

Communication Technology for Children with Cerebral Palsy



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Holland Bloorview Kids Rehabilitation Hospital



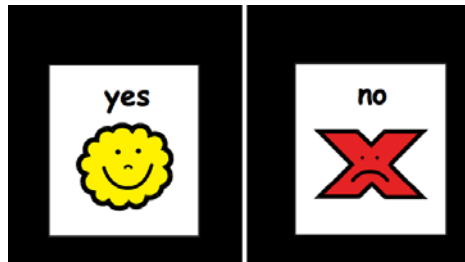
CP-NET
Childhood Cerebral Palsy
Neuroscience Discovery Network



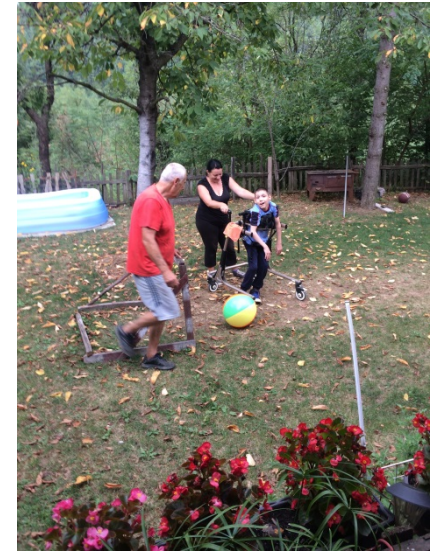
**ONTARIO
BRAIN
INSTITUTE**

Why is communication research important?

Danijela Grahovac
Parent Researcher, CanChild

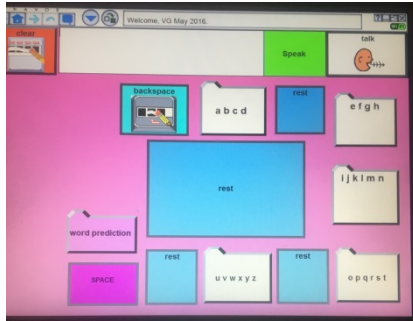


What do I wish people knew about children who don't communicate through speech?



What dreams and priorities we have for the future?

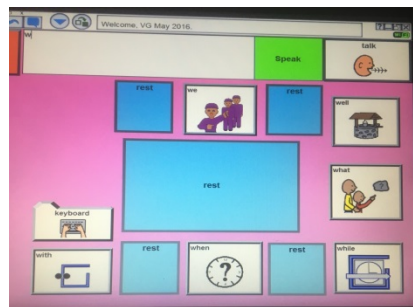
NOW



Folders with letters



Choose a letter, go back on main page, choose “Word prediction” button



Hope that your word will be there

What we are hopping for



F-WORDS: How to communicate ABOUT your child

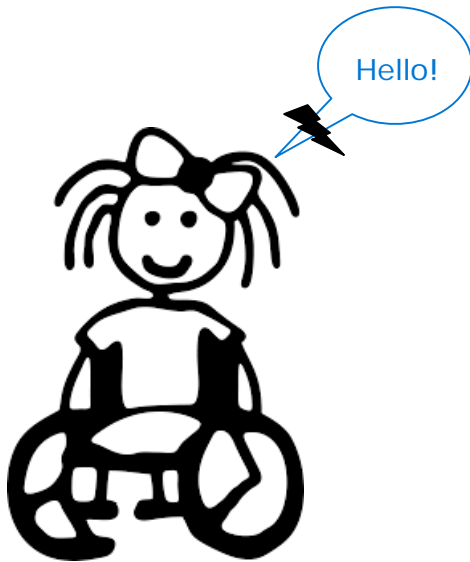


<https://www.canchild.ca/en/research-in-practice/f-words-in-childhood-disability>

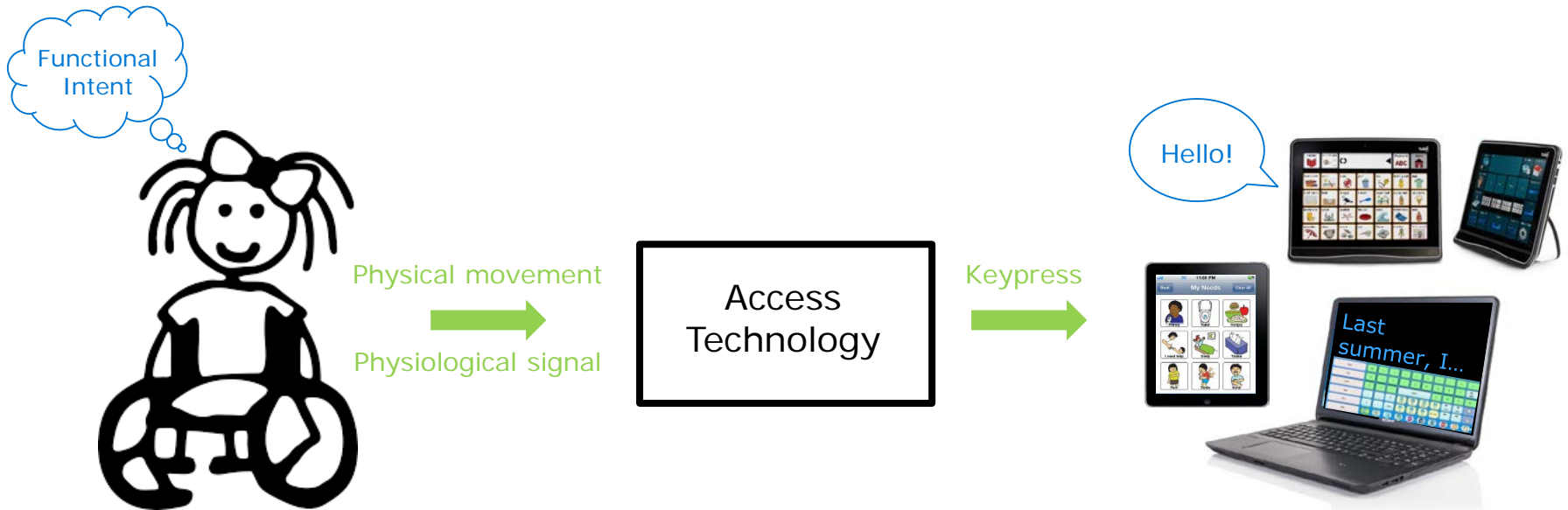
Access Technologies for Communication

Fanny Hotzé, PRISM Lab

Background – Access technology

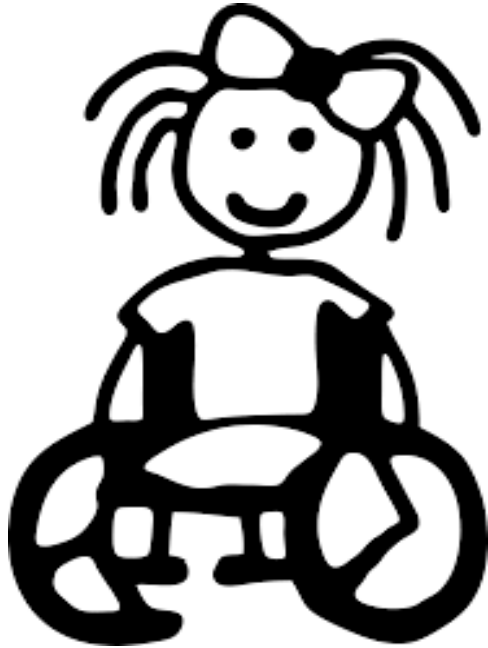


Background – Access technology



Background – Orofacial access technologies

Commercially available switches



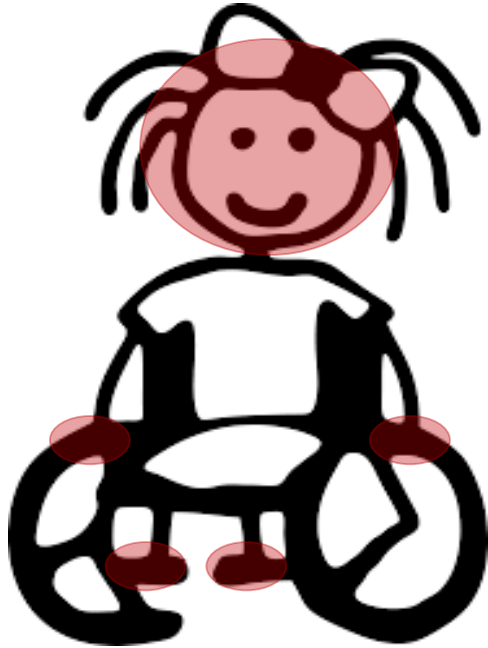
Background – Orofacial access technologies

