Strategies for Enhancing Speech Intelligibility in Children and Youth with Cerebral Palsy



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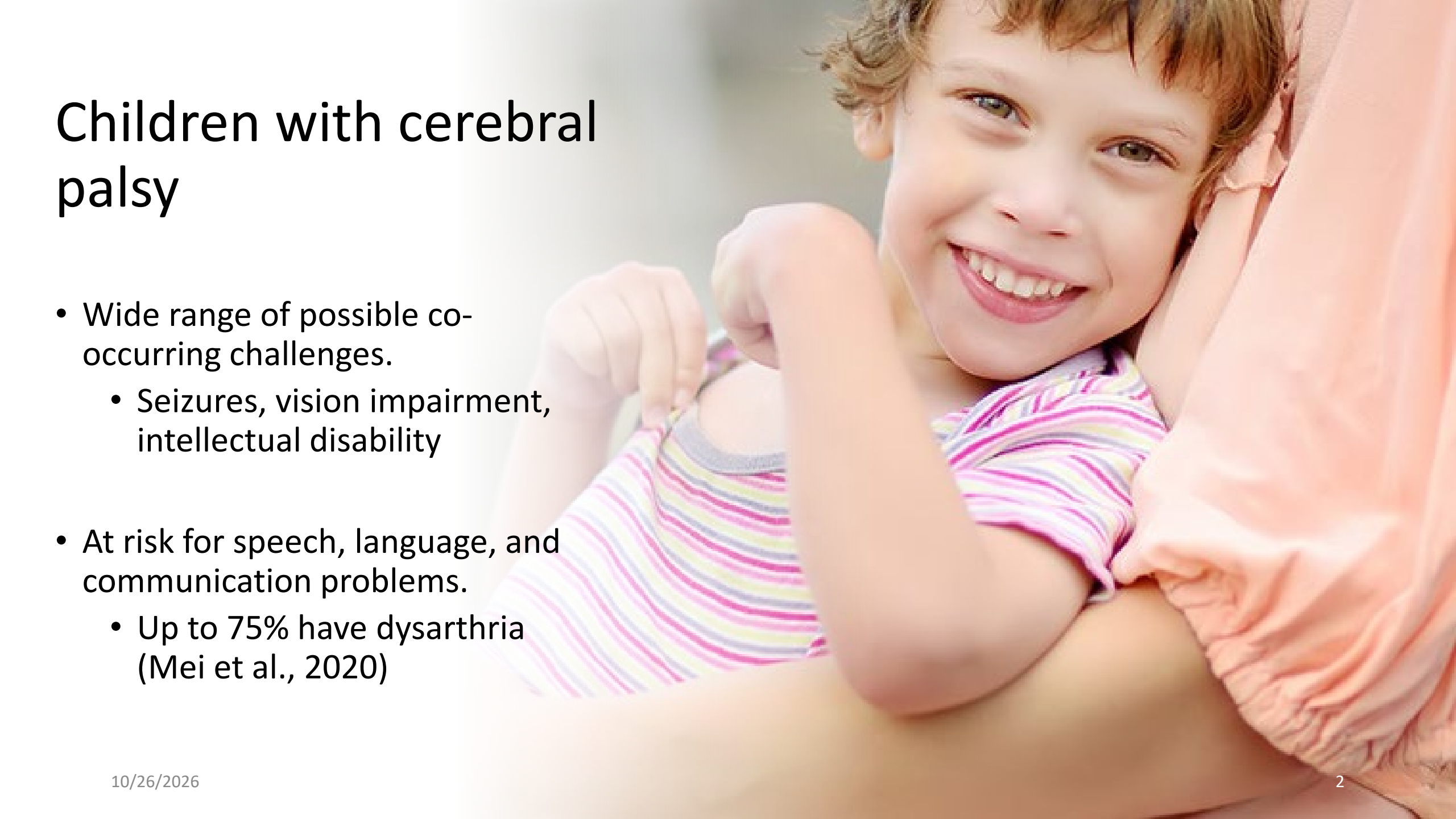
isconsin Intelligibility, Speech, & Communication Lab

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Children with cerebral palsy

