

Low Socioeconomic Status Linked to Impaired Auditory Processing

By Nina Kraus, PhD, & Samira Anderson, AuD, PhD

Children raised in homes with lower-income and less-educated parents are at an auditory disadvantage compared with children who come from more privileged circumstances.

This gap begins early—children from low socioeconomic status (SES) backgrounds add 30 percent fewer words to their vocabulary between the ages of 18 and 24 months compared with children from high SES backgrounds (*Dev Sci* 2013; 16[2]:234-248). Even at 18 months, high SES children have faster processing speeds on receptive language processing tasks than low SES children (*Dev Sci* 2013;16[2]:234-248).

Reading achievement is also closely related to family socioeconomic status, especially at the time of kindergarten intake assessment, but community factors also influence learning rates over time (*J Educ Psychol* 2008;100[2]:235-251). The reduced language input and decreased exposure to socially and intellectually stimulating experiences that are associated with low socioeconomic status underlie the relationships of SES with reading and language.

Socioeconomic status may also be a factor in the development of auditory processing skills. For example, in higher SES children, cortical evoked responses to unattended stories are smaller than responses to attended stories, but these attended-unattended differences aren't seen in lower SES children (*Int J Psychophysiol* 2015;95[2]:156-166). Therefore, attentional effects may be a factor in impaired auditory processing in lower SES children.

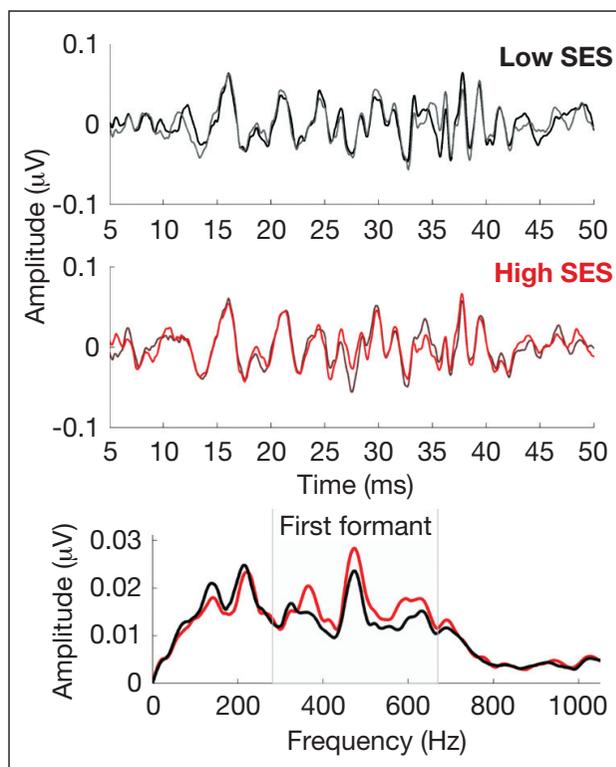
“Low socioeconomic status appears to affect neural mechanisms important for developing literacy skills.”

SOCIOECONOMICS OF SPEECH PROCESSING

Until recently, little was known about the effects of low socioeconomic status on subcortical speech processing. Nina Kraus's Auditory Neuroscience Laboratory at Northwestern



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Top panels: The children from low socioeconomic status (SES) backgrounds have less consistent auditory brainstem response results when their average responses for the first (black) and last half (gray) of the recordings are compared with the first (red) and last half (gray) responses in the high SES children. **Bottom panel:** High SES children have larger spectral amplitudes than low SES children in the region corresponding to the first formant of the speech syllable. (Adapted with permission from *J Neurosci* 2013; 33[44]:17221-17231.)

University conducted a study to examine differences in subcortical processing among adolescent children attending the same schools who were matched for age, sex, and ethnicity but differed in socioeconomic status, defined by maternal education level (*J Neurosci* 2013;33[44]:17221-17231).

Brainstem responses to a 40-ms speech syllable [da], otherwise known as complex auditory brainstem responses (cABRs), were recorded for these children, who were also tested on a number of reading measures.

In addition to lower literacy levels, the low SES children had reduced intertrial response consistency and smaller

HEARING MATTERS

spectral amplitudes in their cABRs. In addition, they had higher neural noise levels in the regions of the response where no stimulus was being presented.

These results are significant because the noted brainstem speech encoding differences between low and high SES adolescents are similar to the differences previously found between poor and good readers. Compared with poor readers, good readers have higher spectral amplitudes in the brainstem response region corresponding to the first formant speech frequencies of the syllable (*Cereb Cortex* 2009;19[11]:2699-2707) and increased response consistency (*J Neurosci* 2013;33[8]:3500-3504). Therefore, a low SES background appears to affect neural mechanisms important for developing literacy skills.

MIND THE GAP

The mission of the Bridging the Word Gap initiative is to examine the disparities in early language and vocabulary skills between children from high and low SES backgrounds and to consider solutions.

Given that children from low SES backgrounds are also likely to have impaired auditory processing, it is important for those concerned with these disparities to consider including the evaluation and management of auditory processing and related skills in their efforts.

Audiologists often see young children who were referred because of language delays, but the typical audiologic exam is limited to assessment of peripheral hearing function. The cABR testing described in this article only takes 20 minutes to administer and would, therefore, be a feasible addition to an audiological protocol.

“Complex auditory brainstem response testing only takes 20 minutes to administer and would, therefore, be a feasible addition to an audiological protocol.”

We hope to eventually see more widespread use of objective measures such as the complex auditory brainstem response in evaluations of children who come from low socioeconomic status backgrounds or have suspected language-based learning impairments. 

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