Commercially available switches

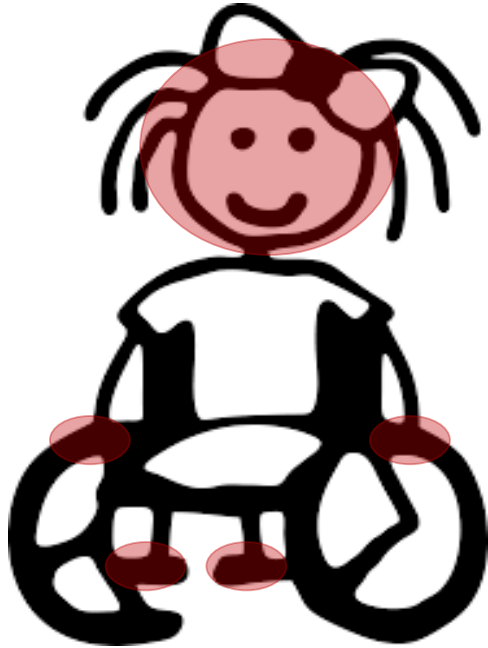


Background – Orofacial access technologies

Commercially available switches



Background – Orofacial access technologies



Commercially available switches

- Limited use due to:
- involuntary movements
 - variable muscle tone

Background – Orofacial access technologies



Commercially available switches

- Limited use due to:
 - involuntary movements
 - variable muscle tone

Orofacial technologies

- Facial gestures
 - smiling/mouth movements
 - eyebrow movements
 - tongue movements
 - blinking
 - eye tracking
- Vocal abilities
 - hums
 - specific keywords

