. coordinating the ***Jyväskylä Longitudinal study of Dyslexia (JLD)*** for almost 30 years to

e. focus on finding developmental routes from birth to different levels of literacy skills for 20 years

f. using JLD for finding an easy-to-use method for identification of children in need of help (fig)

g. collecting understanding of the situation of literacy research globally (including Africa & China)

h. ***developing digital learning games (based on a.) to support children to acquire basic reading skills***

i. making it by empasizing the need to train at-risk children to overcome their reading difficulties

j. After establishing efficiency of my first game in Finland, we started making it to work globally

k. Noting that mastery of **basic reading skills is not enough for reaching the goal of reading**

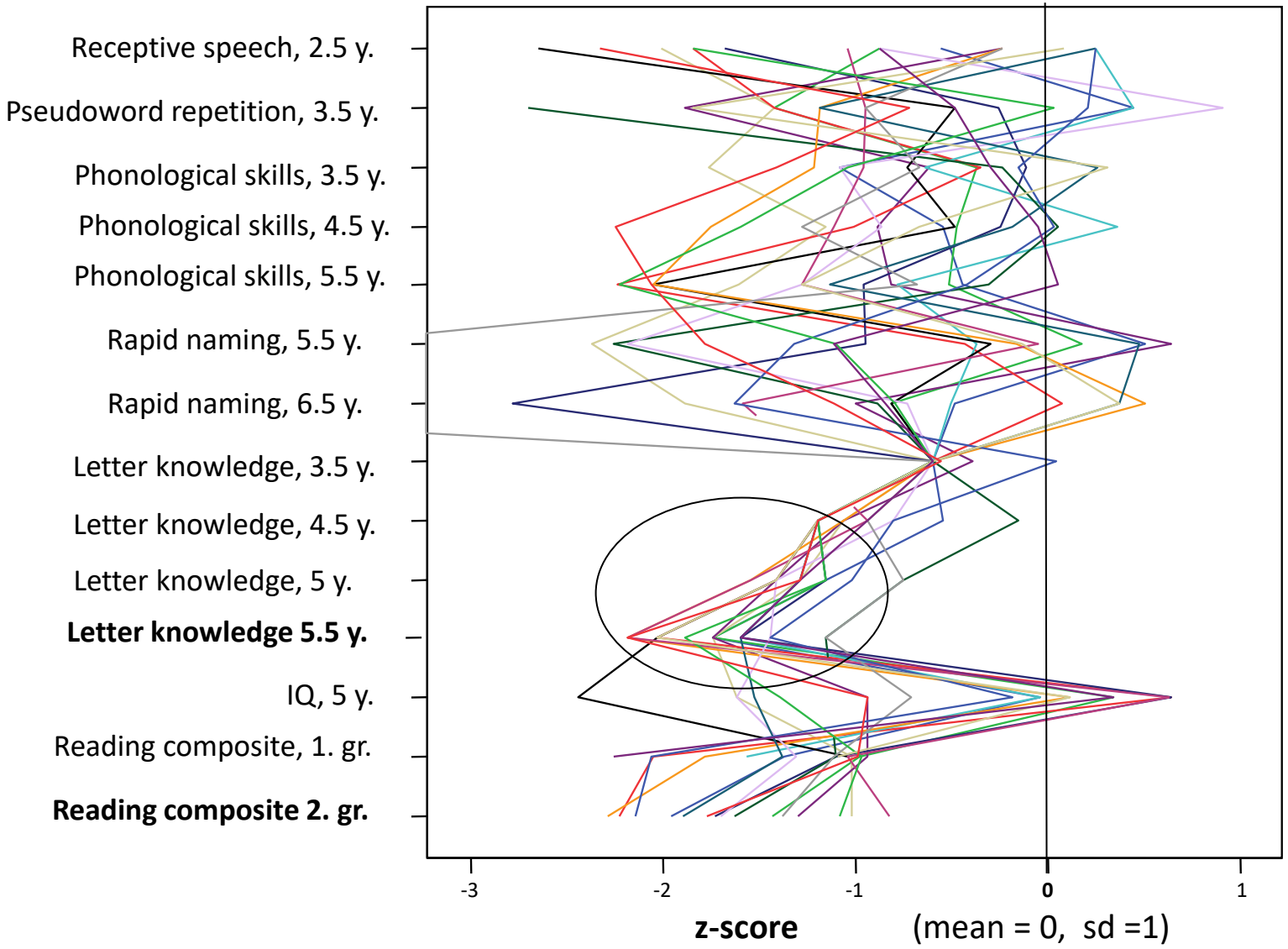
l. Running R&D for **new learning games** to **train reading comprehension** to reach full literacy(FL)

m. Developing a further game to help those who have nothing to read (e.g. Africans) to learn to read

n. Starting to hope that my games migh suffice for all to reach FL after validation studies

o. Validation completed (2023) in rural Zambia showing how illiterate people can reach the goal by using first the GraphoGame (GG) and then the second=ComprehensionGame (CG)

