SIMPLE AND DIFFERENTIAL REACTIONS TIMES IN CHILDREN WITH HEARING SENSE DISORDERS WHO GROW UP AND DEVELOP IN VARIOUS ENVIRONMENTAL CONDITIONS

by

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The goal of the research was finding the answer to the following questions:
- What is the development of psychomotor efficacy features in hypo acustic children in comparison with the properly hearing ones?
- Is there any difference in the psychomotor efficacy between the children from the Educational Centre for Deaf Children and the children from the integrated school, the evaluation was based on:
- rate and accuracy of the reaction to the visual stimuli,
- correctness and rate of the choice complex reaction,
- Is there any difference in the development of the psychomotor efficacy depending on the age and sex of the examined children?

The research included 163 children aged 7-15. They were pupils from 3 schools of Wroclaw: The Education Centre for Deaf Children - group I (72 children); Special School for Hypo acoustic Children -group II (47 children) ; Primary School - Group III (44 people) representing the control group.Children from groups I and II shared the same school building and some of the classes were joined.

The level of hypoacousis varied from 50 dB to 100 dB in the children from special schools.

The research proved that psychomotor efficacy of the hypo acoustic children was generally worse in comparison with the properly hearing children. However, it was found out that it largely depended on the environment which the children were staying and learning.The children from Integrated School (group II) reached better results than those from The Education Centre for Deaf Children (group I). In all groups , the level of psychomotor efficacy depended on the age of the examined children. However, no clear relation was found between psychomotor efficacy level and the sex of the children.

Key words: disable children, reaction time, environmental differentiation

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Introduction

Motor development is a process the features of which undergo gradual differentiation from simple to more and more complex. The process is strictly directed and is ruled by defined laws. In reference with children and teenagers, the notion ` psychomotor development` is used very often as motor development is strictly connected with the overall cognitive process as well as with emotional state. (Galkowski et al. 1976, Spinek 1965) In all children, particular features sequences apply to the same pattern but their dynamics is differentiated and changing. Individual differences of the development pattern originate from the differences in nervous passages myelinization variations.(Paulo et al. 1978) Normal development can be disturbed by inborn effects of nervous system or sense organs as well as acquired diseases which affect the structure and function of other organs.The example of such disturbances can be partial or total deafness. Efficacy of the hearing organ largely influences general development of the child. Due to it , a number of integration processes can be preserved in the central nervous system. It forms the basis of the abstract thinking and gives background of internal speaking.However, deafness does not determine significantly physical development or motor efficacy. Maximal effects reaching takes longer in that case. Apart from individual qualities, living and environmental conditions play an important function. (Wolanski 1979, Maszczak 1975, Matwijko 1984)

Definition of a real psychomotor development of a child contributes towards his physical and psychical development as well as it allows disturbances of this process some anomalies and pathologies. (Bogdanowicz 1968)

Material and methods

The studies goal was assessment of reaction times in children with hearing sense disorders depending on age and development in various living and environmental conditions. The examined children came from two special schools:

- The Education Centre for Deaf Children in which the children stayed for the whole of the day,
- the integration school which they shared with normally hearing children

The control group was made of normally hearing children living with their families. The examinations were carried on 163 children aged 7 – 15. The children were divided into three groups:

I.pupils from The Education Centre for Deaf Children (72 pupils)

II.pupils from Special School for Hypo acoustic Children (47 pupils)

III.pupils from the Primary School (44 persons)

Children from groups I and II shared the same school building and some classes were organised together.

The material was divided into four subgroups in accordance with age:

A- pupils from levels I and II (group I - 15 pupils ; II -9 pupils; III - 9 pupils)

B- pupils from levels III and IV (group I - 20 pupils ; II - 14 pupils; III -12 pupils)

C- pupils from levels V and VI (group I -19 pupils; II - 7 pupils; III - 9 pupils)

D- pupils from levels VII and VIII (group I - 18 pupils; II - 17 pupils; III - 14 pupils).

All the children were in good psychical condition at the day of the examination and they willingly approached all the orders and exercises. No child revealed any abnormalities or deviations from the normal cognitive function.

Reaction times meter MRK - 80 was used in the examinations. They were carried on in the morning hours (8 a.m. - 1 p.m.).

The conditions enabled measurements at proper light and isolation from noise which was very important in the case of the control group.

The examinations consisted of two trials:

1. definition of the time of simple reaction to visual stimulus,
2. definition of differential reaction time.