Technology development/customization

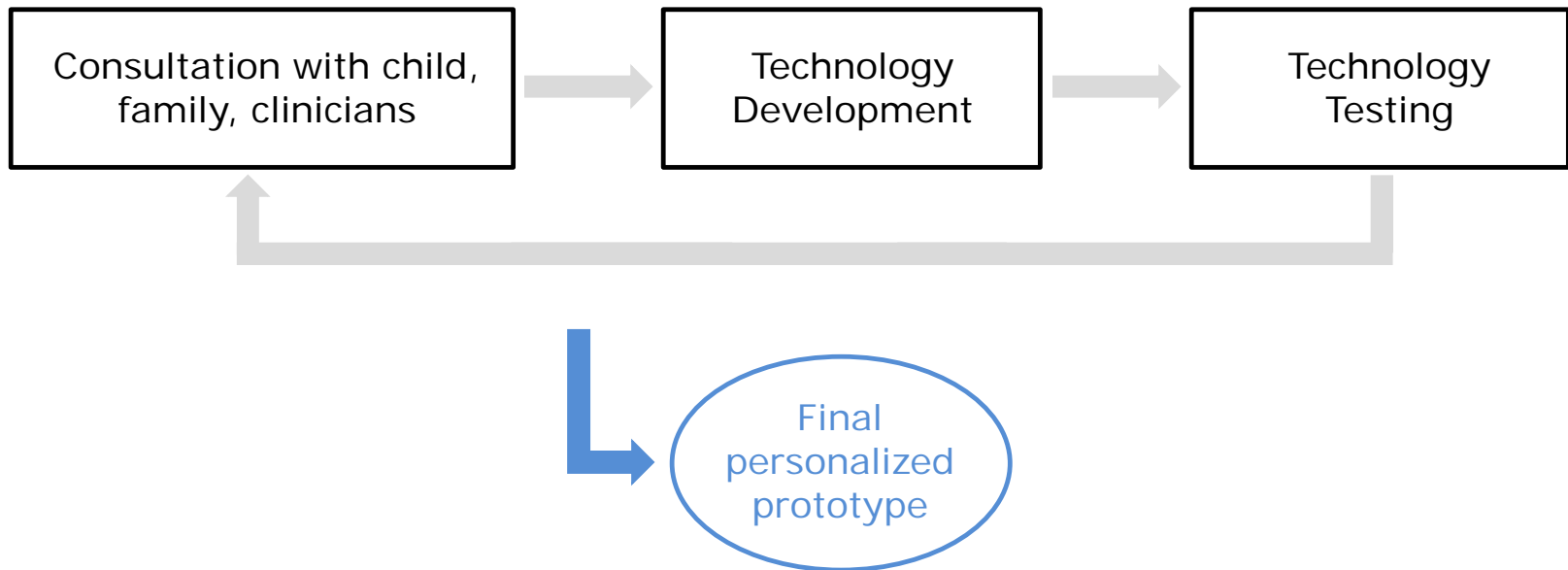
Collaborative and iterative process



No boundaries

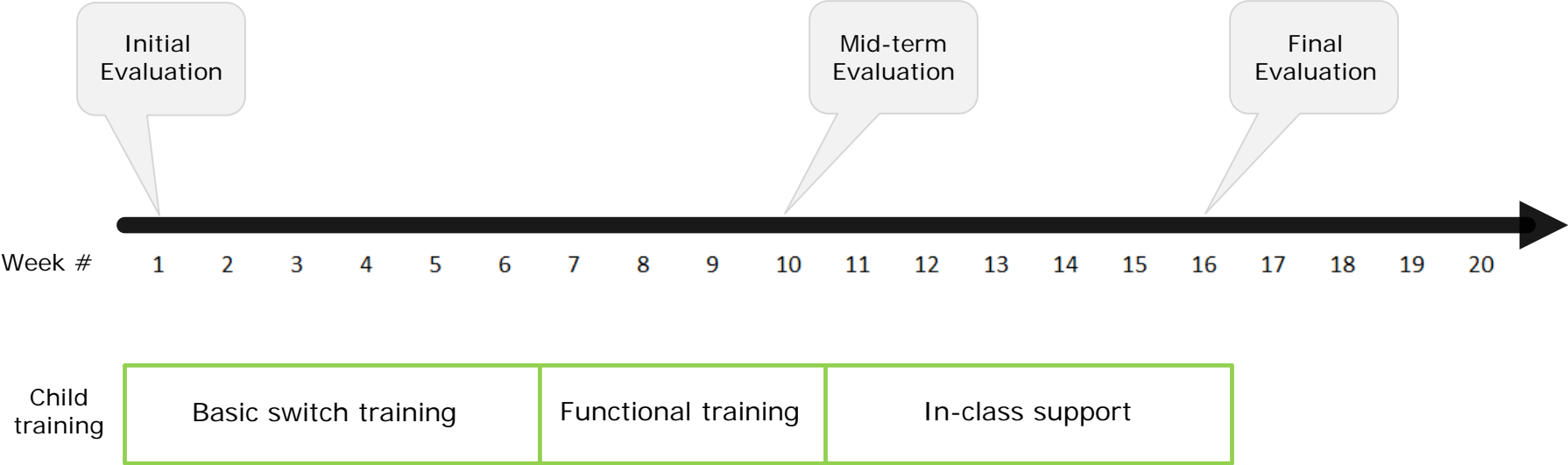
Technology development/customization

Collaborative and iterative process



No boundaries

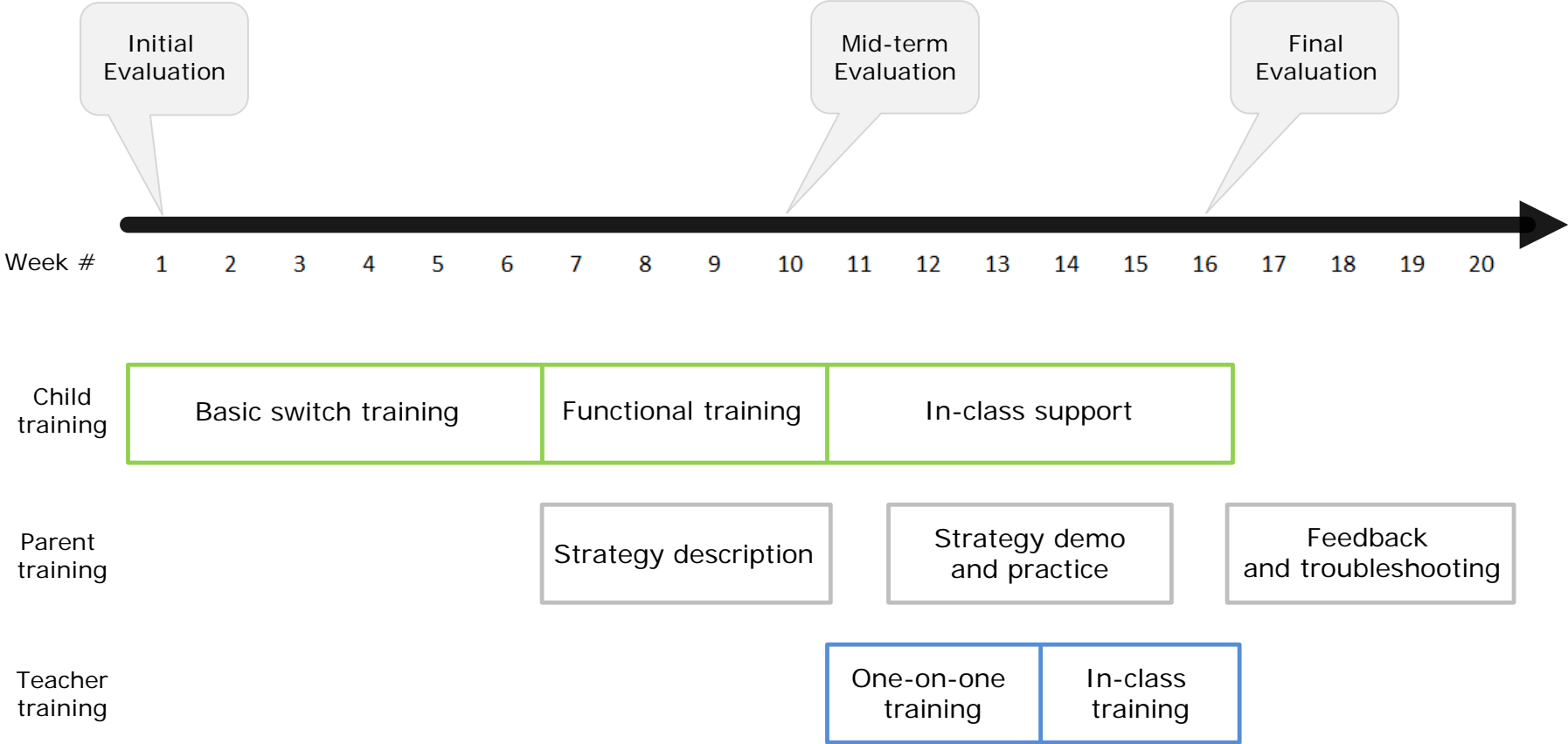
Training and evaluation protocol



Desai et al., 2014

No boundaries

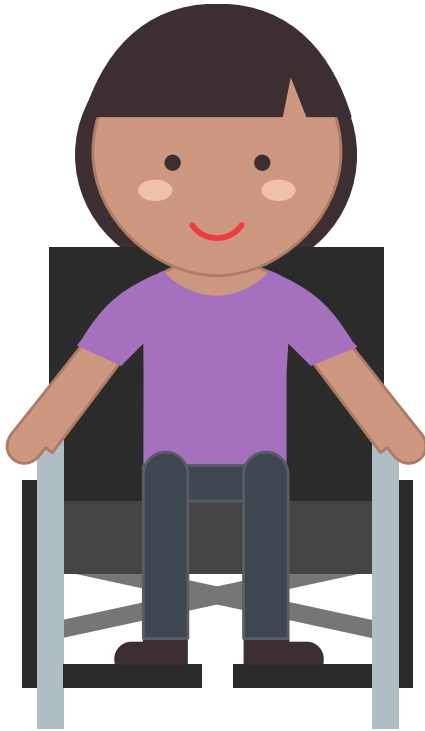
Training and evaluation protocol



Desai et al., 2014

