ORIGINAL ARTICLE

UDC: 159.922.76-056.49
DOI: https://doi.org/10.2298/VSP191004025P

Recognition of emotions and affective attitudes in children with attention-deficit hyperactivity disorder

Prepoznavanje emocija i afektivnih stavova kod dece sa poremećajem pažnje i hiperaktivnošću

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Abstract

Background/Aim. Children with attention-deficit hyperactivity disorder (ADHD) show lower degree of recognition of their own emotions and greater behavioral difficulties than children who do not have this disorder. This also affects the recognition of other people's emotions that are expressed not only by their language content, but also by their facial expression and the way they express the emotional message through speech. Most research in this area focuses on recognizing emotions based on facial expressions rather than on emotions in speech. The aim of this study was to examine how children with ADHD recognize emotions in speech (joy, anger, fear, sadness) and affective attitudes (threat and commandment) in relation to children of typical development. **Methods.** The study included 31 children with ADHD and 29 typical developmental children aged 6 to 13. To assess the ability to recognize emotions and affective attitudes, a corpus of Speech Emotional Expression and Attitudes (*Govorna emocionalna ekspresija i stavovi* – GEES, in Serbian) was used. This corpus included sentences that expressed emotions of anger, joy, fear, and sadness, and of affective attitudes, threat and command. **Results.** The results obtained showed that children with ADHD had worse recognition of emotions and affective attitudes in speech than children of typical development ($t = 8.81$; $p = 0.000$). Joy was the only emotion where no statistically significant difference was found. In all other emotions and affective attitudes, statistically significant differences were found ($p < 0.01$). Also, the results showed that there was a statistically significant association between age and recognition of emotion and affective attitudes in both groups, but this association was more pronounced in children of typical development. **Conclusion.** The results of this study provided important clues about the perception of emotions and affective attitudes in speech in children with ADHD. These results are very important for the conception of therapeutic procedures, especially in the development of strategies for modeling the behavior of children with ADHD.

Key words:
affective symptoms; attention deficit disorder with hyperactivity; emotions; speech.

Apstrakt

Uvod/Cilj. Deca sa poremećajem pažnje i hiperaktivnošću (ADHD) pokazuju slabije prepoznavanje sopstvenih emocija i veće ispoljavanje teškoća u ponašanju od dece koja nemaju tu smetnju. Samim tim je pogođeno i prepoznavanje tuđih emocija koje se ispoljavaju ne samo jezičkim sadržajem već i izrazom lica i načinom izražavanja emotivne poruke govorom. Cilj ovog istraživanja je bio da se ispita kako deca sa ADHD prepoznaju emocije u govoru (radost, ljutnju, strah, tugu) i afektivne stavove (pretnju i zapovest) u odnosu na decu sa tipičnim razvojem. Većina istraživanja iz ove oblasti fokusirana je na prepoznavanje emocija na osnovu izraza lica, a ne na osnovu emocija u govoru. **Metode.** Istraživanje je obuhvatilo 31 dete sa ADHD i 29 dece sa tipičnim razvojem uzrasta od 6 do 13 godina. Za procenu sposobnosti prepoznavanja emocija i afektivnih stavova korišćen je korpus za procenu Govorne emocionalne ekspresije i stavova (GEES). U tom korpusu su bile rečenice koje su izražavale emocije ljutnje, radosti, straha i tuge, a od afektivnih stavova pretnju i zapovest. **Rezultati.** Deca sa ADHD imala su lošije prepoznavanje emocija i afektivnih stavova u govoru u odnosu na decu sa tipičnim razvojem ($t = 8.81$; $p = 0.000$). Radost je bila jedina emocija gde nije utvrđena statistički značajna razlika. Za druge emocije i afektivne stavove utvrđene su statistički značajne razlike ($p < 0.01$). Utvrđena je statistički značajna povezanost između uzrasta i prepoznavanja emocija i afektivnih stavova u obe grupe, ali je ta povezanost bila izraženija kod dece sa tipičnim razvojem. **Zaključak.** Rezultati istraživanja su dali važne pokazatelje o percepciji emocija i afektivnih stavova u go-

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voru kod dece sa ADHD. Ovi rezultati su veoma bitni za osmišljavanje terapijskih procedura, posebno u razvoju strategija za modeliranje ponašanja dece sa ADHD.

