Short-Term Habituation of the Infant Auditory Evoked Response *

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In adults, the amplitude of the auditory evoked response (AER) at the vertex decreases as a negative exponential function of the number of stimulus presentations; it decreases faster, the faster the stimulus presentation rate, and recovers spontaneously when stimuli are withheld (Fruhstorfer, Soveri, and Jarvilehto, 1970). The decrease in AER amplitude reaches asymptote by the third to fifth presentation of a stimulus in a train (Ritter, Vaughn, and Costa, 1968; Fruhstorfer et al., 1970). Fruhstorfer (1971) has argued that the observed short-term reduction in AER amplitude over the first three to five presentations of a stimulus in a train is an instance of habituation (Thompson and Spencer, 1966).

In infants, habituation to stimuli in the auditory modality has been difficult to demonstrate (Jeffrey and Cohen, in press). The present study used a short-term habituation paradigm similar to that of Fruhstorfer et al. (1970) to investigate the effects of repeated stimulus presentation on the amplitude of the infant vertex AER. At the same time, the study served to establish an efficient methodology for collecting reliable AERs from awake infants.

METHOD

Subjects. A total of nine infants completed all of the conditions of the study. Artifact-free AERs were obtained from six (five male, one female) of the infants. All of these Ss were between 10 and 14 weeks old.

Apparatus. Recording of the electroencephalogram (EEG) was made from the scalp using a single silver-disk electrode located at the vertex (Jasper, 1958) which was referenced to the right earlobe. Electrodes were attached to the

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scalp by styrofoam adhesive pads and an elastic headband. Electrode impedance was less than 6K Ohms.

The EEG signals were transmitted by telemetry (Narco FM-1100-E3) to an AC preamplifier (W-P Instruments DAM 6) and an oscilloscope amplifier (Tektronic RM 502A) which also served as a monitor. The frequency response curve after amplification was flat, between 2.0 Hz and 30 Hz. The amplified EEG was stored on tape for later analysis using a Vetter FM-3 Recording Adapter and Sony 355 tape deck.

The extraction of the evoked response from the EEG was carried out on- and off-line by a computer of average transients (Fabri-Tek 1072). The sweep duration was 1 sec. The averaging cycle of the computer was triggered by a pulse from the second channel of the stimulus presentation tape. The onsets of the cuing pulses and the synthetic speech sounds were simultaneous. The AER records were written out on an X-Y plotter (Hewlett-Packard 7035b).

**Stimuli.** The stimuli used in this study were trains of the stop consonant-vowel syllable [ba]. The duration of the syllable was 250 msec; the rise time, 25 msec; the intensity, 65 db SPL. The stimuli were generated on the Haskins Laboratories computer-controlled speech synthesizer (Mattingly, 1968).

**Design and procedure.** During a session, fifteen trains of four stimuli were presented at a rate of 1 train/30 sec from an AR 4-X loudspeaker placed two feet in front of the Ss.1 The repetition rate of the stimuli was 1 stimulus/2 sec.

The Ss were held in their mother's lap and were either bottle or breast fed during the test session. The mothers were instructed to hold the infants as quietly as possible and not to move the infant's bottle during presentation of the stimuli.

**Analysis of the AERs.** The amplitude of the N1-P2 response was determined from the X-Y plots by measuring the difference in millimeters between the maximum peak of negativity between 75 and 150 msec after stimulus onset (N1) and the maximum peak of positivity between 175 and 275 msec (P2). The responses to each member of the stimulus train were averaged separately. Ten good responses (i.e., those with no movement artifacts) were accumulated for each average.

**RESULTS**

The amplitude of the N1-P2 response as a function of the position of the stimulus in the train is shown in Figure 1. The amplitudes of the second, third, and fourth stimuli in the train are expressed as a percentage of the first stimulus amplitude. The mean amplitudes of the second, third, and fourth stimuli in the train were 36.0%, 41.0%, and 21.7% of the first stimulus amplitude. All amplitude reductions were significantly different from the first stimulus amplitude (p<0.01) using a rank sum test.

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1The stimuli were never presented when an infant was active or fussing. Thus, on a number of trials for all Ss, an intertrain interval of greater than 30 sec was used.
Figure 1: The amplitude of the N1-P2 response as a function of the position of the stimulus in the train, expressed as a percentage of the first response. ISI 2 sec refers to a 2-sec interstimulus interval; IBI 30 sec refers to a 30-sec interblock interval.
DISCUSSION

Little difficulty was encountered in collecting artifact-free AERs from the awake infants. As long as the infants were brought into the laboratory hungry and were fed during the recording session, artifacts due to infant movement were nil. The use of FM telemetry rather than long cables to convey the EEG data to the recording apparatus also helped minimize movement artifacts.

The N1-P2 amplitude of the vertex AER in the awake infants decreased rapidly as a function of the repeated presentation of the syllable [ba] in a stimulus train. The magnitude and time course of the decrease in N1-P2 amplitude of the infant AER is consistent with the findings of both Ritter et al. (1968) and Fruhstorfer et al. (1970) on the short-term habituation of the adult AER. However, because of the differences in the interstimulus and intertrain intervals between the present study and the previously cited studies with adults, the rates of habituation of the infant and adult AERs cannot be directly compared.

When the stimulus train was withheld during the 30-sec intertrain interval, the N1-P2 amplitude recovered spontaneously. This was evidenced in the absolute N1-P2 amplitude to the first and fourth members of the stimulus train. Thus, the decrease in the amplitude of the N1-P2 components of the infant AER in response to the repeated presentation of the syllable [ba] satisfies two of the characteristics of short-term AER habituation (Fruhstorfer, 1971).

In adults, a habituated AER to the syllable [ba] can be at least partially dishabituated by the presentation of a novel syllable [pa] (Dorman, in preparation). The results of the present study suggest that the AER could serve as a useful dependent variable in studying the perceptual abilities of awake infants.

REFERENCES