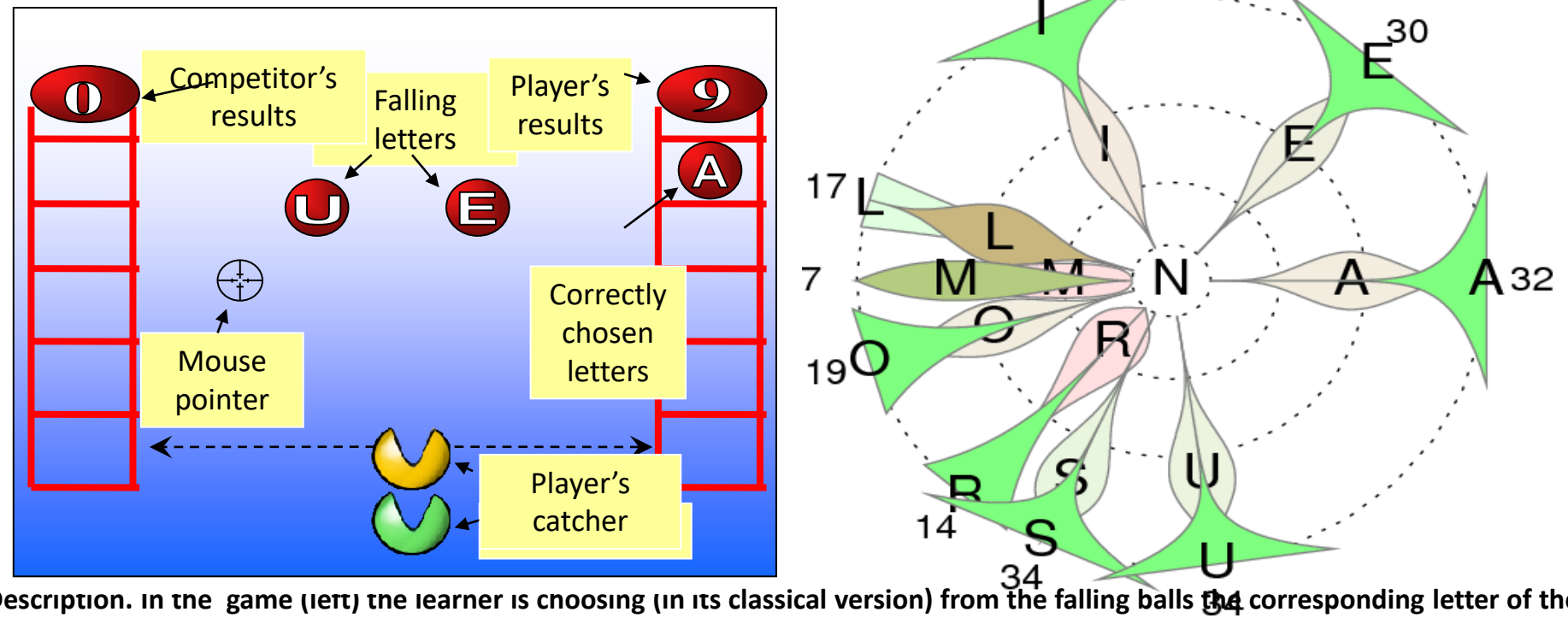
Figure 2. The JLD-follow-up from birth to school age of reading-related development



Lyytinen, et al. Scand. J. of Psychology, 2009.