Ključne reči:
afektivni simptomi; hiperkinetički sindrom; emocije; govor.

Introduction

Attention deficit hyperactivity disorder (ADHD) is diagnosed in childhood or adolescence and is characterized by three groups of persistent symptoms: hyperactivity, attention deficit and impulsiveness [1]. In addition, children with ADHD can have a number of comorbid externalizing and internalizing psychiatric conditions such as anger, aggression, behavioral disorders, delaying responsibilities, anxiety, depression, guilt [2]. ADHD affects optimal children's development, their self-esteem, weakens social contacts with parents and teachers [3, 4], but it also affects the occurrence of school skills difficulties and academic failure [5, 6]. Worldwide prevalence of ADHD ranges from 5% to 7% [7, 8]. The high prevalence of this disorder has attracted a great deal of attention from researchers and clinicians trying to understand the causes and mechanisms leading to the onset of characteristic symptoms of ADHD, as well as finding the best therapy for it. ADHD is believed to be a neurobehavioral developmental disorder but its pathophysiology has not been fully known yet. So far, the investigated causes of ADHD can be classified into two categories: environmental and molecular-genetic. In the category of environmental causes, those arising from obstetric complications [9], fetal or infantile exposure to various agents [10], as well as the conditions in which children grow and develop, have been studied [11–13]. Molecular genetic causes have been extensively investigated in the field of dopamine transmission [14], or catecholaminergic dysregulation [15].

Studies conducted in recent years show that children with ADHD have specific social deficits such as: poor recognition of role-playing behaviors, inflexibility in responses, inability to modify their own behavior in response to changes in environmental demands, and unconscious subtle, but very important social cues [16–18]. Research findings up till now have suggested that impaired social skills and present behavioral problems in children and adolescents with ADHD are not fully explained by additional comorbidities or secondary consequences in the form of executive function deficits [19–21]. A number of authors believe that answers related to social skills disorders and behavior in children and adolescents with ADHD can be found in understanding possible deficits in emotion recognition. Studying the emotional competence of children with ADHD can be an important complement to these children's social skills research. In order for children to engage in appropriate social interactions, they must be able to recognize and make judgments about the emotions of others. The ability to interpret and respond appropriately to the emotions of others is crucial for interpersonal interactions. Evidence to support this finding can be found in studies of the social functioning of children with autism and their poor recognition and processing of emotions [22]. Based on this, it can be assumed that in children with ADHD, there is an association between poor social skills and difficulties in recognizing emotions.

Research to date has shown that children with ADHD show poorer results in recognizing facial emotions than the typical population [17, 23, 24]. For these children, tasks that required the interpretation of emotional cues from face photos were difficult and they made more mistakes solving those tasks than the typical population [25]. Also, it was difficult for children and adolescents with ADHD to reconcile the primary emotion face expression with the emotional message of the story read to them [26]. There is evidence that children with ADHD were less successful in recognizing their own emotions [27].

It is important to note that most of the research performed so far has been examining the recognition of facial emotions and contextual cues in children with ADHD. The general impression is that there is no research related to recognizing emotions in the voice. Through research done on typical developmental children, it has been concluded that the emotional properties of vocal cues can influence the infant's focus on objects and the exploratory behavior of the world [28–30]. Typical developmental children have been shown to be able to accurately classify prosody as joy or sadness at a very young age [31]. A survey of typical developmental children aged 5 to 10 has shown that children as young as five are able to easily and accurately recognize and interpret a range of emotional cues from the voice [32]. Also, this research has shown that there is improvement in results with advancing age. There is a very interesting study comparing the recognition of emotions on the basis of visual (facial expressions), auditory (speech) and audio-visual (facial expressions and speech) modalities of information transmission. Children between the ages of 5 and 18 were exposed to: only auditory, only visual or audio-visual modalities of parent-child communication. For younger children (up to 8), the auditory canal was more important than the visual. Older children, on the other hand, relied more on visual cues [33].