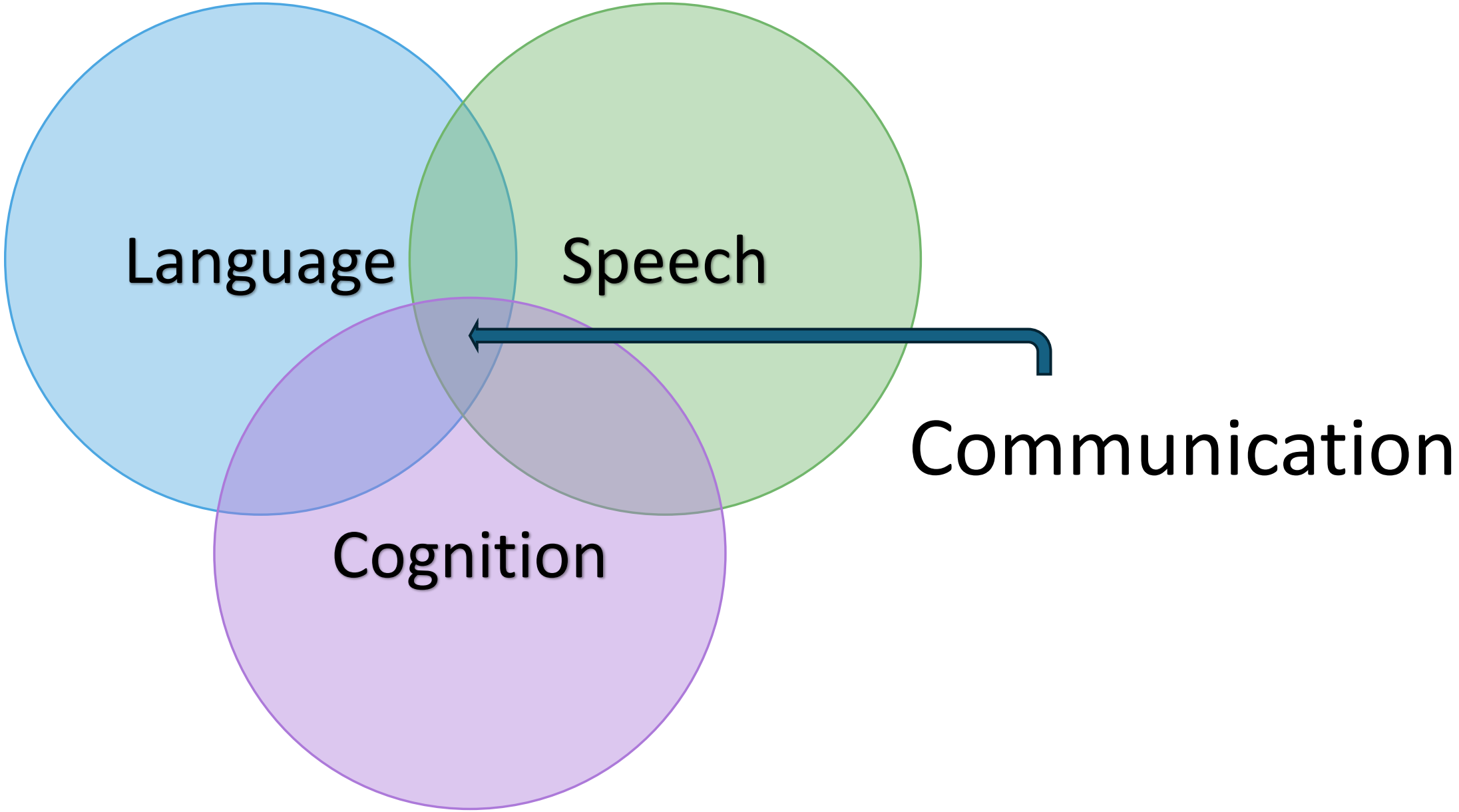
- Wide range of possible co-occurring challenges.
  - Seizures, vision impairment, intellectual disability

- At risk for speech, language, and communication problems.
  - Up to 75% have dysarthria (Mei et al., 2020)



Potential communication challenges in CP

Cognition	Intellectual ability Attention, memory, intentionality, awareness Mapping ideas to language and then to speech
Language	Receptive: Understanding words and sentences Expressive: Being able to put words together conceptually to make sentences
Speech	Producing words and sentences physically Requires motor control for articulation, voice, breathing… Motor problems that affect the body can also affect speech


Language
Speech
Cognition
Communication

What does “at risk” mean?

- History of neurological event or involvement
- Developmental lag in early vocal and speech milestones
- Developmental lag in language and cognitive milestones
- Developmental lag in gross motor milestones
- Oral-motor difficulties (sucking and swallowing)



Focus on speech development

- Babbling at 7-9 months
- First words around first birthday
- Combining 2 words before 2 years of age
- Longer sentences after 2 years
- 50% intelligible 3-4 years
- 75% intelligible 4-5 years
- 90% intelligible 5-7 years

What is dysarthria?



- Dysarthria is a **motor** speech disorder that makes it difficult to control the muscles needed for speaking.
  - It can affect how clearly a child speaks, how their voice sounds, and the rhythm and rate of their speech.
- Affects muscles in one or more subsystem:
  - Articulation
  - Resonance
  - Voice
  - Respiration
  - Prosody



Dysarthria severity: Impact on speech intelligibility

Early diagnosis of speech-language delays is challenging in CP

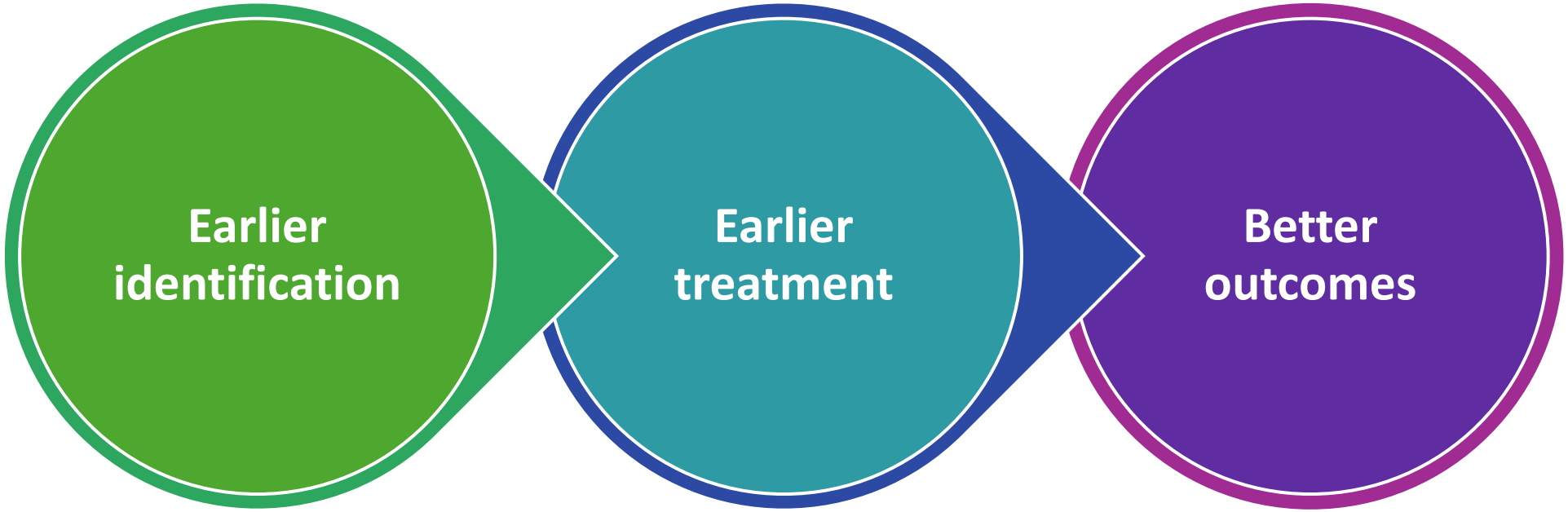


- Differentiating borderline / mild dysarthria from age-appropriate variability is difficult.
- Overlap between dysarthric speech features and developmental speech features
- Range of variability in typical children

How does typical speech overlap with dysarthric speech?