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

Figure 23 GraphoGame – an enjoyable digital game (Android/Apple/MS) supporting learning to read: How it helps in overcoming the fuzziness of the phonemic representations of written items



Description. In the game (left) the learner is choosing (in its classical version) from the falling balls the corresponding letter of the one s/he hears from headphones. The illustration (right) shows an example of how results can be followed. Here we follow how /N/ sound (in the centre) which learner has heard in the game more than 100 trials at the moment this picture is printed from the game logs has made him/her to choose incorrect alternative letters (shown with the number of times these have occurred with the correct N-letter). The red distributions reveal that the learner has had difficulties in **not** to choose R and M during the first fourth of such trials, but became able to learn during the last fourth (with green distribution) that e.g.R does not represent the /N/ sound. For this learner acquiring that the /N/ sound is **not** represented by M-letter has been a real challenge as shown by the red and darker green distributions which reveal that most of the choices during the first and second fourths of trials (respectively) have ended up to this mistake. The learner has failed to learn to identify the correspondence of the /N/ sound during the whole session in trials where M has occurred (7 times) as an alternative. On the other hand s/he has not chosen e.g. S to represent the /N/ sound any more during the last fourth of the trials (no misidentifications during the 9 last of the 34 trials with S as an alternative). For more details, see Lyytinen et al., Scand.J.Psychol., 2009, 50, 668-675 and for documentation of the efficiency of the game in supporting learning among at risk children,. Modified from **Saine et.al., Child Development , 82,3,1013-1028**.

This all had not happeded earlier due to mistakes of Reading Research

(largely due to the dominance of reading research based almost exclusively on English language)

- Avoiding the to-be listed mistakes has helped me to offer effective help (mentioned earlier)

1. FL (making possible learning from schoolbooks) is emphasized too late in the instruction
2. Instruction of Basic Reading skills does not apply learning theory (association learning)
3. The theories emphasizing phonological skills are not sufficient for efficient instruction
4. Too many believe, that Basic Reading skills are sufficient to all for acquiring FL
5. Opportunities and supports which digitalization gives us have been insufficiently taken up
6. Possibilities of the Internet and Artificial Intelligence (AI) also insufficiently taken up
7. Explicit training of the reading comprehension skills & strategies are almost neglected.

Correction of these mistakes provides keys for helping children globally to acquire FL

- How this can be actioned is described in my recent publications+will be summarized next
- These will become available for free soon at www.comprehensiongame.com
- Games will be given to all who are joining to my work to reach mentioned ambious goals

1. The goal of reading is comprehension (FL), not only sounding out written material

- We read mostly to understand what the text is mediating to us
- Too large portion of resources of instruction go to supporting sounding, neglecting FL
- We need a much stronger focus on building reading comprehension
- There are many ways to go to this direction
  - The most natural first step is:
    - To read exciting stories to children before school – to motivate starting to read as soon one is fluent reader
  - For those who do not read, I developed CG+Storyteller, used first in Africa where parents can't read:
    - Storyteller helps children to enjoy listening a variety of stories which they see+hear as they're read to them
    - This may be helpful for all across the world and will be made available to everyone, after shown to be effective
  - Reading instruction should focus more on motivating children to retell what the text says
    - (Wise teachers can do that, instead of requesting children to read aloud so that classmates can hear it)
  - Children who start reading as soon they master fluent basic reader skill can learn FL naturally
  - This happened earlier without too much pushing but this habit is not necessarily followed any more
  - **Today many boys are not reading outside school.** This was my reason to make 2.training game (CG)
  - This may be helpful also to many adults (e.g. in Finland 16% of adults don't compehend text well)
- **All mentioned learning games require participation of teachers or other experts to enable children to proceed in efficient ways+have appropriate content in the game**

2. Reading can be instructed efficiently by applying basic learning theory

- **Learning the basic reading skills follows the same procedure in all languages if association learning is applied**
  - **Storing the connections of the units of spoken language to the corresponding units of written language**

  This means applying the association learning theory, the basis of all learning

  But the to-be-connected units have to be chosen according to the needs defined by the orthography to be learnable
  - In orthographies whose connections between spoken and written language behave consistently,

    the unit depends on the type of the orthographic - consistency between the units must be used in optimal way

    The so-called transparent writing are consistent at letter (or multi-letter grapheme) - phoneme level

    In less transparent writing such as English, larger units (such as rime units) are needed to focus on consistent connections
    - To be sure that the connection is **consistent=learnable, one often has to use whole words in English**
    - **Whole words are used for learning to read English in nations where English language is learned as 2. language**
    - This happens perhaps usually incidentally (as it has not been studied) because this is the way vocabulary is instructed
    - The most clear expressions of the dominance of English language in reading research are e.g. the facts that:
      - all English experts of reading tell that this whole word approach should not be followed
      - They say English had to instructed using phonics, although practically no one can explain how!
    - **The learning theory tells that one can learn easily associations when these are true at least almost always**
    - None knows exactly which smaller than whole word size items are true always in English to apply for phonics
    - Computationally it has shown up to be almost impossible to find a sufficient number of such units
    - The closest solution being the one which we have applied in our Grapholearn technology concerning also English
    - **Thus learning whole words (or orthographic images) might be a possible solution to our newest tool to follow**