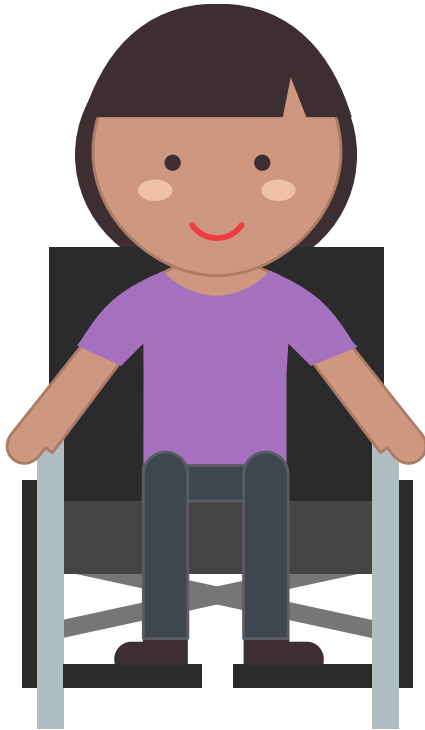
No boundaries

Blink switch



No boundaries

Blink switch

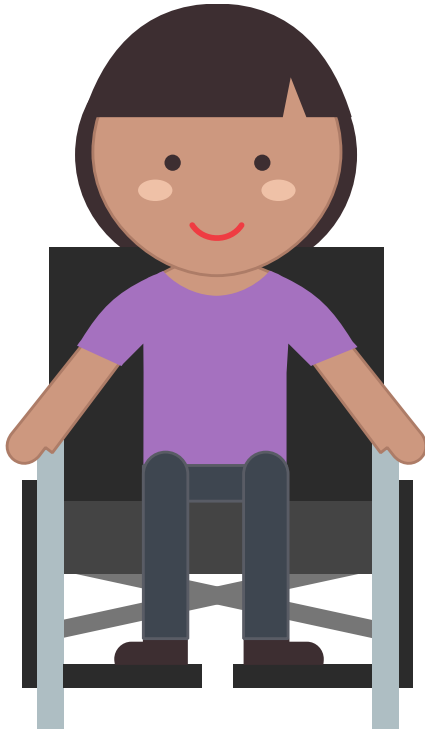


- 22 years old
- Progressive demyelination



- 15 years old
- Leukodystrophy

Blink switch



- 22 years old
- Progressive demyelination

Intentional
blinks
for YES

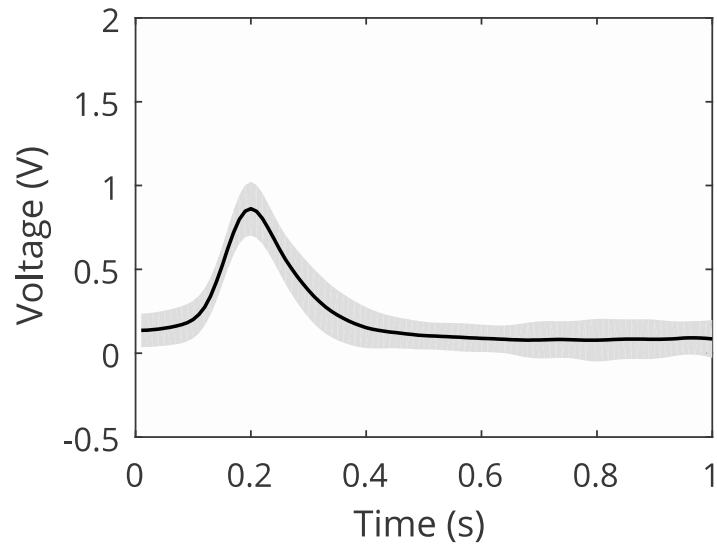


- 15 years old
- Leukodystrophy

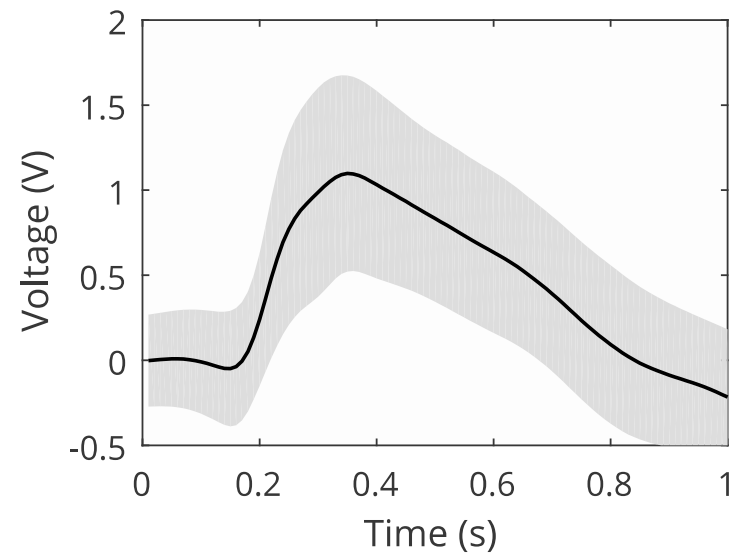
Blink switch

What does a blink look like?