The examination was carried on both eyes seeing in the direction enabling optimal visual perception. Child's task consisted on pressing the reaction button at the moment of perceiving light stimulus. In the case of simple reaction, 30 red light signals were emitted with irregular intervals within 110 seconds. After the test, total reaction time as well as average answer time and the number of errors were deciphered. During differential reaction test, 30 light signals (20 red and 10 green) were emitted at irregular intervals during 120 seconds. The task

was pressing the button at the moment of red light appearance and suppressing the reaction to the green one. (red - positive stimulus, green - negative stimulus). The sequence of positive and negative stimuli was irregular. In differential reaction test the following values were assessed : correct answers total number (max. 20), errors total number (reaction to green light or lack of reaction to red light) as well as differential reaction average time.

Shapiro-Wilk test was used for statistical analysis of the results at the significance level $\alpha = 0,05$, arithmetic averages were found and standard deviation from each variable. In order to estimate differences significance, t-Student test was used for non correlated groups (results horizontal analysis). analogous test was used for finding differences significance between subgroups of each group (vertical analysis). Significance level was accepted as $\alpha = 0,05$. Variables, the distribution of which was not normal (e.g. wrong reactions), were compared with the usage of non parameter test using zero hypothesis (variables do not differ one from another).

Results and discussion

Definition of real differences in reaction to stimuli was very important for the researches. In order to make it more objective, similar conditions of the experiment were established in all the tested schools. acquired results can be treated as coming from individual features of the examined persons as well as other internal factors. (Ritzke 1975, Woodworth et. al. 1966)

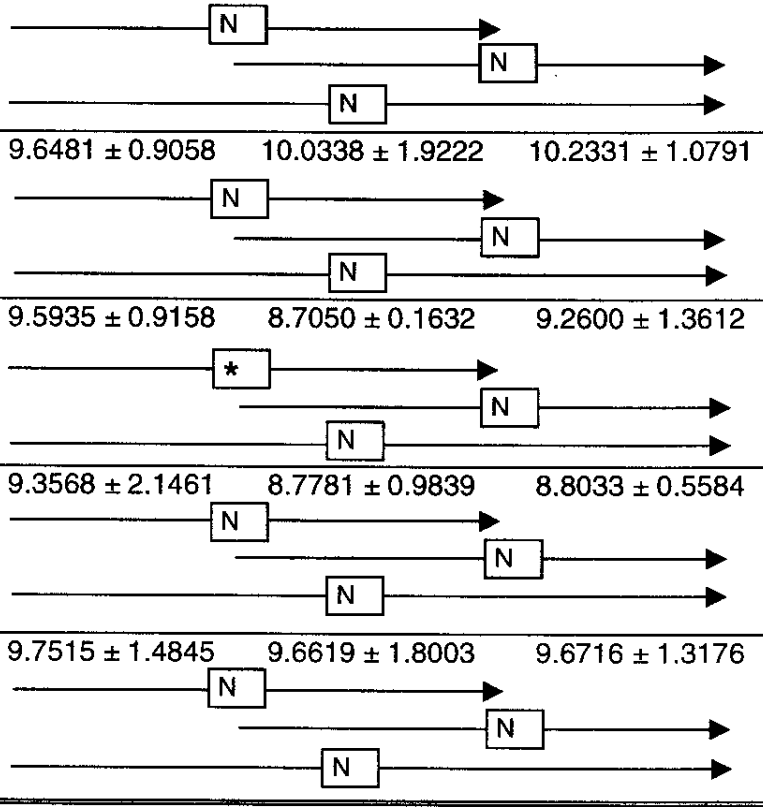
Time of simple reaction to visual stimulus.

Results statistical analysis proved that integration school pupils as well as control group pupils acquired very similar results which were slightly better than the ones gained by the children from the Education Centre. The average simple reaction time in the case of visual stimulus was from 9,6716 +\- 1,3176 msec (control group pupils) up to 9,7515 +\- 1,4848 msec (Education Centre pupils).(Tab. 1, Fig. 1)[1]

[1] * - statistically significant difference
N - statistically insignificant difference

Table 1. Comparison of average time values for simple reaction to light stimulus in examined subgroups.