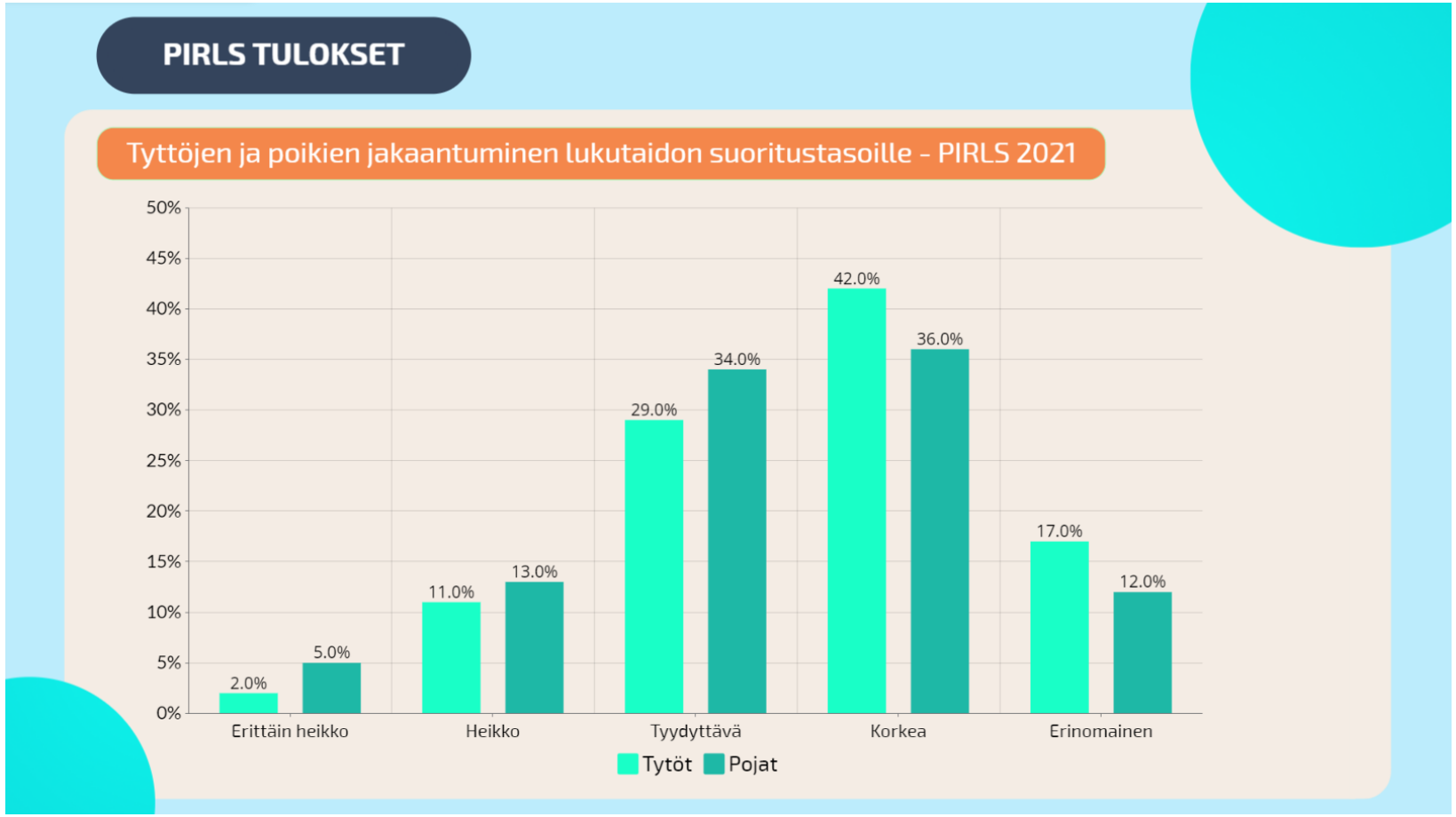
3. Digitalization has not been taken up sufficiently