In their interactions with others, children, just like adults, need to interpret a wide range of social signals to understand the intentions and feelings of others. The ability to distinguish social signals is thought to develop very early, as early as about the fifth month of life. Babies at that age are able to respond to approvals and bans [34], even when spoken in an unfamiliar language [35]. These discriminations can be made on the basis of differences in lower cognitive stimulus classes, such as Fo's height, while connecting auditory cues to social circumstances and events require more sophisticated cognitive abilities [36]. These findings highlight the im-

portance of auditory modality in recognizing emotion in speech as an important component of understanding social communicative context.

One of the reasons for performing our study was the small number of studies that dealt with examining the abilities of children with ADHD as well as of the typical population children to understand and recognize the emotional forms of spoken expression. Based on the evidence that this form of obtaining information about the emotional background of spoken expression plays an important role in children's behavior and directing attention to important components of the environment, it can be assumed that children with ADHD have altered patterns of processing emotions in speech relative to the typical population. This was the starting point of this research.

The aim of the study was to evaluate the ability to recognize emotions and affective orders in speech, and to examine whether there were differences in their recognition in children with ADHD compared to the typical population children. It has been hypothesized that children with ADHD perform worse in recognizing emotions and affective speech orders than the typical population children, and that there is a difference in the ability to recognize different types of emotions and affective speech orders in this population of children.

Methods

The research was approved by the Academic Council and Ethics Committee of the Faculty of Special Education and Rehabilitation, University of Belgrade, Serbia and the consent was also signed by the parents of children who participated in this research. All participants were examined individually in the Speech Therapy Cabinet "Plećević" in Belgrade, Serbia. Speech and language status of children was assessed by the Speech and Language Test Battery of the Institute for Experimental Phonetics and Speech Pathology in Belgrade, Serbia which is standardly used in the Serbian speaking language. The diagnosis of ADHD was made at the Institute of Mental Health by competent neurologists and psychiatrists and the children sent for rehabilitation to the Speech Therapy Cabinet "Plećević". Based on the received medical records, information was obtained on the type and severity of the disorder present, and this institution followed the protocol recommended by the American Pediatric Academy [1]. The protocol includes: detailed medical history, general and neurological medical examination, parent-child interview, Swanson, Nolan and Pelham Teacher and Parent Rating Scale (SNAP IV scale), child observation, psychological tests for measuring intelligence quotient (IQ) as well as social and emotional adaptability tests and neuropsychological tests for diagnosing specific learning disorders. At the time of testing, children with ADHD did not use pharmacotherapy, and the rehabilitation program they attended included metacognitive strategies, psychomotor reeducation, neurofeedback training, and sports and recreational therapy.

The criteria for determining whether children would be included in the sample of this study were as follows: children had no other disorders or disorders, no other neurological or psychiatric illnesses, did not use pharmacological therapy, all children on the Raven matrices had scores above 80 and all children on the SNAP IV scale had over 70% expression of combined type ADHD symptoms. The experimental group was selected from the population of children who, due to ADHD, were included in the rehabilitation program of the Speech Therapy Cabinet "Plećević". The control group also met the above criteria (except those related to the severity of ADHD) and was selected from a population of children who attended regular schools and were never included in defectology or speech therapy programs.

Assessment of emotion recognition and affective attitudes was performed using the Speech Emotional Expression and Attitude Assessment Corps (Govorna ekspresija emocija i stavova − GEES) [37], which was accepted by the Institute for Experimental Phonetics and Speech Pathology and the Center for the Advancement of Life Activities, Belgrade, Serbia. The speech materials were uttered by six actors (three women and three men) who are final year students of the Faculty of Dramatic Arts (FDU). The recording of the voice base was performed using professional digital audio equipment in the antisonor room of the FDU studio. The choice of recorded spoken content respected the criteria of the phonetic and linguistic proportions of the Serbian language. For the purposes of this research, a portion of the GEES corpus was used, namely: 3 short sentences for 4 primary emotions, totaling 12 sentences, and 3 sentences for 2 affective attitudes, totaling 6 sentences uttered by a male speaker. Accurately recognized emotions and affective attitudes were scored with 1 point, so the maximum score for each task group was 3 points and the maximum total score for GEES was 18 points. Inaccurate answers and no responses were scored with 0 points, so the minimum score could be 0 points for each task group and also for the total score at GEES. The test was performed during one encounter and the children were presented with the pronunciation of selected sentences in a randomized schedule. The task was for the children to recognize the emotion and affective attitude in the spoken material, without paying attention to the linguistic content, and to verbalize their observations. To help them, they were provided with a list of selected emotions in writing. The recorded material was presented using computer equipment and the participants used headphones. Children were expected to respond within 300 to 6,000 ms and the next task was set 1,200 ms after the registered response. If no response was given, it was automatically switched to the next task. The GEES internal consistency was good ($\alpha = 0.831$).