SRT	I	II	III
A	10.783 ± 1,5024	11.5425 ± 2.0373	10.6733 ± 1.5526
B	9.6481 ± 0.9058	10.0338 ± 1.9222	10.2331 ± 1.0791
C	9.5935 ± 0.9158	8.7050 ± 0.1632	9.2600 ± 1.3612
D	9.3568 ± 2.1461	8.7781 ± 0.9839	8.8033 ± 0.5584
Total:	9.7515 ± 1.4845	9.6619 ± 1.8003	9.6716 ± 1.3176



SRT – Simple reaction time
I – Pupils from Educational Centre for Deaf Children
II – Pupils from Special School for Hypoacoustic Children
III – Pupils with normal sense of hearing
A, B, C, D – Age subgroups

Kelly et al. (1993) reached better results for children with hearing sense disorder. Besides, shortening of reaction times which depended on age was observed. For each group, average time values were established. Average values varied from 10,6733 +\- 1,5526 msec (control group were youngest children) to 8,7781 +\- 0,9839 msec (integration school oldest children).

Significant statistical differences were observed between C subgroups of groups I and II. (Tab. 1).

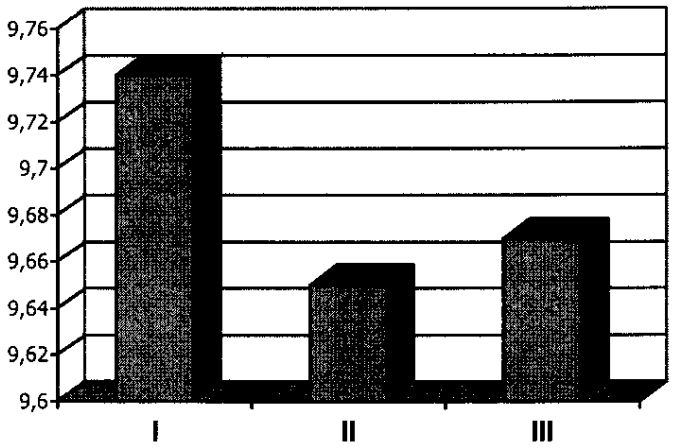


Figure 1. Comparison of simple reaction time means values to the light stimuli in the examined groups

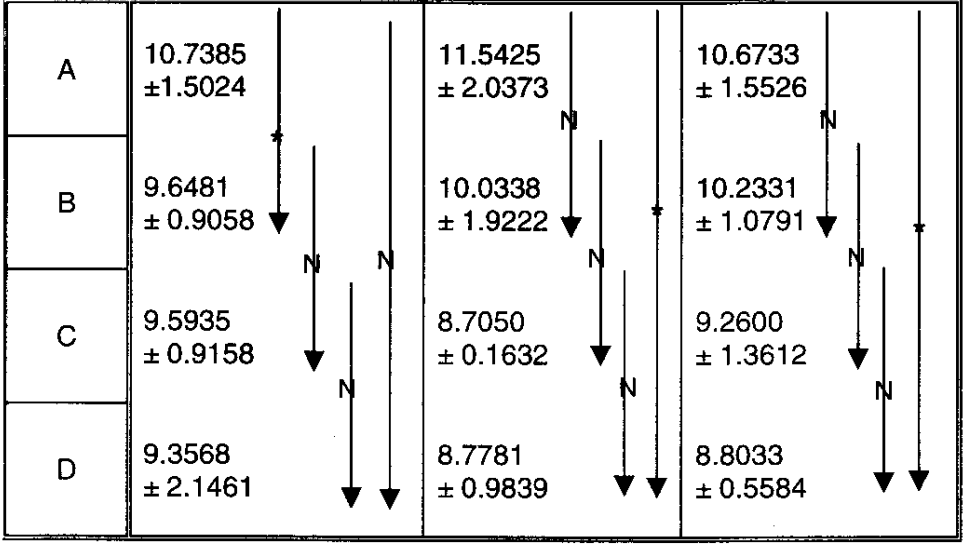
Differences refereed to reaction average times and they were observed between particular age subgroups. However, statistical significant results referred to the subgroups of the youngest children in group I as well as the youngest and the oldest children from groups II and III. (Tab.2)

Similar observations were made by Atwell and Elbel (Geblewiczowa 1961).They proved gradual and stable increase of reaction speed up to 17th year of living which was the age upper limit of the examined persons. Gorynski and Kuczynska obtained slightly different results (Gorynski et al. 1977) They observed reaction time drop up to the age of 11. after this moment , the changes diminished gradually. Speed of reaction to stimuli is a developmental feature of specific development dynamics.

The biggest difference between reaction times averages for the youngest and the oldest children was observed in the group of pupils from the integration school. Analogous value for their friends from Education Centre turned out to be the smallest. (Tab. 2)

Table 2. Comparison of average time values for simple reaction to light stimulus in examined age subgroups.