Speech Characteristic	Typical	Dysarthric
Speech sound errors	✔	✔
Reduced speech intelligibility	✔	✔
Reduced rate of speech	✔	✔
Breathy voice	✔	✔
Short phrases	✔	✔

Differential diagnosis of speech problems is critical!



We know a child has CP, but we can't tell if they will have speech problems (dysarthria) yet…

Is there any way to figure this out so we don't have to "wait and see"?

Key research finding from our lab

- Speech intelligibility clearly separates dysarthric from non-dysarthric children with CP beginning at 3 years of age.



Differentiating among groups of children with CP based on speech intelligibility

ASHA American Speech-Language-Hearing Association

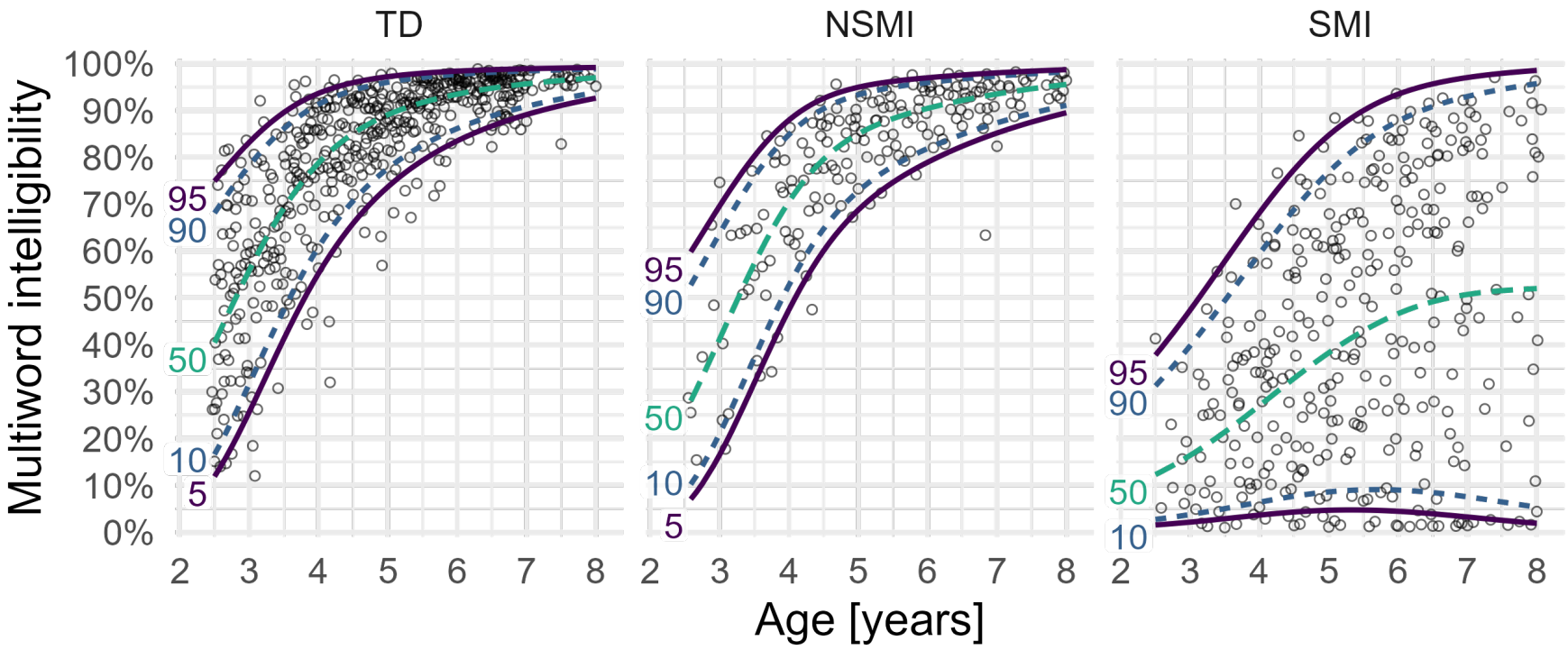
JSLHR

Research Article

Developmental Cut-Points for Atypical Speech Intelligibility in Children With Cerebral Palsy

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Intelligibility thresholds for differentiating dysarthric from non-dysarthric children with CP

90% of dysarthric children detected with age specific cut points

3 years	4 years	5 years	6 years
39% intelligibility or less	59% intelligibility or less	76% intelligibility or less	87% intelligibility or less

Threshold positive predictive value = 80-90%

A child with intelligibility below 39% at 3 years has an 80-90% chance of having dysarthria.

If we know that a child has CP, but we are unsure if they have dysarthria, we can look at speech intelligibility…

At 3 years, if intelligibility below 40%, child has speech motor impairment

At 4 years, if intelligibility below 60%, child has speech motor impairment

At 5 years, if intelligibility below 75%, child has speech motor impairment

Treatment

- We know a child with CP has dysarthria, now what?











Multimodal communication

- Maximizing the use of speech; ensure listeners can understand
- Providing supports via AAC for situations where natural speech does not meet all communication needs
- Ensuring that people have communication options across all context and partners
- AAC and speech are not mutually exclusive communication options.