Typically developed adult



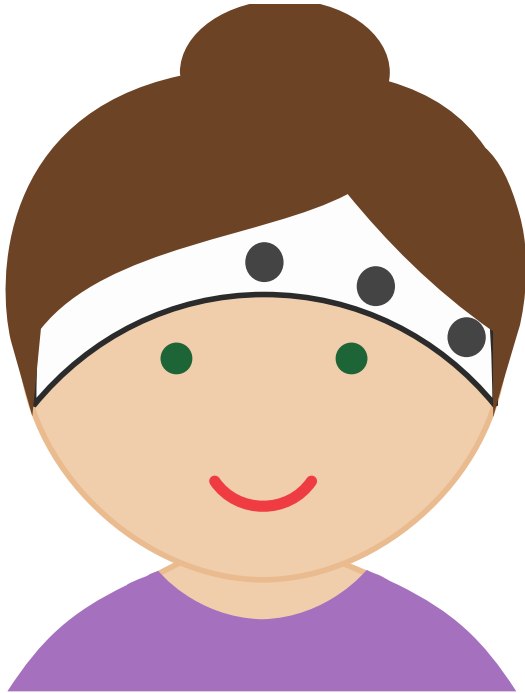
Client with neuromuscular disability



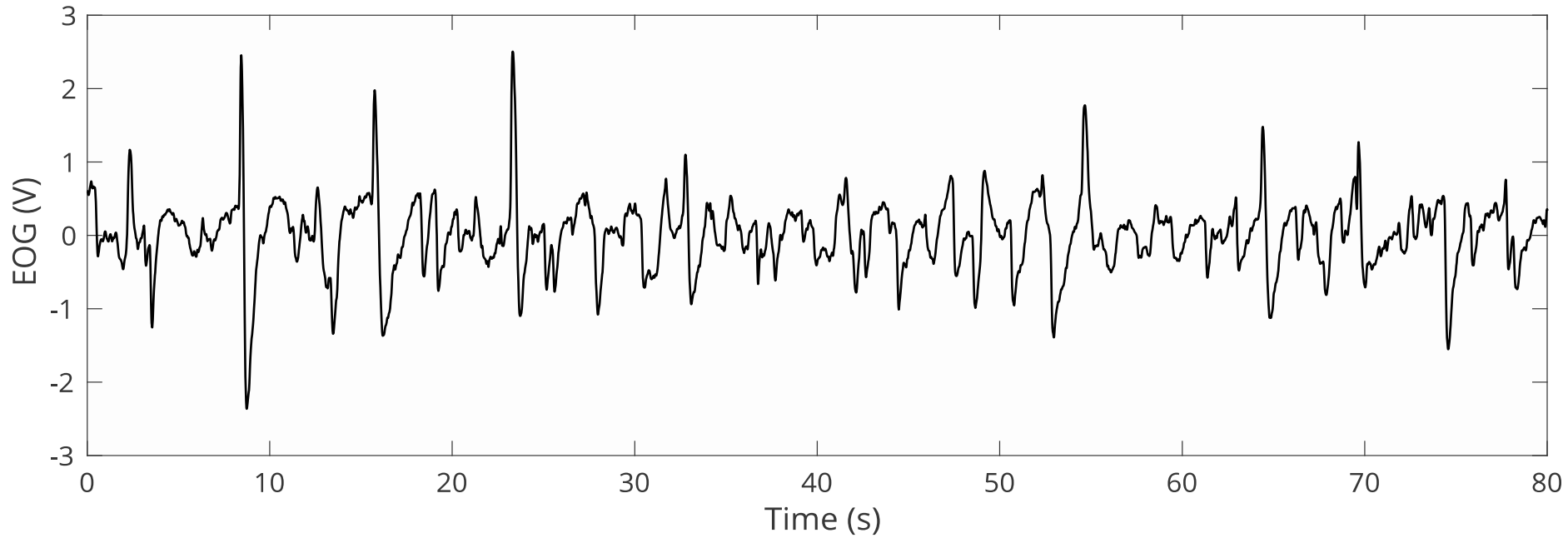
No boundaries

Blink switch

Fabric EOG headband



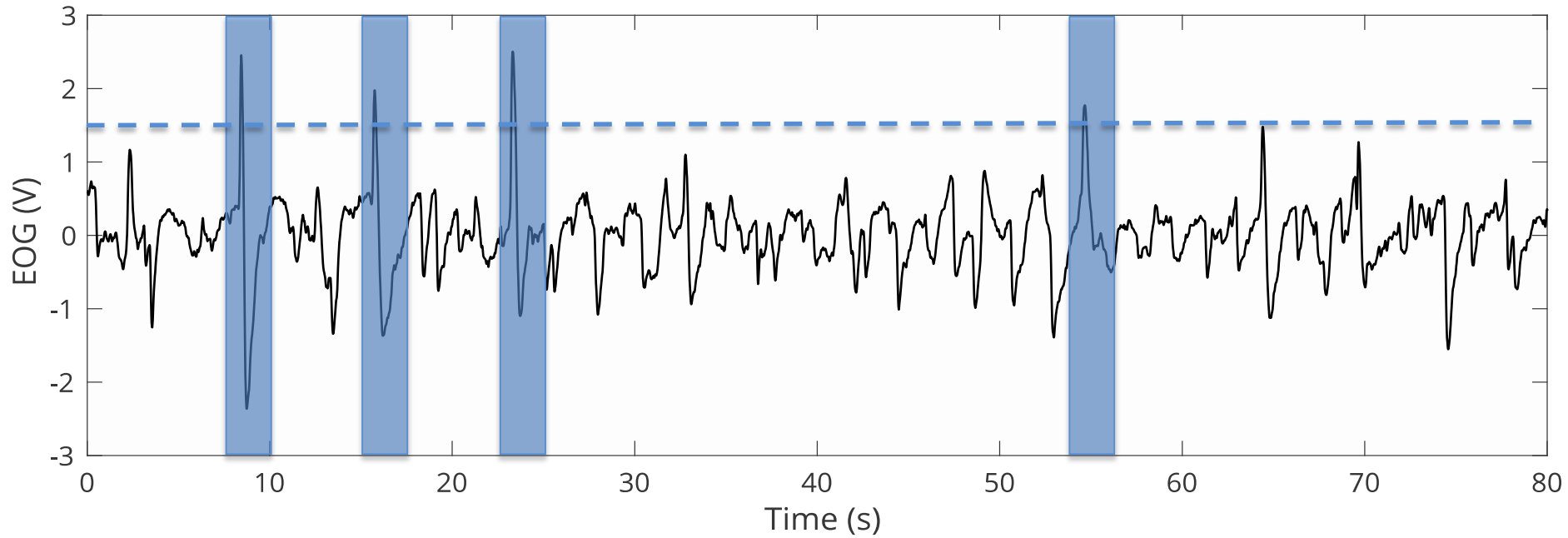
Blink switch



No boundaries

Blink switch

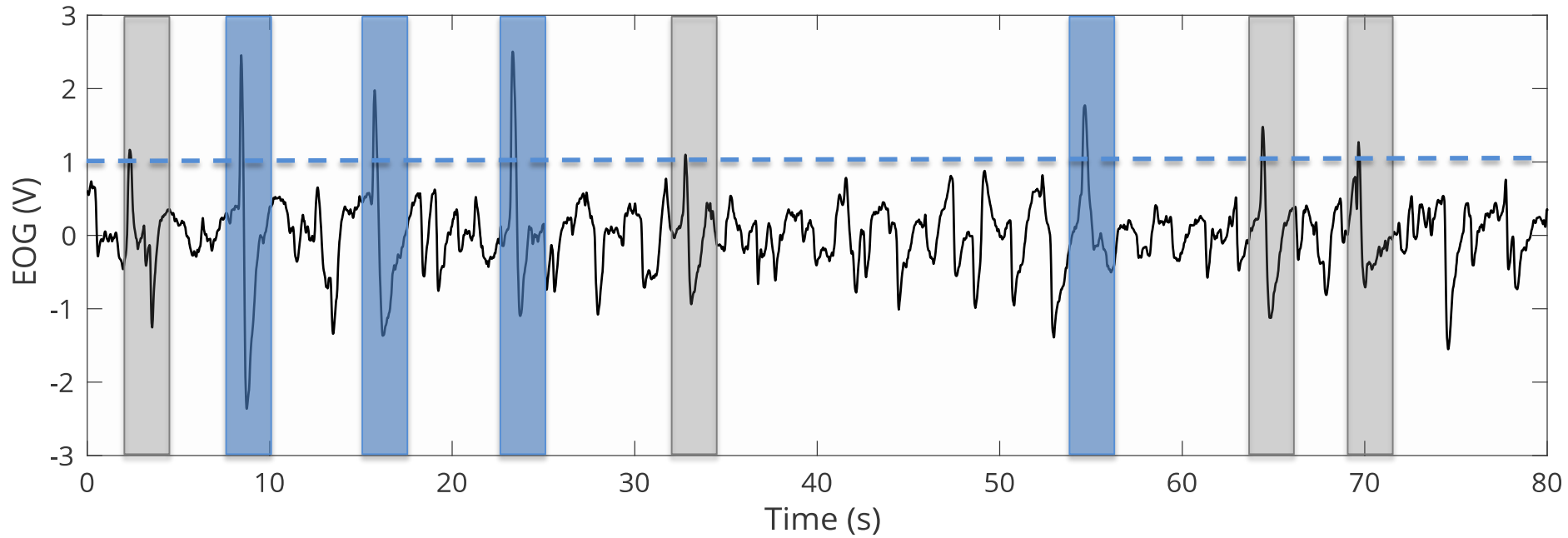
Blink detection algorithm



No boundaries

Blink switch

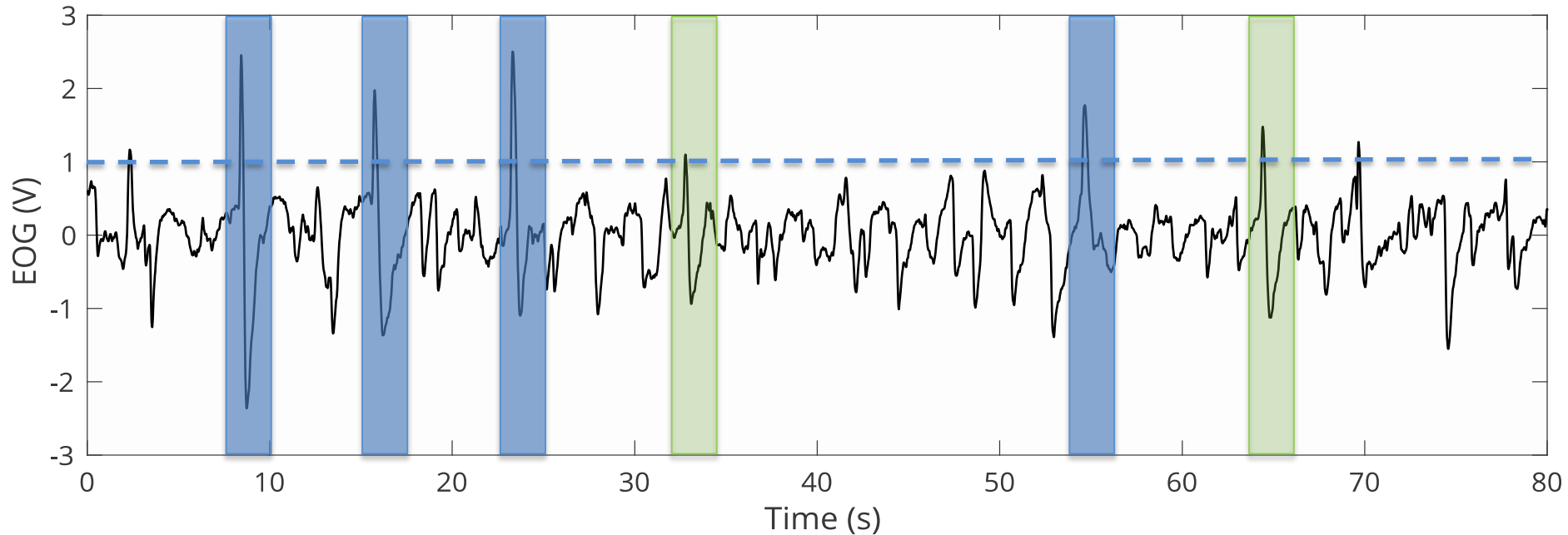
Blink detection algorithm



No boundaries

Blink switch

Blink detection algorithm

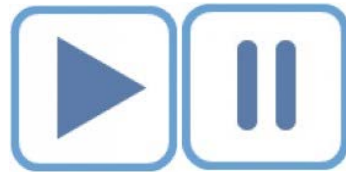


Offline accuracy: 70%-80%

No boundaries

Blink switch

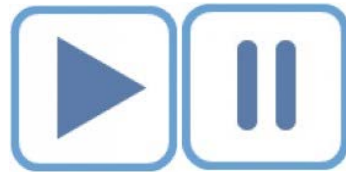
Online testing



No boundaries

Blink switch

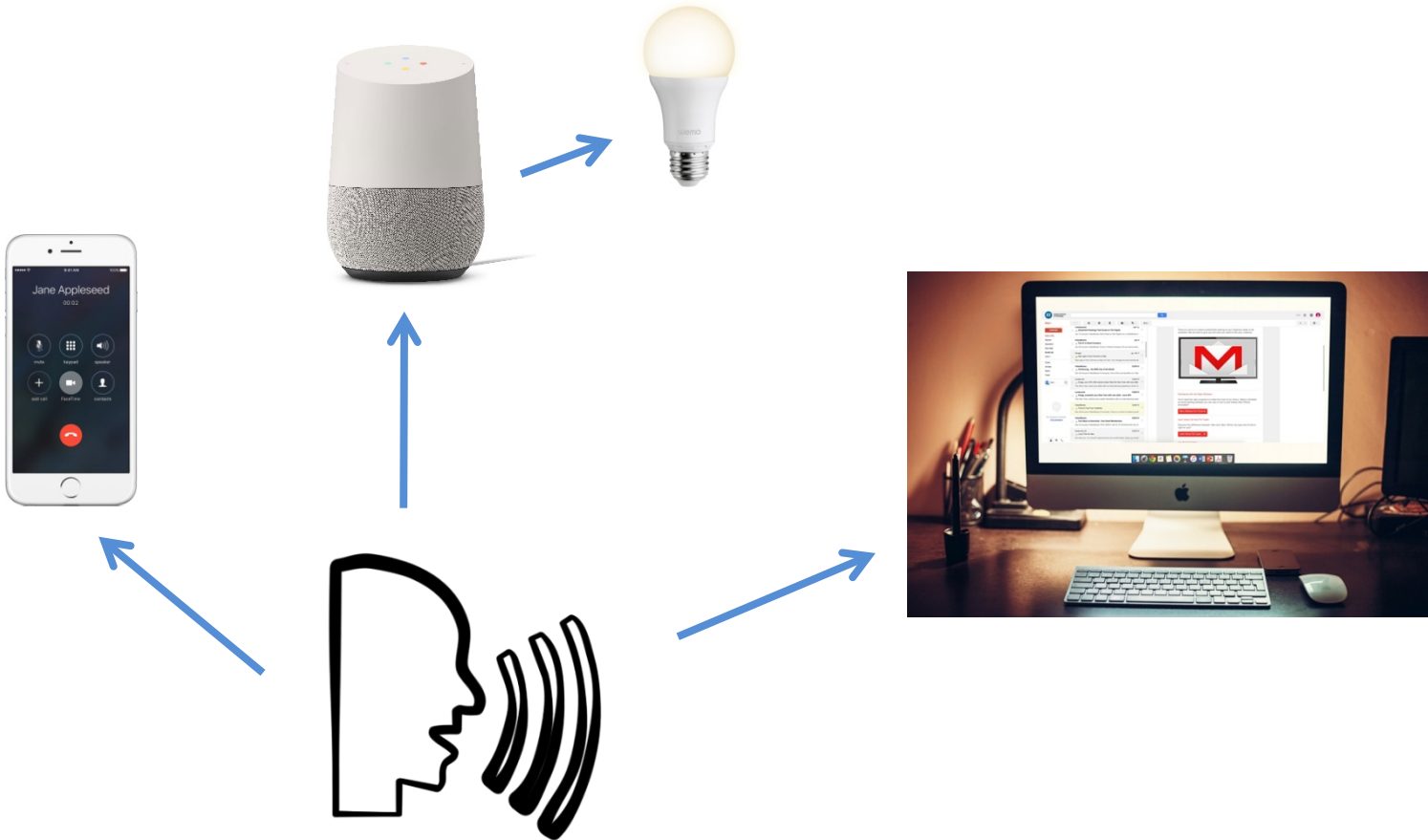
