Preschool Biomarker for Predicting Literacy Skills

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PICO

Question: Among 3- and 4-year-old children who have not yet learned to read, does the presence of impaired neural processing of consonants in the presence of background noise predict early and later reading difficulty?

Question type: Diagnosis

Study design: Prospective cohort

Investigators from Northwestern University in Illinois developed and evaluated a biomarker, the precision of neural coding of spoken consonants in the presence of background noise, as a method to identify individuals with poor literacy skills and predict literacy problems in pre-reading children. The biomarker was based on neural synchrony – consistent and uniform neural population discharges in response to certain crucial phonemic features of speech even in the presence of background noise – assessed by measuring frequency following response, a scalp recorded auditory evoked potential. Scalp electrodes recorded neurophysiologic responses over a 30-minute period in study children while they watched a video that presented the children with consonant sounds in the presence of background noise.

An iterative process was used to develop and evaluate a biomarker of literacy skills. In an initial study a "consonants-in-noise score" was developed by using features from the neurophysiologic response data collected on 4-year-old children, which were then included in a regression model and associated with measures of phonological processing in the children. This developed score was then validated as a marker of preliteracy skills in a group of 3-year-old children. One year later, early literacy was assessed in a subgroup of children from these initial 2 studies. A composite reading score and scores for sight word reading and spelling were measured and compared to the baseline consonants-in-noise score. Finally, consonants-in-noise scores were measured in 8- to 14-year-old children and compared to several standardized scores of reading competence.

Early literacy skills were compared to baseline consonants-in-noise scores in 34 preschool children. The baseline consonant-in-noise score was statistically correlated with each of the 3 literacy skills scores assessed, with *P* values ranging from .004 to .015. Similarly, among 55 children 8-14 years old, consonant-in-noise scores were statistically associated with 6 measures of reading competency.

The authors conclude that the neural coding of speech in noise may be an objective biomarker in preschool children that predicts future reading problems.

Commentary by

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Dr Millichap has disclosed no financial relationship relevant to this commentary. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

Dyslexia or delayed literacy is defined as a specific learning disability, neurobiological in origin, characterized by difficulties with accurate and/or fluent word recognition and by poor spelling abilities, despite normal cognitive abilities and effective classroom instruction.[1] Of the recognized theories of the mechanism of developmental dyslexia, the phonological theory is most often accepted. This theory postulates that dyslexic individuals have a specific impairment in the representation, storage, and/or retrieval of speech sounds. The origin of the disorder is a congenital dysfunction of the left hemisphere perisylvian brain areas underlying phonological representations. Connecting between phonological and orthographic representations and learning the grapheme-phoneme correspondence are disturbed.[2,3]

The results of the current study suggest that the neural coding of speech in the presence of background noise plays a role in language development. Children having difficulty listening in noisy environments may struggle to understand the meaning of the language they hear daily, placing them at risk for delayed literacy. Neural coding of speech in noise provides an objective neurophysiological marker for these at-risk children, and alerts educators to the need for early specific interventions that may prevent delayed literacy.

Editors' Note

Third grade reading proficiency is one of the strongest predictors of high school graduation rates. This work informs neurobiologic theories fundamental to literacy. Perhaps more importantly, it suggests that a 30-minute test reliably identifies those children who will struggle with reading over a lifetime, before they are even old enough to read.

References

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