A total of 60 children were included in the study.

Descriptive statistics, 95% confidence interval, effect size (Cohen's d), *t* test for independent samples, *t* test for dependent samples and Pearson's correlation coefficient were used in the analysis of the results. Statistical analysis was performed using the IBM SPSS 25 software package.

Results

The study involved 60 children, which were divided into two groups: 31 (51.7%) of children with ADHD and 29 (48.3%) typical population children. The children were from 6 to 13 years old [mean age ± standard deviation (SD) = 9.25 ± 1.97]. Based on the *t* test for independent samples, it was concluded that the two groups did not differ significantly in terms of age [t (58) = -0.974, p = 0.332]. There were 51 (85%) boys and 9 (15%) girls in relation to gender in the sample. The *t* test for two independent samples showed no statistically significant difference with respect to gender [t (58) = 1.913, p = 0.061]. Speech and language assessment was performed prior to the GEES examination and the results showed that children from the two observed groups did not differ statistically in terms of achievement [t (58) = 0.942, p = 0.327].

Table 1 shows the arithmetic mean, standard deviation, and 95% confidence interval and statistical significance of differences in arithmetic means for recognizing emotions and affective speech orders in ADHD and the typical population. Children with ADHD best recognized joy and typical children sadness. The affective threat order was the least recognized in children with ADHD and in the typical population, fear emotions and the affective command order.

The typical population of children was better in recognizing most emotions and affective orders with a statistically higher significant difference ($p < 0.01$) than children with ADHD, except for the joy emotion, where statistical significance was not established. Based on the analyzed effect size (Cohen's d) for all statistically significant differences found in recognizing emotions and affective orders, it can be concluded that there was a large difference in effect for emotions: fear (d = 1.13), sadness (d = 1.23) and anger (d = 1.42) as well as for affective orders threat (d = 2.01) and command (d = 0.98). The effect size for the overall results was also large (d = 2.28).

The results presented in Table 2 indicated that children with ADHD recognize emotions and affective orders with different success, whereas this was not the case with the typical population. Children with ADHD had a statistically significantly better recognition of joy than all other emotions and affective orders, and the statistical significance of differences also appears in fear–threat and sadness–threat. The typical population children differently recognized only the emotion of sadness in relation to the affective command order. Both groups of children had statistically significant higher recognition of emotions than affective accounts.

Table 1

Recognition of emotions and affective speech orders in ADHD patients relative to a typical population

Parameter	ADHD patients (n = 31)			Typical population (n = 29)			*t*-test	
	mean ± SD	95% confidence interval		mean ± SD	95% confidence interval			
		lower	upper		lower	upper		
Emotion							*t*	*p*
joy	2.48 ± 0.77	2.20	2.77	2.72 ± 0.53	2.52	2.92	1.41	0.167
fear	1.61 ± 0.84	1.30	1.92	2.48 ± 0.69	2.22	2.74	4.36	0.000
sadness	1.81 ± 0.98	1.45	2.17	2.76 ± 0.51	2.56	2.95	4.76	0.000
anger	1.48 ± 0.99	1.12	1.85	2.62 ± 0.56	2.41	2.83	5.49	0.000
Affective orders								
threat	1.19 ± 0.91	0.86	1.53	2.69 ± 0.54	2.48	2.90	7.79	0.000
command	1.58 ± 1.12	1.17	1.99	2.48 ± 0.69	2.22	2.74	3.78	0.000
Total	10.13 ± 2.96	9.04	11.22	15.76 ± 1.80	15.07	16.45	8.81	0.000

ADHD – affective orders in attention-deficit hyperactive disorder; SD – standard deviation.