Augmentative and Alternative Communication

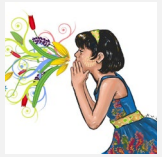
- AAC is a set of procedures / processes to maximize communication skills for ***functional*** and ***effective*** communication
  - Augmentative: AAC supplements existing speech.
  - Alternative: AAC is used in place of speech that is absent or not functional.

AAC and Speech

- AAC is useful for anyone who is unable to use speech to meet all communication needs
  - Across all partners
  - Across all contexts / settings

AAC and Speech

AAC and speech are NOT mutually exclusive



AAC is useful for anyone who is unable to use speech to meet all communication needs

Examples of AAC Tools and Systems

Low-tech Communication Boards



Picture-Based Systems



Speech-Generating Devices (dedicated devices)



Tablets and Apps



Computers



Eye Gaze Systems



Switch Access



Alternative Access

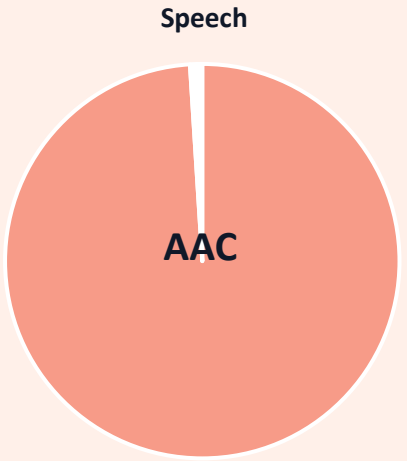


Computer Access



Relationship between AAC and Speech

AAC as a primary mode



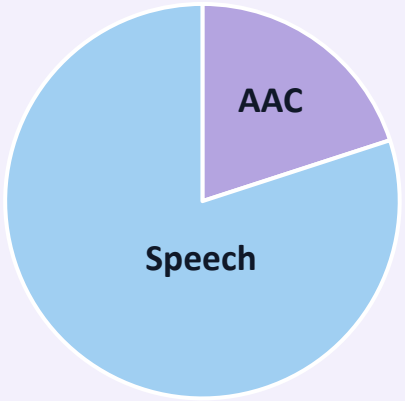
AAC is the main way the person communicates. Little or no functional speech is used.

AAC as a partner with speech



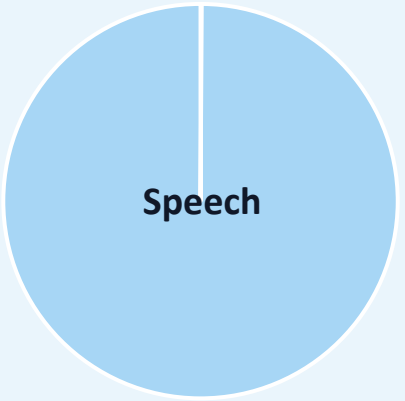
AAC and speech are used together, often for different purposes or situations.

AAC as a back-up to speech



Speech is the primary mode; AAC supplements it when needed.

No need for AAC



Speech meets the person's communication needs without AAC.

AAC as an equal partner with speech

- Able to meet some communication needs across partners and contexts using speech
  - moderately reduced intelligibility
  - speech may be functional with familiar communication partners or in quiet situations
  - Participation limited without significant scaffolding

- Role of AAC:
  - Support language development
  - Support speech development
  - Enhance functional communication and participation
  - AAC used simultaneously with speech

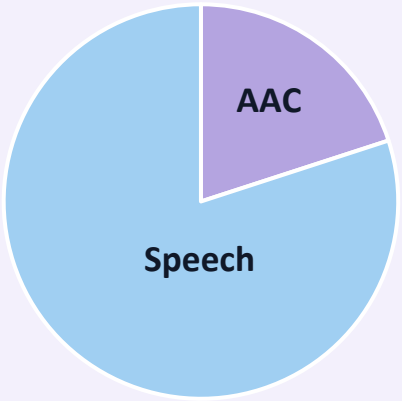


AAC and speech are used together, often for different purposes or situations.

AAC as a back-up strategy

- Able to meet most communication needs across partners and settings using speech
  - mildly reduced intelligibility
  - difficulty in adverse communication situations.

