

CHILDREN'S PERCEPTION OF WORDS WITH LOCAL DISTORTION

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ABSTRACT

Two abilities of children-listener (4-6 aging) was studied: 1-recognition of words with one of the syllable replaced with noise and 2-detection of words with one consonants segment replaced with noise. The procedure of reaction on target stimulus presented among the consequence of contexts words was designed using IBM PC. In the recognition paradigm reaction time (RT) was largest and were made less errors for words with 1-st replaced syllable. RT for „pure“ words and words with last syllable replaced did not differ significantly. During the task of detection of distortion no effect of place of the segment distorted was observed. In both paradigms effect of child's age on RT and number of correct responses was revealed. It is proposed 4-5 years old children use on line „up-down“ strategy for word recognition, and this tasks carry out in parallel with detection of non-speech noise in words. This abilities both are developed with age of children.

1. INTRODUCTION

Normal speech communication process includes inevitably the perception not only clear speech but also speech distorted by a noise of different nature. The ability to recognize of noised speech (words) was showed [3] to be developed with age when children grow from 4 to 5-6 years old, and is connected with the general maturity.

The noised conditions are not only interfering factor of speech communication, but it also can helps to study of speech perception process. In two experiments the peculiarities of word perception by 4-5 years old children in different noised conditions were studied. The two questions have to be cleared: 1 - on what part of words do the children pay attention in the lexical processing? 2 - if detection of distortions in words is connected with lexical decision or they are independent?

2. METHOD

2.1. Subjects

The participants were 26 children (10 boys and 16 girls from 4,2 to 5,11 years of age) and 16 adults (4 men and 12 women from 22 to 41 years of age) as a control group. The subjects were native Russian speakers with no problems in hearing and speech.

2.2. Stimuli

All test words were three-syllable ones (mean duration 750 ms) and familiar for the children. The words spoken by a man were recorded through a microphone straight in the computer in

digital form, using A/D, D/A converter (20 kHz sampling frequency, 12 Bit of level). The device developed on the base of the IBM PC and provided with hardware and software advanced for working with speech signals [1] was used to make the test stimuli. Two types of distorted stimuli were made: 1) words with one syllable (1-st, 2-nd or 3-rd) replaced by noise with same level as replaced segment, 2) words with one phoneme (fricative or stop consonants in initial or middle position, stressed or unstressed vowel of second syllable in a word) replaced by white noise with the same level as replaced segment. White noise was used as a distortion and a level of signal was valued by max of amplitude.

2.3. Procedure

Two series of the experiments were carried out. In the first one words with one of the syllables replaced by white noise were used as the distorted stimuli, in the second one stimuli were the words with one phoneme replaced by noise. In all experiments different distorted and „pure“ words were followed randomly with constant inter-stimuli interval 1200 ms (time between the end of previous word and the beginning of the following one).

In the Experiment 1 child was asked to answer when he (she) has listened to determined (target) word independently „pure“ or distorted it was. Four words were used as the targets:

„*Shokolad*“ (chocolate),
"Chemodan" (suitcase),
"Pechenje" (biscuits),
"Popugaj" (parrot).

The 4 series with different target words in every one (60 stimuli-words were included in every series) were carried out. In Experiment 2 child was asked to react when he has listened to any distorted word. There were 3 series in this Experiment 2 (48 stimuli-words in every series). Words with all kinds of distortion (phoneme, position) were included in every series. Duration of one series in all experiments was near 2 min. The stimuli were presented to subjects through two loudspeakers at comfortable loudness level using PC IBM, and the children had to react pushing on the button of the "mouse". The testing was individual and was conducted during some sessions. The nature of the stimuli had been explained beforehand. The children were told that they would hear the words some of which would sound "correct", „good“ and others - "incorrect" or "distorted“. The training session was made before testing. When the subject understood the task and his responses were found to be not chance, the main test began.

2.4. Analysis of the data

The number of correct responses and RT - reaction time (from the beginning of stimulus) were estimated. The significance of different factors was carried out by multivariate analysis of variance (MANOVA).