SRT	I	II	III
A	10.7385 ±1.5024	11.5425 ± 2.0373	10.6733 ± 1.5526
B	9.6481 ± 0.9058	10.0338 ± 1.9222	10.2331 ± 1.0791
C	9.5935 ± 0.9158	8.7050 ± 0.1632	9.2600 ± 1.3612
D	9.3568 ± 2.1461	8.7781 ± 0.9839	8.8033 ± 0.5584



These children committed the smallest number of mistakes which can prove better concentration during the test, however, in accordance with the references, concentration disturbances appear more often in children with hearing sense disorders than in children with proper hearing (Matwijko 1984). Lack of reaction to stimulus or pressing the button before the light signal appeared were regarded as the mistake. At changing intervals between stimuli, the examined person may react too early and than the proper stimulus meets the period of psychological refraction (Analew et al. 1977, Arnold 1993, Kupietz et al. 1976, Surwillo et al. 1976) which causes elongation of the time of proper stimulus reaction. Such rhythm disturbances can be caused by attention fluctuation which can be also observed in evoked potentials changes (Haider 1967). It was observed that if a person gets ready to react on the basis of the information brought by the last stimulus, EEG examination records expectation potential besides lacking stimulus. (Haider 1967) That is why not only sensomotor reaction speed but also reaction accuracy are so indispensable.

Analysis of boys and girls results revealed that boys reacted to the light signals quicker. The biggest difference , insignificant however, between average reaction times of boys and girls appeared in integration school

children.Control group children showed twice as small difference between boys and girls. The results coming from the tests performed in the Education Centre were similar.(Tab.3)

Table 3. Comparison of average time values for simple reaction in boys and girls.

SRT	I	II	III
G	9.7214± 0.9441	10.1135 ± 1.9181	9.9067 ± 1.4532
B	9.7714 ± 1.7632	9.3665 ± 1.6915	9.5148 ± 1.2221

G – girls
B – boys

Similar data were obtained by Wala (Wala 1985) on examinations of deaf teenagers. In the proper hearing population, better results are also obtained by boys and men. (Geblewicz et al. 1960, Geblewiczowa 1961, Henry 1960, Hodgins 1963, Paulo et al. 1978, Stwarz 1984, Woodworth et al. 1966) It was found out that female sex is characteristic for accuracy of reaction rather than its rapidity (sensor attitude). Male sex, in turn, reveals motor attitude which tends to the fastest results even with bigger number of mistakes. (Gorynski et al. 1977, Paulo et. al. 1978).

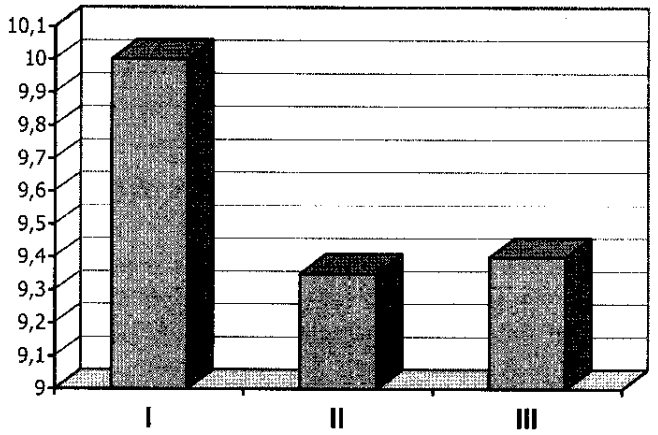
Differential reaction time.

Stimuli differentiation is connected with stimulation and suppression processes which take place in cerebral cortex. One of the methods enabling following these processes are the studies of conscious reaction formation in so called differential trials. (Humes et al. 1984, Sutylo et al. 1965). Differential reaction time measurement was another trial of the examinations. It should be remembered that obtained results were influenced by the two opposite factors:

e positive one - practise, and the negative one - concentration drop. fferential reaction was much more difficult for the examined persons than the mple one. The examined person dealt with uncertainty connected with the nd and time of the stimulus appearance. Each signal underwent the processes differentiation and classification which gave basis for the answer in the case a positive stimulus (red light) or no answer in the case of a negative stimulus reen light).