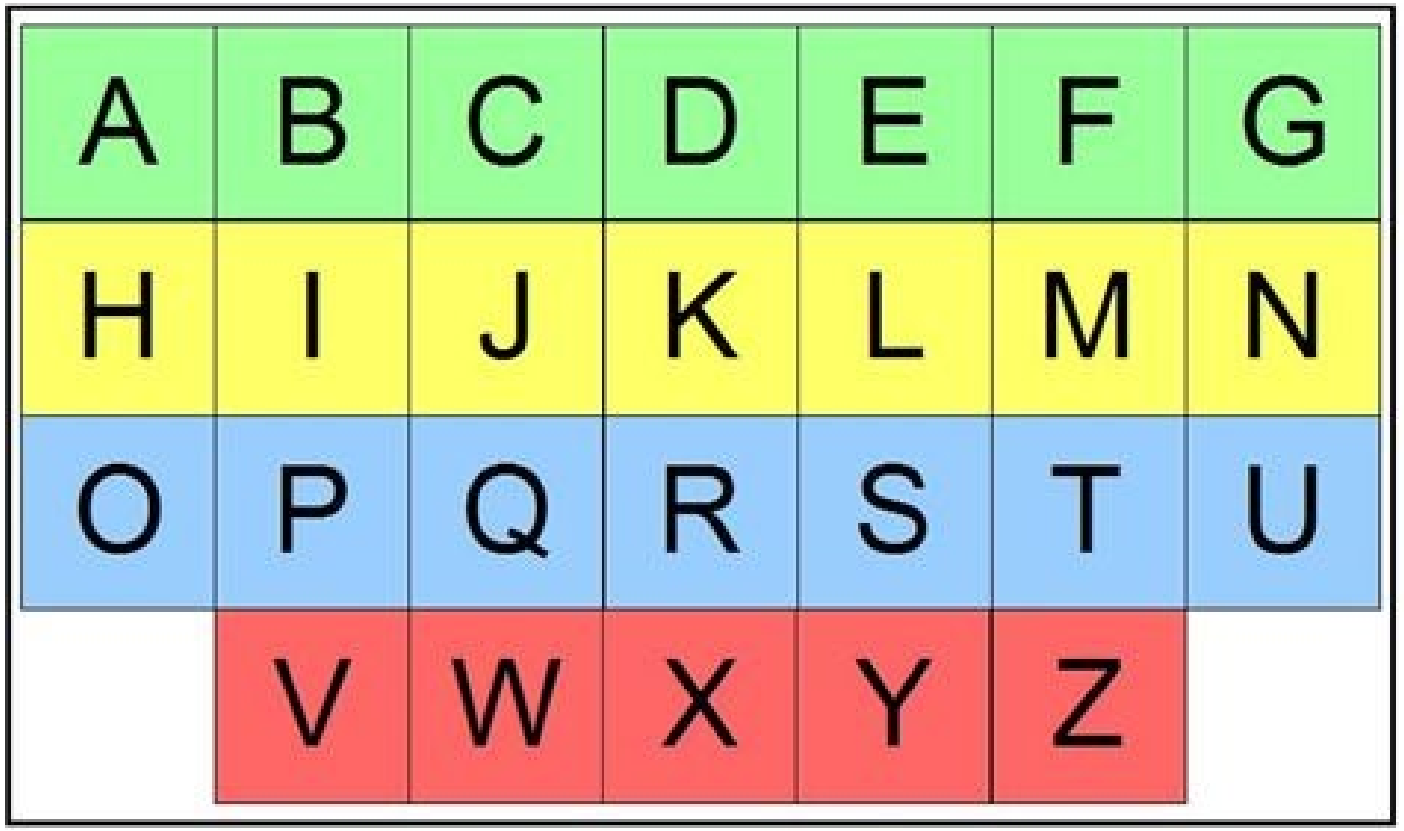
- Role of AAC:
  - support language development
  - supplement speech
  - resolve breakdown situations
  - backup strategy



Speech is the primary mode; AAC supplements it when needed.

What is speech supplementation?

- The use of linguistic cues and speech modification strategies to augment or enhance the usefulness of natural speech
- Compensatory strategies