3. RESULTS AND DISCUSSION

3.1. Experiment 1

The data for the Experiment 1 are shown in the Table 1. For this task the factor of word distortion was significant for correct responses ($F=17,33$ (3,96) and for reaction time ($F=12,62$ (3,96). The largest reaction time was for words with 1-st replaced syllable. The factor of localization of replaced syllable was significant ($F=6,64$ (3,99). However, the children recognized more exactly words with 1-st replaced syllable. It shows that children made decision about word on the base of recognition of two last syllables that provided the more correct answer.

The reaction time was significantly larger for 4 years old children than for older ones ($F=4,06$ (3,96)). In control study adults revealed 100% recognition score for such stimuli and the significant factor of localization of replaced syllable for reaction time ($F=11,49$ (4,02). There were two kinds of errors in both groups of children in this experiment as in previous one. The main kind of errors was missing of target words. Some children had also other kind of error: they reacted on words with similar initial syllable as in target word. It proves again the special role of initial part of word for its recognition.

Stimuli	Reactions	4 years old children	5 years old children	Adults
„pure“	correct response	91 %	88 %	100 %
words	reaction time, ms	1,06	0,91	0,69
1-st syllable	correct response	81 %	82 %	100 %
replaced by noise	reaction time, ms	1,31	1,25	0,84
2-nd syllable	correct response	68 %	74 %	100 %
replaced by noise	reaction time, ms	1,28	1,08	0,73
3-rd syllable	correct response	79 %	76 %	100 %
replaced by noise	reaction time, ms	1,05	0,99	0,69

Table 1. Percent of correct responses and reaction time for recognition of target word with one syllable replaced by noise for 5 years old children and adults.

Experiment 2

More large differences in reaction time between 4 and 5 years old children were found for the task of detection of distorted words among sequence of „pure“ words (see Table .2). Moreover, near 30 % of 4 years old children couldn't perform this test at all because they couldn't understand the task.. The 4 years old children who could perform the task had high score of

correct responses which didn't differ from older children. However, 4 years old children did it more slowly ($F=11,84$ (3,96).

		4 years old children	5 years old children
initial consonant	correct responses	81 %	82 %
replaced by noise	reaction time	1,39 ms	1,18 ms
middle consonant	correct responses	87 %	91 %
replaced by noise	reaction time	1,51 ms	1,08 ms
unstressed vowel	correct responses	76 %	88 %
replaced by noise	reaction time	1,41 ms	1,19 ms
stressed vowel	correct responses	81 %	86 %
replaced by noise	reaction time	1,69 ms	1,21 ms

Table 2. Percent of correct responses and reaction time for detection of distortion in word for 4 and 5 years old children.

There were no significant effect of position and characteristics of replaced phoneme on responses in both children's groups in this paradigm. This result is different from our previous data [2]. In that study children were asked to repeat the word with phoneme replaced by noise, detect distortion and name distorted phoneme (letter). It was shown 5-6 years old children had more correct detection for replaced phoneme with acoustical characteristics similar to noise. There was some phoneme's position effect also. Presumably the effect of acoustical characteristics and position of missing phoneme in word is revealed only in task which demands linguistic analysis. In recent paradigm children didn't need to recognize word to detect the distortion in word.

Perhaps, they processed the noised distortion in words as separate and independent stream and ignored the linguistic analysis of word. It may to suppose that 4 years old children who couldn't perform this task in fact couldn't ignore the linguistic processing of words and process non-speech stream of noise by parallel way.

4. CONCLUSION

The study of recognition of noised words and words with one syllable replaced by noise proves that 4-5 years old children use on-line „top-down“ lexical processing as it proposed for adult speech perception [4]. The initial part of word plays special role in this process. At the same time children recognized distorted words less effectively and more slowly than adults. The younger children (4 years old) answer with larger time delay and make less correct responses than 5 years old ones in different tasks of distorted words perception. But they dramatically differ from 5 years old children in the task of detection of distorted words among sequence of „pure“ words: 30 % of 4 years old children couldn't perform this test at all because they couldn't

understand the task.. Presumably, the detection of distortion in word is a result of special perceptual process different from recognition and is less automatic. This processing could be organized by parallel way with lexical analysis and demands the additional attention.

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