Compound process of stimuli differentiation can indicate central processes nctioning (Bulenda 1993, Kosiłowa et al. 1977, Ratajczak 1974). Motor act -ordination with visual stimuli influences the accuracy of particular vement performance. Kinestetics and movement analyser plays an important le in eye-movement co-ordination (Spinek 1965).

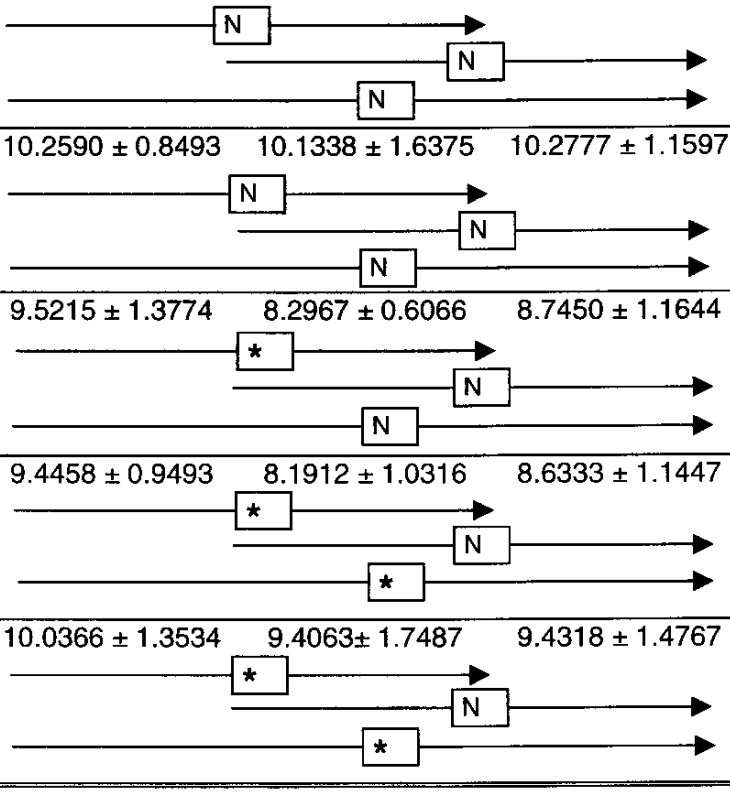
Similarly to the simple reaction test, in this part of the experiment, the best sults were obtained by integration school children. The average time for amined groups was 9,4063 +\- 1,7487msec (for integration school children) to 10,0366 +\- 1,3534 (for Education Centre pupils). Statistically significant fferences occurred in Education Centre children between (group I) and other oups (group II and III).Statistically significant differences referred to the sults obtained by the pupils of the two oldest subgroups of groups I and II ab.4, Fig.2).



igure 2. Comparison of differentiation reaction times mean values in the examined group

Table 4. Comparison of average time values for differential reaction in examined subgroups.

DRT	I	II	III
A	11.3331 ± 1.5957	11.4862 ± 0.9222	10.1511 ± 1.7564
B	10.2590 ± 0.8493	10.1338 ± 1.6375	10.2777 ± 1.1597
C	9.5215 ± 1.3774	8.2967 ± 0.6066	8.7450 ± 1.1644
D	9.4458 ± 0.9493	8.1912 ± 1.0316	8.6333 ± 1.1447
Total:	10.0366 ± 1.3534	9.4063± 1.7487	9.4318 ± 1.4767