Types of speech supplementation

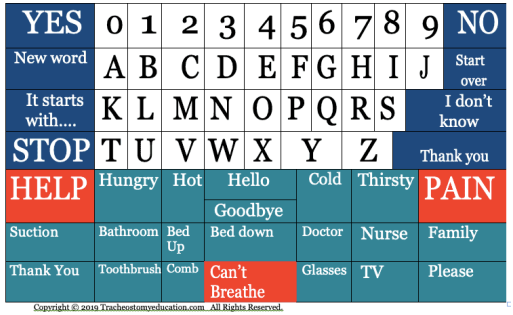
Alphabet supplementation

Topic supplementation

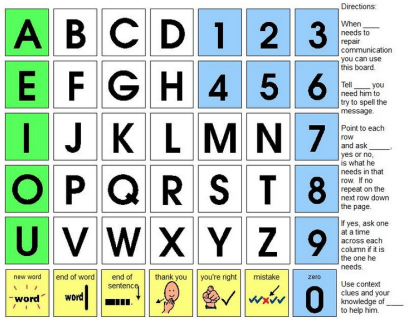
Pacing or rate control

Emphatic stress on key content words

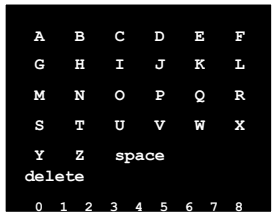
Gestures used with speech





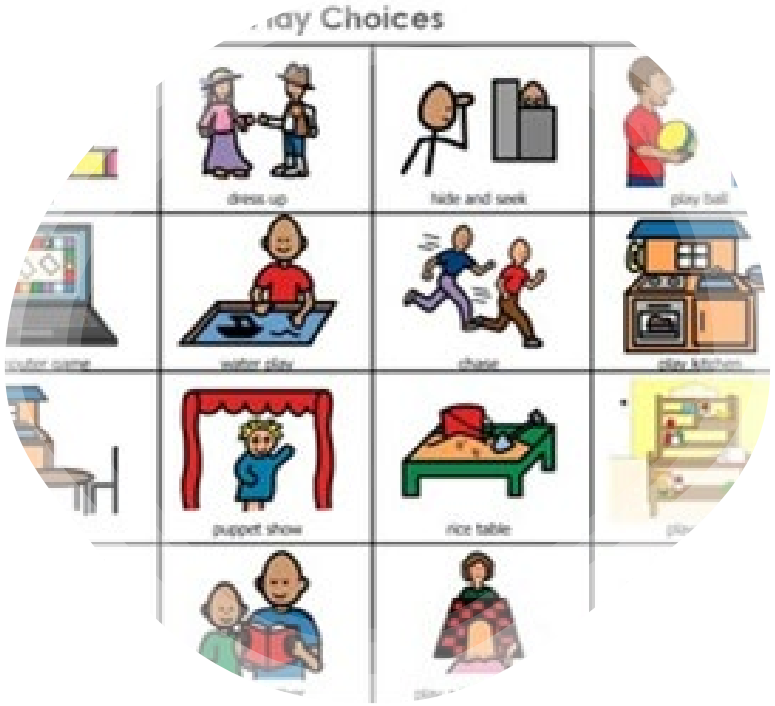






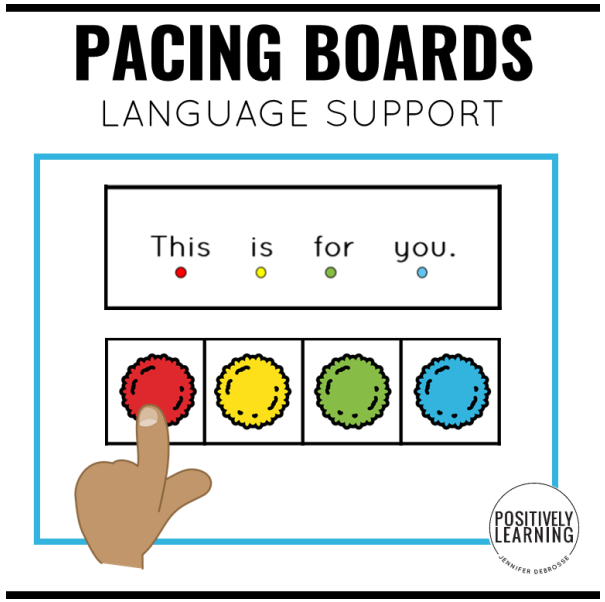
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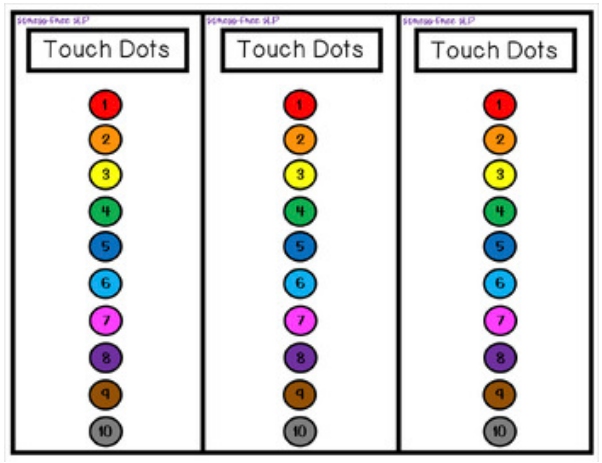