- Tens of years of supporting African children via development aid-supported teaching has failed - no success in achieving FL nor even the basic reading skills
- Even today digital game-based support of learning had not been accepted
- Not even after e.g. our GraphoLearn (GL) technology was shown to help millions
- Now when we have further games, the same fate may be expected, despite we have used hundreds of thousands €:s (from our pockets) to show their efficiency
- Now we have proven the efficiency of the GL and CG to help them to acquire FL
- The final step is under validation: overcoming the unavoidable situation in Africa that they have no books to read, and can thus not acquire Full Literacy (FL)
- FL can possibly be acquired by letting children to have a Storyteller in their cheap phones which, if implemented correctly, builds FL via statistical learning
- This newest technology for reaching the final goal of reading = Full Literacy, is now under validation in Africa + Finland, and will soon to-be open for trying everywhere

4. Changes of the reading habits have not been observed - what is needed to correct these?

- **PISA & PIRLS (see figs) studies and those of school achievements show widespread falling results**
- These studies + learning in school (noted in Finland) show that the last is caused by falling literacy skills
- Basic reading skills are mostly sufficient in transparent-orthography nations: the problem is elsewhere
- = in learning FL, which is increasingly compromised between ages 7 to 10yrs (PIRLS) and by PISA (15yrs)
- **The natural way to reach Full Literacy = by moving to read a lot (outside school), fails to be used any more**
- Ie. too many – especially boys aren't reading outside school – and fail to acquire Full Literacy naturally
- Thus we had to be able to motivate children to read outside school, or invent how it could be replaced
- This has shown up being very difficult even in Finland, in a most highly literate nation
- The **Finnish strategy has been to reward** those children who accept reading during their leisure time
- This strategy **fails to motivate especially boys** who prefer e.g. computer gaming instead of reading
- Thus, the use of game-like learning environments may motivate them to approach the goal of reading
- Using my **ComprehensionGame (CG)** – they can be trained to use active & effective reading strategies
- Playing CG to learn lessons after reading these from schoolbooks can motivate also boys
- Effective reading requires exchanging information between working and long-term memories optimally
- CG trains how this can be made and also critical reading (please, see www.comprehensiongame.com)
- CG may also help adults – many of whom don't naturally invent optimal reading strategies

The comprison of Girls (Tytöt) and Boys (Pojat) in how their PIRLS results (of 4. graders) are distributed to the different achievement levels



Changes of PIRLS results over years

- Upper figure from Finnish children
- Lower – international results

- Green= girls
- Blue= boys

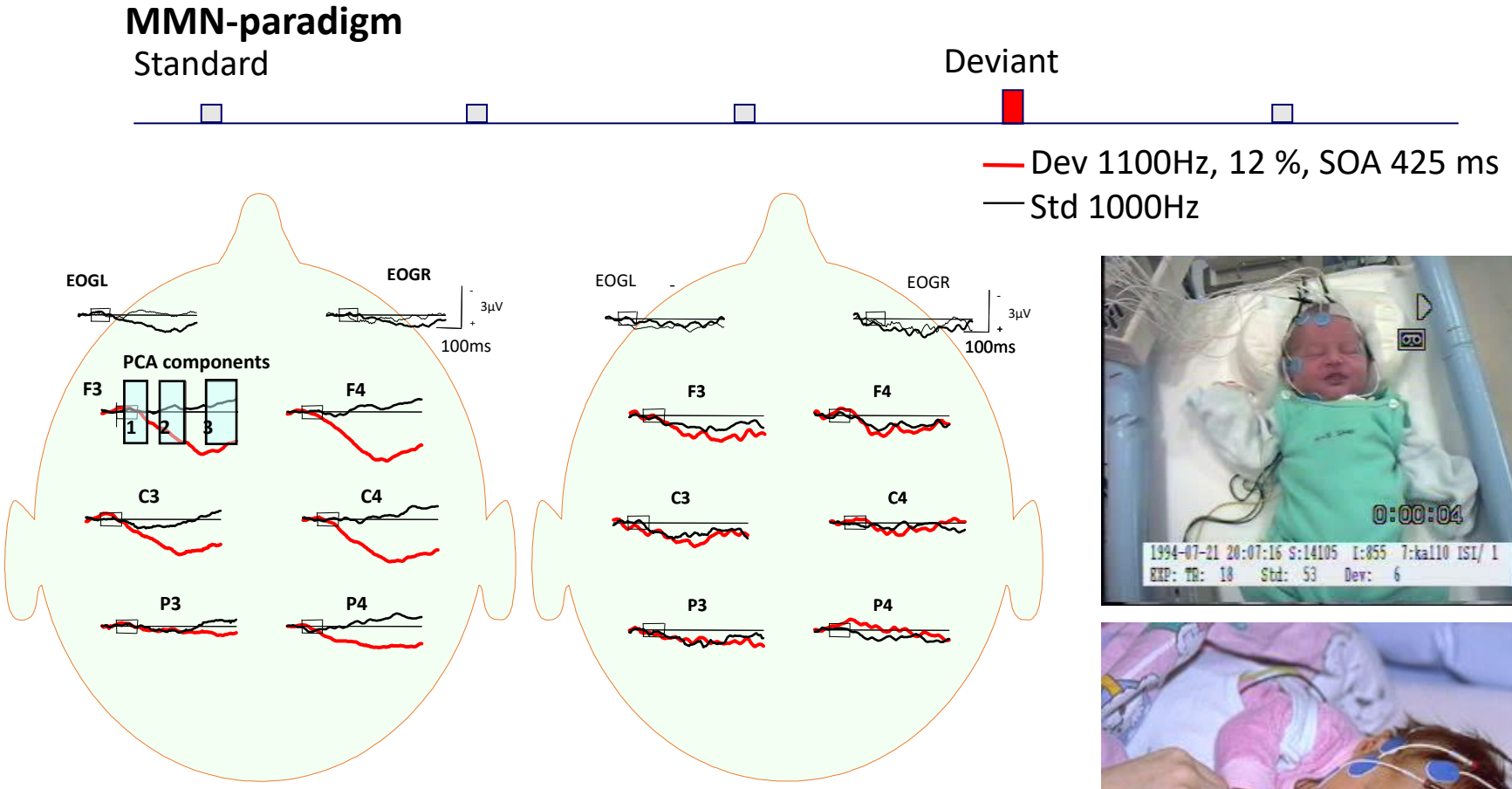
5. The possibilities of Internet and Articial Intelligence (AI) have not been adopted to use for supporting acquisition of FL and collecting knowledge

