Dyslexia and Developmental Dysphasia; a Deficit in Processing Rapid Spectral Changes?

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1. Introduction

P. Tallal and coworkers have found that a group of developmental dysphasics suffer from a deficit in processing rapid spectral changes in the case of the formant transitions of stop-/a/-syllables, whereas synthetic 'stop'-/a/-syllables with unnaturally lengthened formant transitions with a duration of 82 ms were more readily discriminated than syllables with transitions of 30 ms (for review see Tallal and Piercy 1978). The same results were reported for dyslexics (Tallal 1980). In the framework of a German Research Council project on speech pathology we planned to develop a diagnostic test by exploiting this effect with a variety of phonetically controlled stimuli. As we failed to reproduce this effect in preliminary, rather simple discrimination tasks with manipulated naturally produced material and with synthetic material where normal and dyslexic subjects rather showed a tendency to react worse in the case of lengthened transitions, we devised a new testing procedure in order to be able to get a closer view of the resulting effects.

2. Stimuli and Procedure

Our stimuli consisted of two seven-step continua between /abam/ and /adam/ with 40 ms or 70 ms CV-transitions (cf. Fig. 1), synthesized with a program based on Klatt (1980). The critical CV-syllable was embedded in the context /a - m/ to control e.g. speech rate effects.

Formally our procedure resembles a paradigm that has been applied in experiments with young children (Wilson, 1978). A series of background stimuli is presented with a critical target stimulus randomly embedded. The subject has to react on the occurrence of the target stimulus. The background stimulus is one of the endpoints of an acoustically defined continuum, as originally used in categorical perception experiments, and the target is moved from the other endpoint of the continuum in the direction of the background. The discrimination threshold is determined by the target stimuli that produce no reactions. We wrote a computer program to run the following test. The subjects had to react by pressing a button on the occurrence of a target stimulus which was one in a sequence of five stimulus presentations. The normal interstimulus interval was 750 ms, the pause

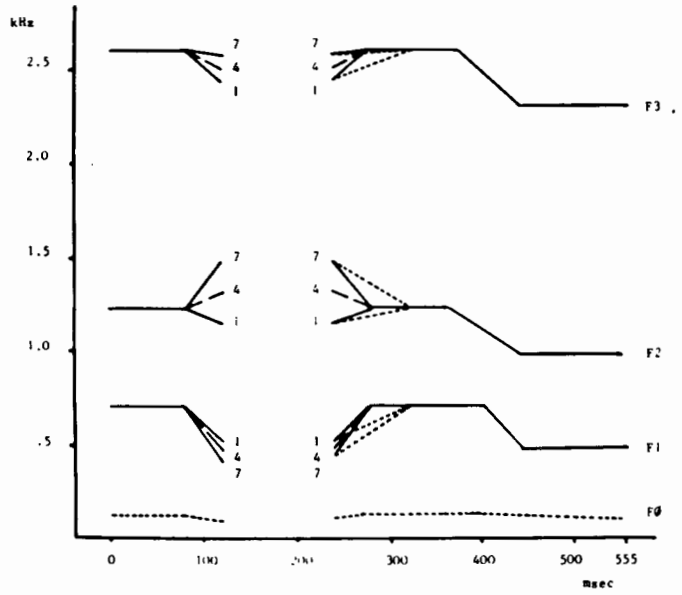

Fig. 1. Schematic sonagrams of the endpoint (and midpoint) stimuli used (1: /abam/, 2: /adam/; unbroken line: 40 ms transitions, dotted line: 70 ms transitions).

between the sequences 4 s. The first part of the experiment was the training phase in which the subject had to learn to discriminate the endpoint target from the complementary background. To indicate the target stimulus additionally a small lamp within the button was switched on and every correct answer was rewarded by playing a short melody. When in the second phase (without supplementary signals) the subject had reacted on the occurrence of the target stimulus three times consecutively, the actual test was started. Now, after a correct response, the target moved one step in the continuum towards the background. As soon as there was a missing reaction the target was moved backwards two steps, and so on. After five missing reactions the test was finished. Besides the discrimination treshold, the reaction times were also automatically measured. This testing was done through the two continua in both directions. The category boundary is defined by the midpoint between the two resulting thresholds (cf. Fig. 2). Eleven developmental dysphasics and eight dyslexics all aged between seven to thirteen took part in the experiments.

3. Results and discussion

The results are shown in Table I. In accordance with the results of our preliminary tests we can see a tendency towards worse discrimination in the test with lengthened CV-transitions by the group of dyslexics as shown by a small gap between the thresholds (in contrast to a small overlap in the other

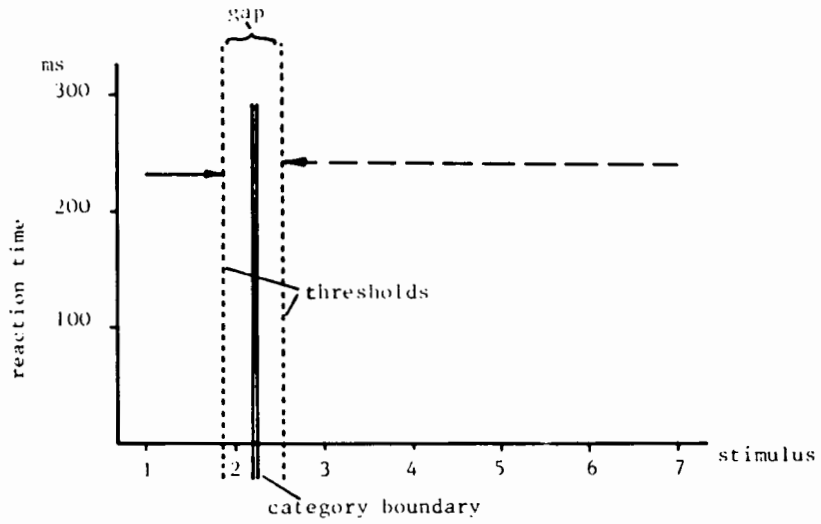

Fig. 2. Schematic representation of the measurements taken; → test with stimulus 7 as background, —→ test with stimulus 1 as background.

Table I. Results of the discrimination threshold test

	Development dysphasics		Dyslexics	
	short transitions	long	short transitions	long
Boundary	3.24	2.9	3.23	3.15
Gap	1.62	1.04	−0.15	0.75
Reaction time	254	365	216	231

test) and also reflected in the reaction time. There is no clear picture for the group of developmental dysphasics. Statistical analysis of the results revealed that there were no significant differences between the tests with short vs long transitions for either group with respect to reaction time, phoneme boundary and gap or overlap at the thresholds (partly due to the great inter- and intrapersonal variability in the responses). Nor were there any significant group differences with respect to phoneme boundary and gap or overlap in either test. Reaction times also showed no significant group differences in the test with short CV-transitions. However, contrary to the predictions of the Tallal hypothesis in the long transition continuum the developmental dysphasics were significantly slower than the dyslexics. We therefore conclude that the possible perceptual deficit in developmental dysphasics is not as simple as proposed by P. Tallal and coworkers.

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