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Holistic brain mechanism in preschool children with weakness in grammar understanding

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Abstract

The goal of this research was to examine the hypothesis that weakness in brain holistic mechanism may explain the problem in grammar understanding in preschool children. 323 Russian-speaking children aged between 5 years 11 months and 6 years 10 months participated in the study. The children were assessed with the task "Comprehension of grammatical structures" from Luria's neuropsychological assessment battery that was adapted for preschool children. The experimental (grammatical weakness) and control group (grammatical strength) were formed. The Rey-Osterieth Complex Figure test was used to assess the holistic abilities in children. We have revealed that majority of children with poor grammar understanding had a piecemeal (immature) strategy when copying the Rey-Osterieth Complex Figure. The received result can be explained by the assumption that preschool children with poor grammar understanding have deficit of the specific brain mechanism responsible for holistic synthesis.

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Keywords: specific languge imparment; holistic mechanism; Rey-Osterieth Complex Figure

1. Introduction

The weakness in grammar understanding is one of the specific language impairments in children (SLI). SLI is diagnosed in children who fail to develop normal language, and in whom this failure cannot be explained by poor

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speech articulation, hearing loss, evident neurological deficit or pervasive developmental disorder [1]. The use of the term “specific” implies that the areas of deficit are directly and exclusively related to language processes. However, over recent years there have been emerging suggestions of the presence of non-linguistic cognitive difficulties in children with SLI, including problems with working memory [2], motor skills [3], attention [4], visual imagery [5], analogical reasoning [6], and perceptual deficits [7]. The extent to which these non-linguistic impairments can explain language impairments in SLI children is a matter of some controversy in current psycholinguistic research [8].

Russian neuropsychologist Alexander Luria proposed the non-linguistic cognitive mechanism that can explain the deficit in grammar understanding [9]. It is plausible that understanding a sentence requires not only the retention of its elements, but their simultaneous (holistic) synthesis into a single, logical scheme. A.Luria argued that there is a particular cerebral mechanism that possibly plays a role when the grammatical codes - case relations, prepositions, word order, and so forth - are decisive in determining how the words of the sentence combine to give its overall meaning, in understanding those constructions where identical words in different relationships receive different values. Thus, it is possible that SLI children have deficits in a specific cerebral mechanism responsible for holistic synthesis. The goal of this research was to examine this hypothesis by assessing Russian-speaking children who have weakness in understanding grammatical structures.

2. Method

2.1. Participants

A total of 323 Russian-speaking children aged between 5 years 11 months and 6 years 10 months participated in the study. Children were recruited from 10 kindergartens in Yekaterinburg (Ural). All children in this study had no medical impairments according to their medical certificates. Children with suspected or known developmental or medical disorders that might affect task performance were excluded from participation.

2.2. Procedure

The children were assessed with the task "Comprehension of grammatical structures" from Luria's neuropsychological assessment battery that was adapted for preschool children [10]. The First part of this task was designed to assess comprehension of reversible passive sentences. For example, child was showed simultaneously two pictures. In one picture a truck is transported by a tractor and in another picture a tractor is transported by a truck. The examiner asked the child to show picture where the truck is transported by the tractor. We used 9 pair of pictures with reversible passive sentences. The Second part of the task was designed to assess comprehension of sentences with prepositions that indicate the spatial relations between objects. For example, child was shown simultaneously two pictures. In one picture the barrel is in the box and in another picture the box is in the barrel. The examiner asked the child to show the picture where the barrel is in the box. We used 4 pairs of such pictures that included prepositions "in", "on", "behind", "in front of". The maximum score of task "Comprehension of grammatical structures" is 13 points.

The children were included in the subgroup with weakness in comprehension of grammatical structures (GW-children) if they made 50% or more errors on this task. There were 94 children with such weakness (29.1%). The children were included in the subgroup with strength in comprehension of grammatical structures (GS-children) if they made less than 25% errors. There were 87 children with such strength (26.93%).

The experimental (GW-children) and control group (GS-children) were formed using the following exclusion criteria. Children with weakness in comprehension of grammatical structures were excluded from experimental group if they had articulatory dyspraxia or phonological disorder and if their performance IQ was 85 or below. Control group included children with strength in comprehension of grammatical structures. Children from the