- The Internet now reaches even rural Africa where we have been testing its use
- In rural Zambia we have trained illiterate people to FL using GL+CG sequentially
- People can then learn to get any information what they wish by using AI
- by asking via writing – using AI – whatever they want to learn (even in their own language)
- Our rural African participants naturally need info e.g. for their food security
- They can ask AI-bots to tell the plants they had to start growing for their survival
- This is already possible today, and will be more complete in very near future
- The next step is to make this possible for young children to learn literacy
- This can happen when our newest games have been finalized for their use

6. Why in the world we still use phono.. words?

- The dominance of English reading research pushes us all to emphasise phono.. words (phonological processing, phonological deficit..) as though they’re some kind of magic!
- Why do we use these when we know that, in most nations, the instruction of reading
  - 1 can not benefit from these phono.words and activities emphasising them.
  - 2 neither teachers nor researchers can explain what these mean and how they could help
  - 3 even when inventing appropriate definitions these do not help in creating effective instruction
- A typical definition: phonolocigal skills (which are needed for learning the basic reading skill) mean an ability to manipulate speech sounds
- But how should children manipulate them in such a way that it would help?
- The only helpful way would be to know which letters/sequences of letters represent consistently certain spoken language units
- No one knows a full answer to that (only a very partial one)
- Dyslexia=phonological disorder, yes, but how this definition helps in correcting it?
- Dyslexia results from auditory insensitivity as we have shown empirically (see Fig)
- And auditory insensitivity can be corrected by drilling using our the GraphoGame
- No one is left behind when GG and CG are used optimally (= eg. preventively)

Figure 1. Newborn ERPs to tone frequency change differ between 2nd grade typical control and dyslexic at-risk readers



Leppänen et al, *2010, Cortex*

Quiet sleep

Thank you for your attention!

- Anyone interested in joining me is welcome to help us build a world where no one needs to be left behind as regards reading schoolbooks successfully
- I am collecting the actual data & information to www.comprehensiongame.com
- All documentation (hundreds of papers) for understanding this all, has been published and the two most important are now accepted for publication and will be there soon
- Please, see heikki.lyytinen.info It lists CV and publications from 2007-
- I only publish in open access forums and the two last summarize all most important info
- The training tools can be used for research purposes following agreements with me so that I can detail what is needed for their optimal use and consider which would be the best way to add the documentation needed for showing their efficiency and thus making the ready for distribution to all in need
- By joining me your whole nations can get it for free (as do all poor countries defined by Unesco)
- Please, content me via heikki.j.lyytinen@jyu.fi