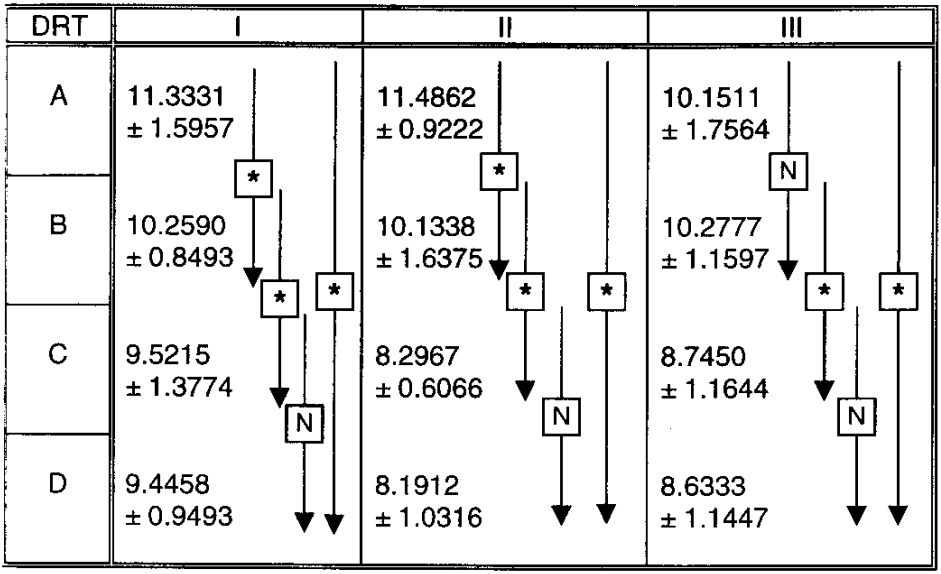


DRT – differential reaction time

Reaction time was found to be dependent on the age of examined persons. The longest reaction times were characteristic for integration school children (11,4862 +\- 0,9222msec) and also the best results were obtained by the pupils of this school (8.1912 +\- 1,0316msec, the oldest subgroup).

Statistically significant differences between subgroups A and B, B and C were revealed by results analysis. This referred also to A and D of groups I and II as well as subgroups B and C, C and D of control group.(Tab.5)

Table 5. Comparison of average time values for differential reaction in examined age subgroups.



Reaction times shortening along with age referred to the children of all examined schools, however, its dynamics was differentiated. The most significant difference of reaction average times between the oldest and the youngest children was observed in integration school children. The best results were obtained by these children in age groups 9 - 15.Only the youngest children had the worst time. The pupils of the youngest groups of Education Centre reacted to the stimuli slightly quicker than the children of the same age i the control group. However, the results of the children aged 11 - 15 were the worst (Tab.5)

A number of other authors detected similar correspondence between the age and the reaction time (Analew et al. 1977, Borkowska Gaertig 1976, Fairweather et al. 1978, Geblewiczowa 1963, Keating et al. 1978, Kosilowa et al. 1977, Pietraszkiewicz et al.1989, Surwillo et al. 1976, Szopa et al. 1987).

Boys` results turned to be better than girls results and the difference was more significant in integration school children (girls 9,6000 +\- 1,5193 msek) than in Education centre children (girls 10,1490 +\- 1,11849 msec, boys 9,9624 +\- 1,4623 msec. They were also comparable with control group results. No difference, however, was statistically significant (Tab. 6)

Table 6. Comparison of average time values for differential reaction in boys and girls.

DRT	I	II	III
G	10.1490 ± 1.1849	9.6000 ± 2.0867	9.6261 ± 1.2335
B	9.9625 ± 1.4623	9.2796 ± 1.5193	9.3022 ± 1.6285

In accordance with the references, (Geblewicz et. al. 1977, Pietraszkiewicz et. al. 1989), girls react more slowly than boys but during the tests they make less mistakes.These examinations proved this statement as well. Boys made more mistakes than the girls from the same groups. The task was done absolutely correctly by 16% of boys and 17% of girls from education Centre (group I), 8%of boys and18% of girls from integration school (group II) and 7%of boys and 6% of girls from control group (group III) The biggest number of mistakes was done by 4% of boys and 3% of girls from group I, 8%of boys and 6% of girls from group II and 4% of boys and 17% of girls from group III.

The children from Educational Centre for Deaf Children as well as those from the integration school were characteristic for more sensor attitude than their friends from the control group. The highest percentage of these groups children made only one mistake (Tab.7).

Table 7. Comparison of errors number in differential reaction in boys and girls.

Errors No	GROUP I (%)		GROUP II (%)		GROUP III (%)	
	G	B	G	B	G	B
0	17	16	18	8	6	7
1	32	39	34	26	22	22
2	14	2	12	19	38	22
3	24	20	12	15	17	22
4	10	9	12	12	17	19
5	3	5	6	4	-	-
6	-	2	6	4	-	4
7	-	2	-	-	-	-
8	-	-	-	4	-	-
9	-	-	-	8	-	-
11	-	5	-	-	-	4

Results comments and conclusions.

1. Hypoacoustic children psychomotor efficacy is generally worse than that of normally hearing children and it is clearly dependant on the environment of living and learning.
2. Psychomotor efficacy of hypo acoustic children assessed in terms of speed and accuracy of reaction to eye stimuli and correctness of choice in compound reaction was better in integration school children than in children from Educational Centre.
3. In all examined groups, psychomotor efficacy level depended on age and this tendency was especially visible in integration school children.
4. No examined group revealed any clear connection between psychomotor efficacy and sex.

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