Online testing



Online accuracy: >80%

No boundaries

Custom word recognition software



No boundaries

Custom word recognition software



No boundaries

Custom word recognition software



- 7 years old
- Moderate-to-severe speech impairment



- 10 years old
- Mild speech impairment

Custom word recognition software



- 7 years old
- Moderate-to-severe speech impairment



- 10 years old
- Mild speech impairment

Custom word recognition software



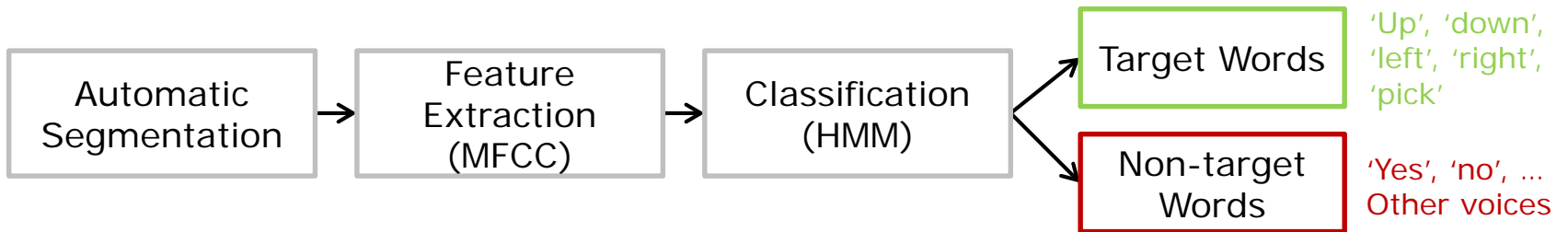
200-400 repetitions
for each target keyword

Custom word recognition software



200-400 repetitions
for each target keyword

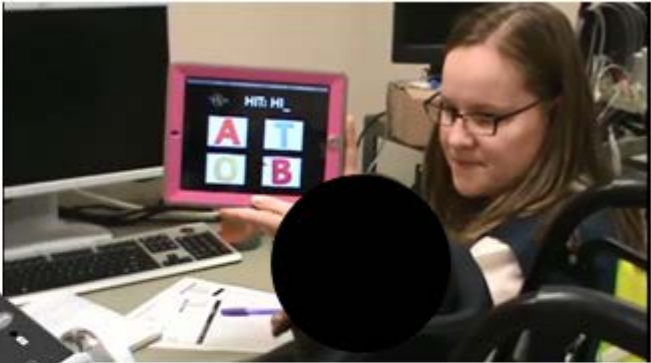
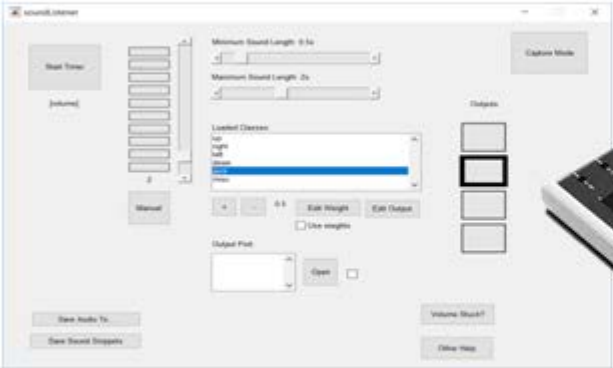
Data analysis



