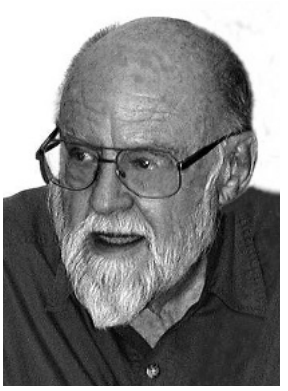
Editorial

Electrophysiological versus Behavioral Responses



Historically, audiologists have relied on behavioral measures to assess differences between groups and to decide whether an individual lies outside the normal limits. From the pure-tone audiogram, through speech audiometry, to temporal gap detection, we instruct the child or adult to listen carefully and respond appropriately by pointing to a picture, pressing a button, raising a finger, or repeating a word. These behavioral responses have been the framework and foundation of the quantitative evaluative process.

For some years, however, audiologists who work with infants and small children have recognized that electroacoustic and electrophysiological measures provide invaluable complementary information about auditory status in this often difficult-to-test group. Tympanograms, acoustic reflexes, otoacoustic emissions, and auditory brainstem responses are now the cornerstones of pediatric evaluation. It is important to remember, however, that this evolution did not occur quickly or easily. The transition from total reliance on behavioral measures to heavy reliance on electroacoustic and electrophysiological measures took place over two decades, a time period during which the value of these new tools had to be demonstrated over and over to doubting traditionalists.

In the case of older children and adults, however, audiologists continue to rely, almost exclusively, on behavioral measures. Electroacoustic and especially electrophysiological tools remain in the wings, waiting to be widely exploited. Many audiologists do not yet seem convinced that they will add substantially to the information gathered by conventional behavioral techniques.

In this issue of *JAAA*, however, authors David McPherson of Brigham Young University and Mimi Salamat of Washington State University show that auditory event-related potentials (ERPs), recorded from scalp electrodes, can actually be more sensitive than comparable behavioral indices in differentiating adults with attention deficit disorder from normal listeners. In a continuous performance task employing a simple oddball paradigm, and three intersignal intervals (ISIs), listeners were instructed to respond to the frequent event (1, 1.5, or 2 kHz tone burst) but not to the rare event (250 Hz tone burst). Participants were 20 normal adult controls and 11 adults who had been diagnosed with attention deficit hyperactivity disorder (ADHD).

Results were instructive. Among behavioral measures (reaction time, hit rate, false alarm rate), only the false alarm rate (button press to the rare stimulus) differentiated the two groups at the 5% confidence level. Neither hit rates (button push to the frequent stimuli) nor reaction times reached significance. In the case of the electrophysiological measures, however, both the amplitude and latency of late positive components (P300a and P300b) differentiated the two groups more effectively. Examination of the hit rate data across the three ISIs (their table 1) reveals that the difference between group means was always less than one standard deviation (SD) of either group. Similarly, examination of the false alarm data, the only behavioral measures significantly differentiating the two groups, reveals that the

Table 1. Ratio of Mean Difference to Standard Deviation of Normal Group

Measure	M_d / SD_{ng}
Reaction Time	0.50
Hit Rate	0.19
False Alarm Rate	1.23
P300a Latency	3.87
P300a Amplitude	1.45
P300b Latency	3.96
P300b Amplitude	1.87

difference between group means, across ISIs, was only slightly more than one SD of the normal group. In dramatic contrast, however, the electrophysiological data (their table 2) show that, in the case of ISI interval 1 (one stimulus per second) the mean difference between the two groups, across amplitudes and latencies for both P300a and P300b, exceeded the SD of the normal group by a factor of 1.45 to 3.96. The exact values for this measure (difference between group means divided by standard deviation of normal group; M_d/SD_{ng}) are tabulated in Table 1 above.

It is clear from these values that, for the 1 sec ISI, the electrophysiological measures did a better job of differentiating the two groups, as quantified by the ratio of the mean group difference to the standard deviation of the normal group.

Can we use electrophysiological measures like these to separate children with auditory processing disorder (APD) from normal children more effectively? Robert Jirsa of Southern Connecticut State University suggested this possibility some years ago. Perhaps it is time to take a closer look.

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