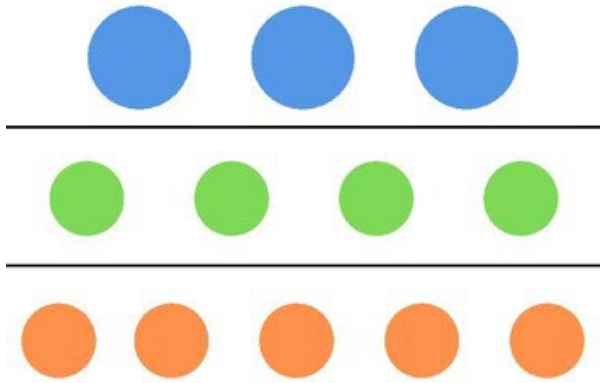


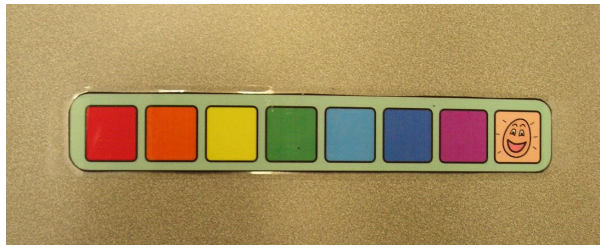


Topic supplementation





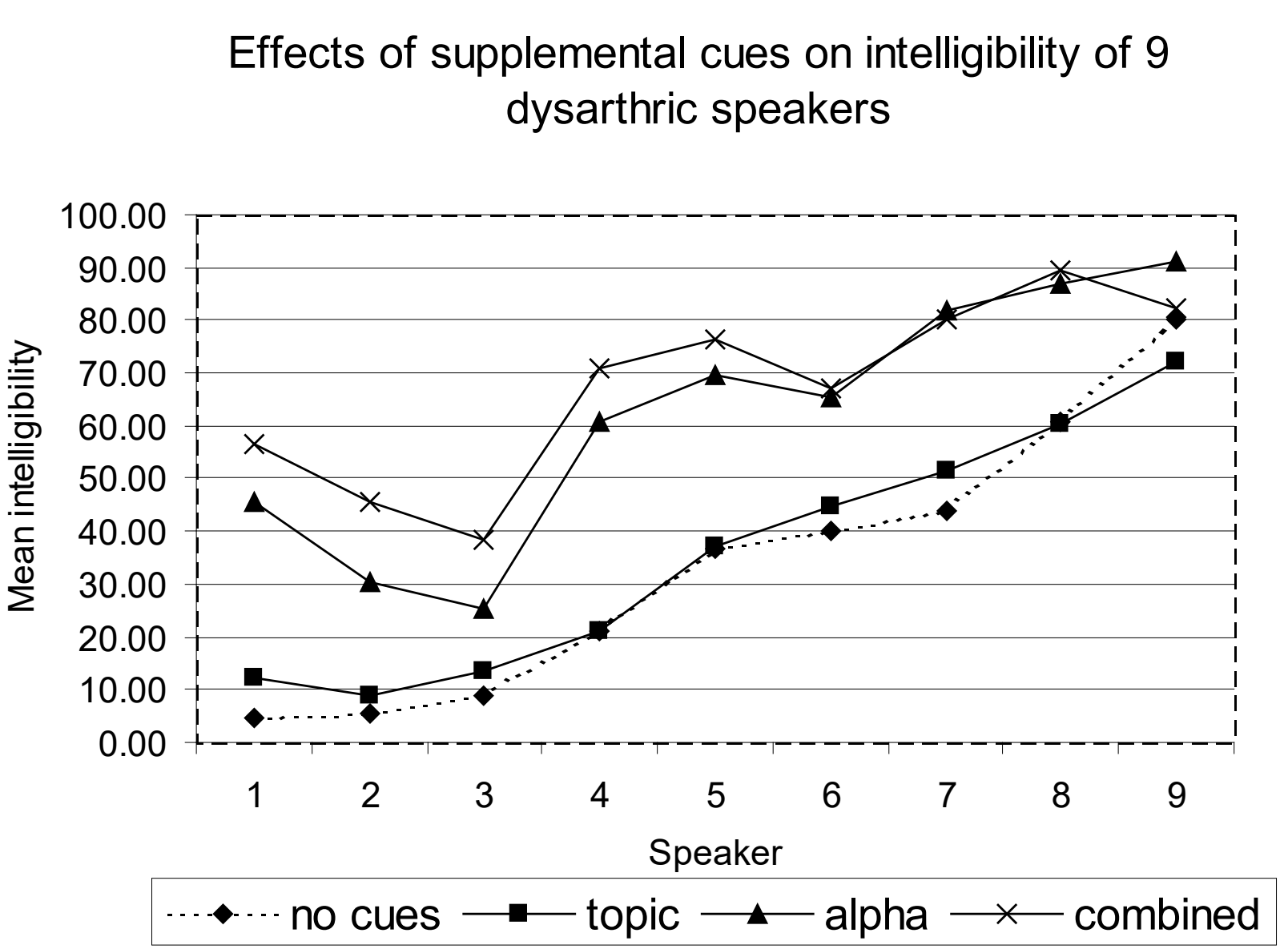


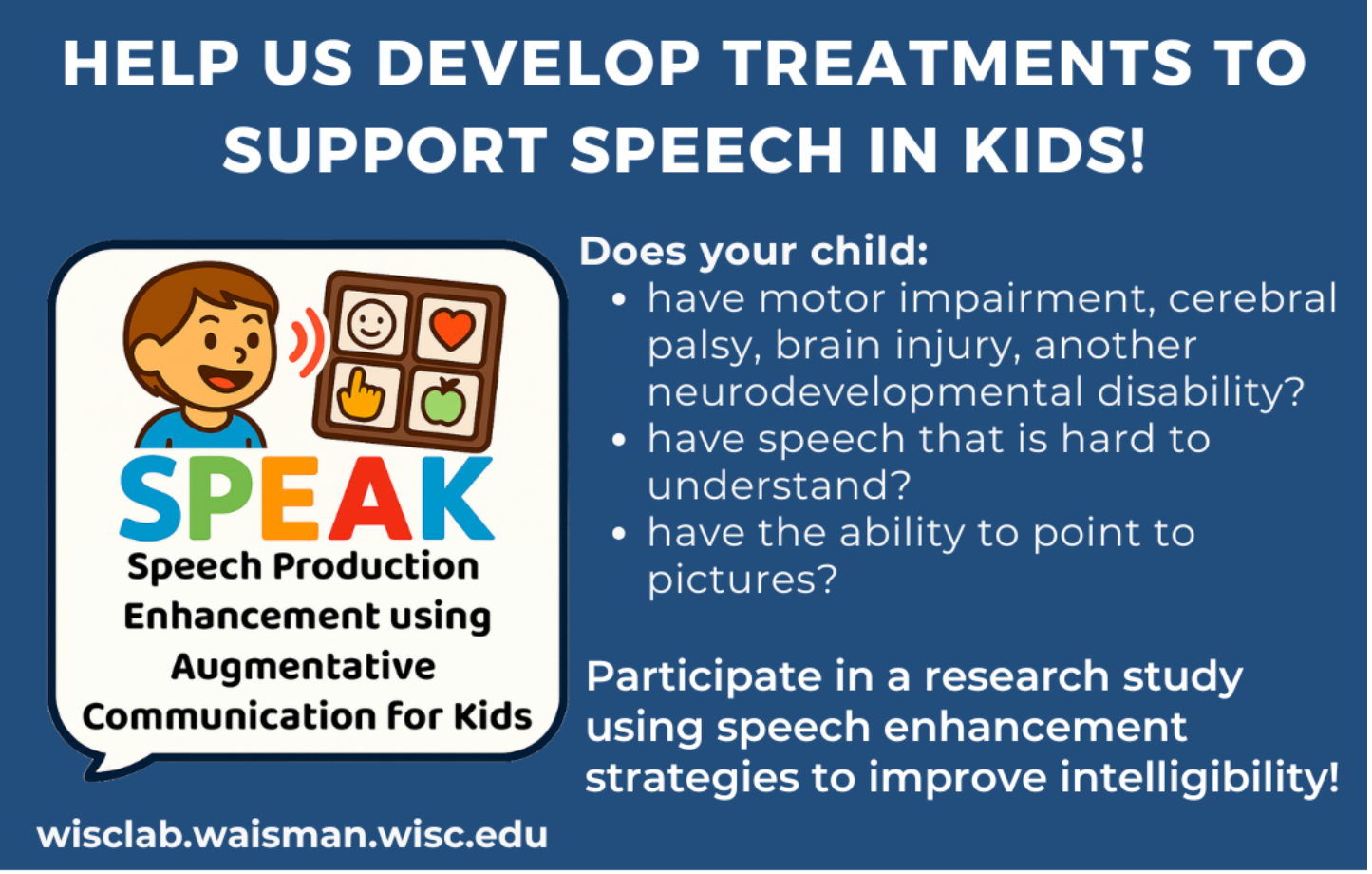


Pacing boards

Supplemental strategies …

Clues & context	• Provide extra sources of contextual information to listeners
Shared knowledge	• Capitalize on multiple sources of shared information in a difficult listening situation
Content info	• Enhance listener content knowledge to help understand speech
Modify speech	• Reduce speech rate, improve word boundaries


Effects of supplemental cues on intelligibility of 9 dysarthric speakers
Mean intelligibility
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1
2
3
4
5
6
7
8
9
Speaker
no cues
topic
alpha
combined



- Treatment study using speech supplementation
  - Topic cues
  - Alphabet cues
  - Rate reduction