No boundaries

Custom word recognition software

Online testing



Online accuracy: 79% and 88%

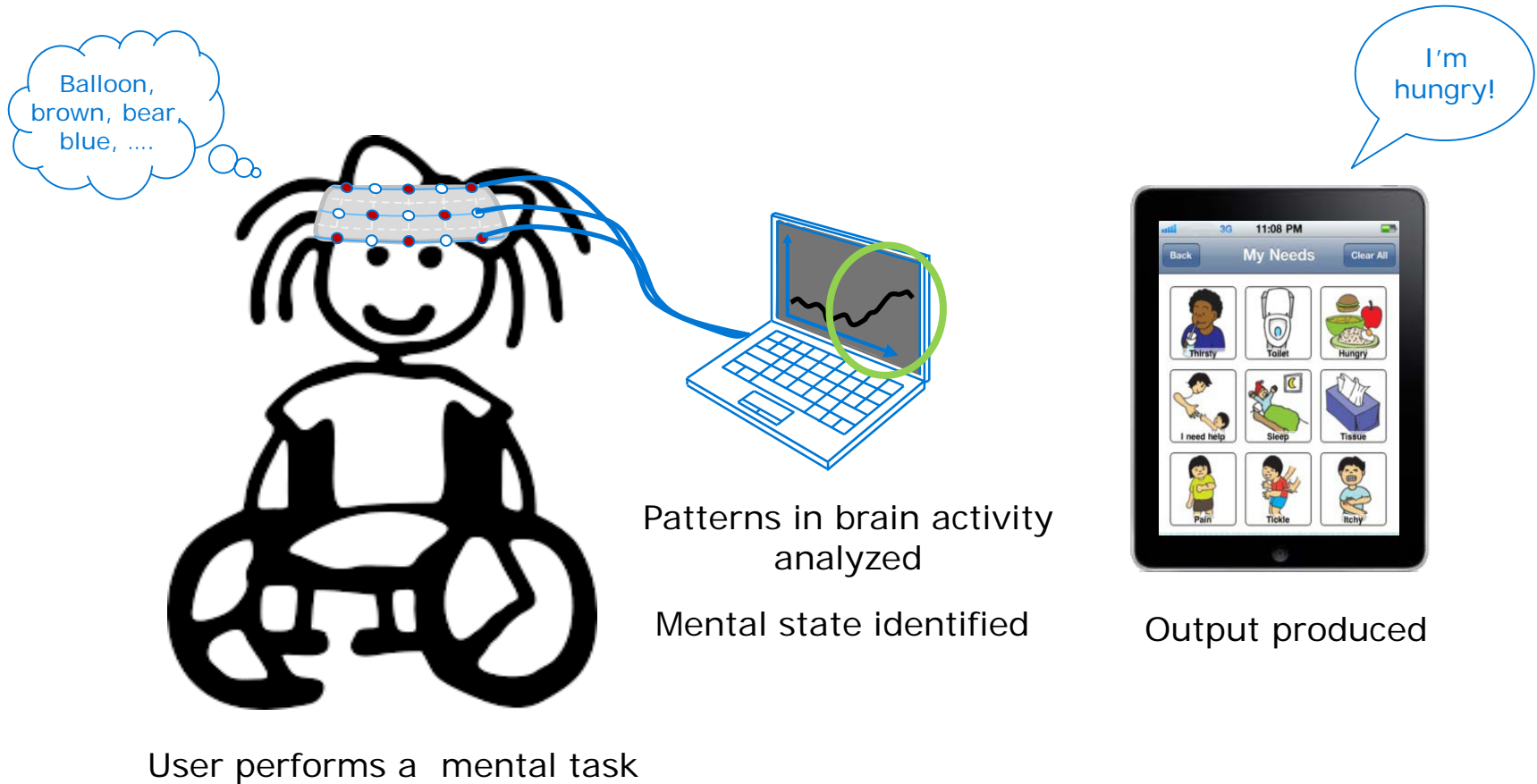
No boundaries

Brain-Computer Interfaces (BCIs)



No boundaries

Brain-Computer Interfaces (BCIs)



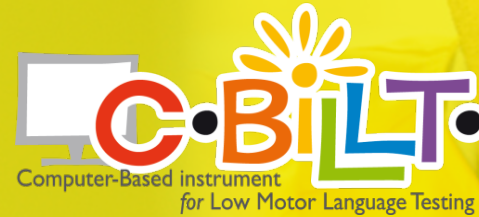
Contact Information

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PRISM Lab

<http://research.hollandbloorview.ca/ResearchCentresLabs/PRISMLab>



Development of the C-BiLLT background, psychometry and interpretation

29 November 2017

Overview

- Importance of language comprehension
- Background C-BiLLT
- Different parts of the C-BiLLT
- Procedure assessment C-BiLLT
- What next....

Multidisciplinary approach

- Pediatric neurology
- Pediatric rehabilitation medicine
- Pediatric (neuro) psychology



Background of the C-BiLLT



Diagnostic relevance

Conceptual skills
Social skills
Intelligence
Practical skills



Language

Diagnostic in non-speaking children with CP

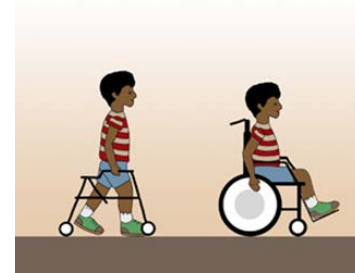
Gross motor function classification system (GMFCS)



I



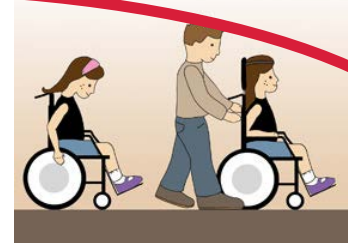
II



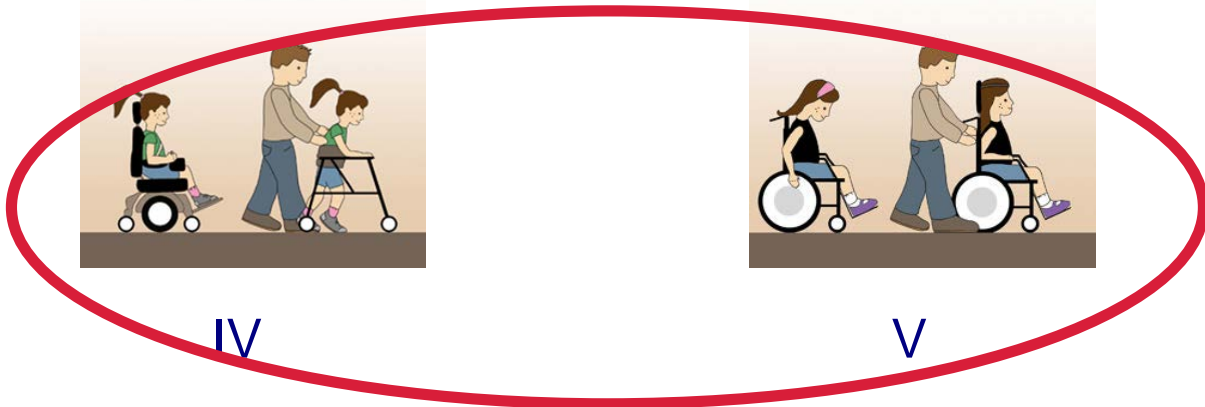
III



IV

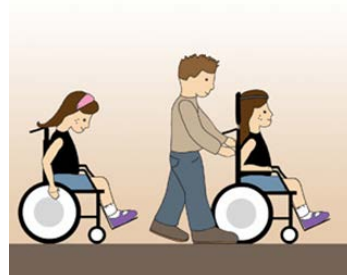


V



Diagnostic in non-speaking children with CP

- Severe motoric impairments:
- GMFCS IV or V
- 85-100% Communication impairments



Main question: Comprehension of spoken language



Diagnostics in nonverbal CP

- Need of AAC systems
- Ability to express
- Participation
- How to address the child
- Which AAC device
- Overestimation
- Underestimation
- Discrepancy expressive and receptive communication



Diagnostics in non-speaking children with CP



Diagnostic in non-speaking children with CP

- Difficulty with common standard language tests
- Motoric tasks
- Direct pointing
- Small material
- Norm group
- Items related to natural environment
- Geytenbeek et al. *Augment Altern Commun* 2010., Deveney et al. *JLSHS*, 2012
- Possibilities of language testing
 - PPVT
 - RDLS
 - CELF
 - Others ?



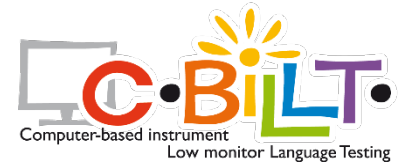
Diagnostics in non-speaking children with CP

No 'golden standard'

- Standardized tests show poor utility
- Need for diagnostic instrument that meets test requirement for severe CP

C-BiLLT

- A newly developed instrument:
- Computer-Based instrument for low motor language testing



• Geytenbeek et al., 2010. Utility of language comprehension tests. *DMCN*

• Geytenbeek et al., 2014. Reliability and validity of the C-BiLLT. *AAC*

Diagnostic in non-speaking children with CP

- AAC may lead to the development of natural speech or spoken language comprehension.
- Selection and development of appropriate AAC systems depend on:
 - Learning and developmental priorities
 - Language and comprehension skills
 - Current and future communication needs

Background C-BiLLT

- Objective measure
- Eligible for children with the most severe limited mobility
- All body parts
- Autonomously response



Build- up C-BiLLT

- **Access Method**
 - Motor impairment
 - Independence in response
- **Images with clear contrast**
- **Duration assessment and appearance**
- **Items relevancy**
- **Gradual construction in complexity**
- **Scoring at chance level**

Background C-BiLLT

- Linguistic hiërarchy
- Reynell
 - Leen van Dungen streeflijst woordenschat (2007)
 - Lexilijst (Schlichting & Lutje Spelberg, 2002)
- Early invention/indication
- Discrepancy expressive and receptive language development

Parts C-BiLLT

- Pretest

- Learning phase A.

- computertest

- Learning phase B.

- Part 1

- Learning phase C.

- Part 2



Pre-test

- Objects
 - Eight objects, child's environment
 - own ball, cup, coat etc.
- Photo round
 - Same eight items
 - Universal
 - 5/ 8 objects correct
 - 5/ 8 photos correct



Parts C-BiLLT

- Pre-test

- Learning phase A.

- Computertest

- Learning phase B.

- Part 1

- Learning phase C.

- Part 2



Association with
computerscreen

Left -right association

Access method

Action-reaction

Parts C-BiLLT

- Pre-test

- Learning phase A.

- Computertest

- Learning phase B.

- Part 1

- Learning phase C.

- Part 2



Parts C-BiLLT

- Pre-test

- Learning phase A.

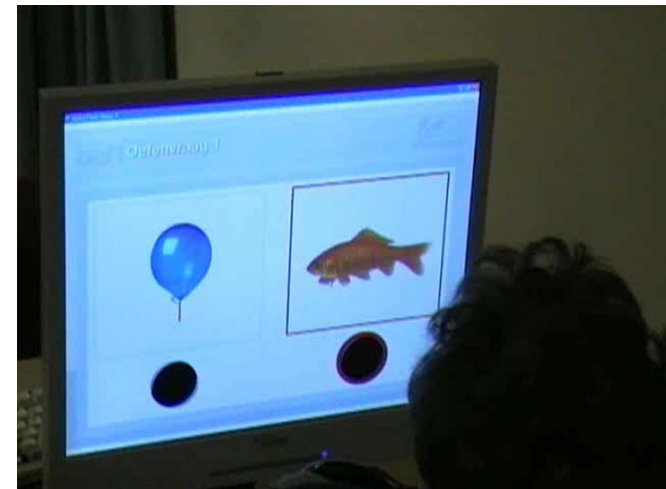
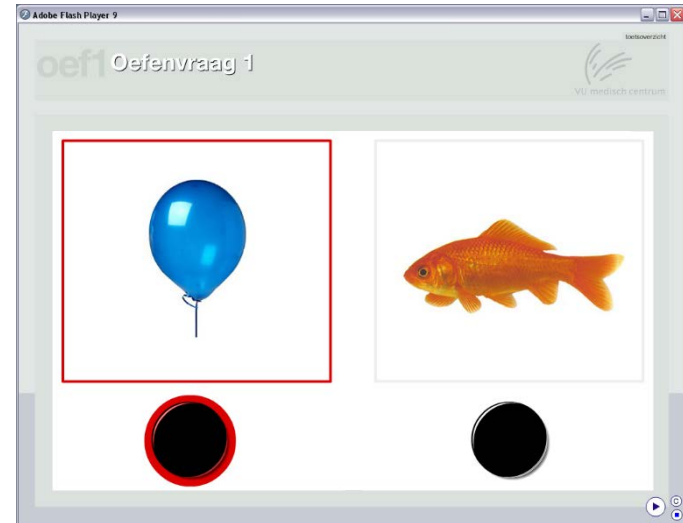
- Computertest

- Learning phase B.

- Part 1

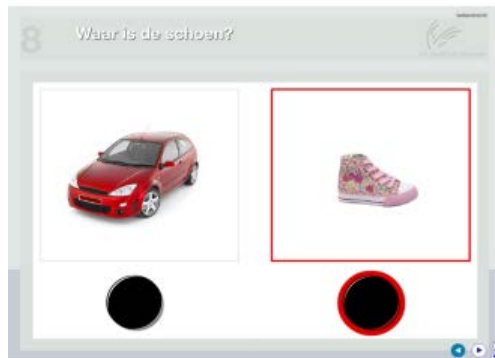
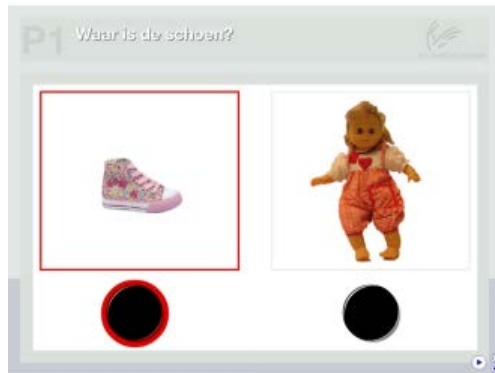
- Learning phase C.

- Part 2



Parts C-BiLLT

• Part 1



- 30 items
- Section 1: objects
- Sectie 2: verbs
- Sectie 3: persons, objects en animals
- Parallell version of each section

Parts C-BiLLT

- Pre-test

- Learning phase A.

- Computertest

- Learning phase B.

- Part 1

- Learning phase C.

- Part 2



- Input switches
- Linear scanning
- Touch screen etc.

Parts C-BiLLT

- Pre-test

- Learning phase A.

- Computertest

- Learning phase B.

- Part 1

- Learning phase C.

- Part 2.



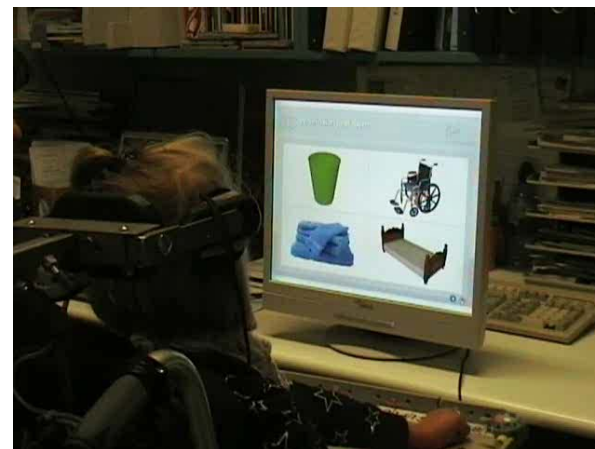
- 56 items
- Increase in complexity
- More difficulty in grammatical structures and sentences

Web-based

- www.c-billt.com

Access methods

- Computertest



Utility of the C-BiLLT

Utility C-BiLLT

- Knowledge of discrepancy between expressive and receptive communication skills of the child
- Access method
- Clinical intervention program
- Appliance of a (suitable) AAC device

Clinical relevance



Results for our participants

- No earlier test results
- Pleasure in assessment
- Underestimation/ overestimation
- Confirmative for subjective impression
- Support for parents
- Implications for teachers, educational program
- Baseline assessment for intervention studies

Diagnostic in non-speaking children with CP

- **Follow-Up research**

- Responsiveness of the C-BiLLT
- GMFCS I t/m III
- Normgroup has been extended (n=1046)
- Other diagnosis groups
- CP-CaLL, follow-up study of 4 years in the Netherlands
- Translation in English, German and Norwegian!!

Acknowledgements



Parents and their children,
Rehabilitation centers,
Special schools,
Primary schools and daycare
centers