- Looking for kids 7-17 years who:
  - Have motor impairment and motor dx (CP, TBI, rare genetic conditions, etc.)
  - Have dysarthria or articulation problems and reduced intelligibility
  - Are able to produce 3 word utterances using speech– can be severely unintelligible.
  - Are able to point with hands

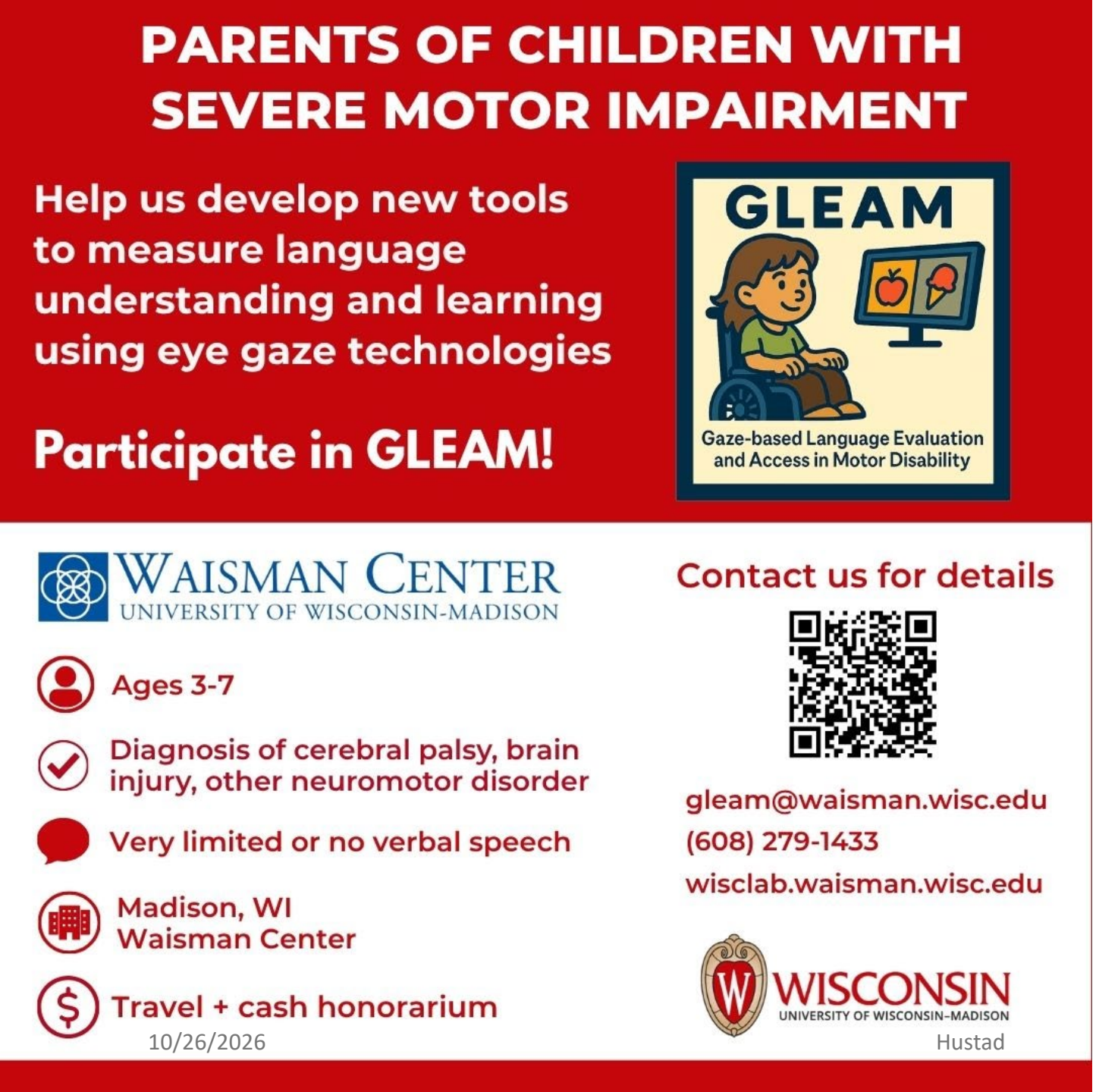
- 2-visits to Waisman Center (both visits can occur in the same day)

- Receive payment for travel + honorarium of $100 for participating

- Hotel stay covered if more than 30 miles away.

- Receive a complete report from the session, including assessment results and speech supplementation suggestions.

Funded by NIH grant R01DC009411



- Assessment study using eye gaze to examine language comprehension and learning
- Ages 3-6 years with severe motor impairment
- Looking for early communicators who:
  - may not be intentional
  - have very limited movement
  - may have intellectual disability
  - No child's abilities are "too low" or "too high" for this study.
- 2-visits to Waisman Center (both visits can occur in the same day)
- Receive payment for travel + honorarium of $50 for participating
- Hotel stay covered if more than 30 miles away.
- Receive a complete report from the session, including assessment results and speech supplementation suggestions.

Take Home Message



Speech and AAC are not mutually exclusive options



AAC can play several important roles, depending on contextual communication needs.



speech supplementation strategies can dramatically improve intelligibility.

Collaborators & Current and Former Trainees

- Tristan Mahr
- Paul Rathouz
- Jennifer Soriano
- Heather Mabie
- Amy Cochran
- Rob Olson
- Carly Sandgren
- Helen Long
- Sydney Jensen
- Marianne Elmquist
- Emily Wang
- Heather Salvo
- Alexandrea White
- John Munday
- Lucas Annear
- Henry Nomeland
- Megan Baranek
- Carrie Arneson
- Kristen Allison
- Phoebe Natzke
- Ashley Sakash
- Michael Molinaro
- Aimee Broman
- Malachi Henry





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NIDCD
Improving the lives of people who have communication disorders

Eunice Kennedy Shriver NICHD
National Institute of Child Health & Human Development

THANK YOU!

Contact me if you have questions.



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