Table 2

Differences in recognition of emotions and ADHD patients and typical population

Pairs	ADHD patients			Typical population		
	mean ± SD	*t*-test		mean ± SD	*t*-test	
		t	*p*		*t*	*p*
Joy – fear	0.87 ± 1.09	0.44	0.000	0.24 ± 0.95	1.37	0.182
Joy – sadness	0.68 ± 1.17	3.23	0.000	-0.03 ± 0.57	-0.33	0.744
Joy – anger	1.00 ± 1.32	4.23	0.001	0.10 ± 0.86	0.65	0.522
Joy – threat	1.29 ± 1.07	6.71	0.003	0.03 ± 0.78	0.24	0.816
Joy – command	0.90 1.33	3.79	0.001	0.24 ± 0.83	1.56	0.126
Fear – sadness	-0.19 ± 1.22	-0.88	0.383	-0.28 ± 0.75	-1.98	0.062
Fear – anger	0.13 ± 1.41	0.51	0.612	-0.17 ± 0.83	-0.89	0.387
Fear – threat	0.42 ± 1.02	2.28	0.000	-0.21 ± 0.73	-1.53	0.133
Fear – command	0.03 ± 1.33	0.13	0.892	0.00 ± 0.96	0.00	0.902
Sadness – anger	0.32 ± 1.27	1.40	0.163	0.13 ± 0.74	1.00	0.322
Sadness – threat	0.61 ± 1.12	3.06	0.000	0.07 ± 0.59	0.63	0.533
Sadness – command	0.23 ± 1.31	0.97	0.345	0.28 ± 0.65	2.29	0.032
Anger – threat	0.29 ± 1.21	1.33	0.193	-0.07 ± 0.84	-0.44	0.662
Anger – command	-0.09 ± 1.51	-0.36	0.721	0.24 ± 0.83	0.89	0.383
Threat – command	-0.39 ± 1.17	-1.84	0.082	-0.03 ± 0.77	1.44	0.162
Affective orders – emotion	-4.61 ± 2.01	-12.77	0.000	-5.41 ± 1.29	-22.49	0.000

ADHD – affective orders in attention-deficit hyperactive disorder; SD – standard deviation.

This study also examined the association between age and recognition of emotions and affective speech orders in children with ADHD and children of typical development. Pearson's correlation coefficient and confidence interval (CI) for linear correlation were used for this analysis. In children with ADHD, a mean association between age and command recognition was found r (31) = 0.481, $p < 0.01$ with 95% CI: 0.15–0.71; age and overall scores r (31) = 0.373, $p < 0.05$, with 95% CI: 0.02–0.64; and age and overall recognition scores of affective orders r (31) = 0.434, $p < 0.05$, with a 95% CI: 0.09–0.68. In the typical development children, a greater association between age and recognition of emotions and affective speech orders was found compared to children with ADHD. Mean correlation with age in typical population children was found in fear recognition r (29) = 0.441, $p < 0.05$, with 95% CI: 0.08–0.69; sadness r (29) = 0.401, $p < 0.05$, with 95% CI: 0.04–0.67; and command r (29) = 0.445, $p < 0.05$ with 95% CI: 0.08–0.69. High correlation with age was recorded in overall scores r (29) = 0.512, $p < 0.01$ with 95% CI: 0.17–0.74. In contrast to children with ADHD, in the typical population children mean correlation between the age and total scores in the recognition of affective orders r (29) = 0.443, $p < 0.05$ with 95% CI: 0.08–0.69 and overall scores in the recognition of emotions r (29) = 0.401, $p < 0.05$ with 95% CI: 0.04–0.67 were recorded. All reported correlations were statistically significant.

Discussion

Considering that there is not much research that has examined emotion recognition solely on the basis of speech prosody labels in children with ADHD, the discussion on this research is limited to the small number of available papers.

The analyzed results indicate a statistically significant poorer recognition of the emotions and affective attitudes in speech of children with ADHD compared to the typical population. Differences were observed in quantitative indicators but also in structure because the typical population children were most sensitive to recognizing sadness, then joy, threat, anger and least sensitive to recognizing fear and command. ADHD children recognized joy best, followed by sadness, fear, command and anger, while threat was the worst. The only emotion in speech that children with ADHD recognized similarly to the typical population children was joy (positive emotion) and there was no significant difference.

Similar results were obtained by Shapiro et al. [38] who used an alternative model of emotion representation, that is, tasks related to recognizing emotions from the face and in prosody. The results of their study showed that children with ADHD were less likely to recognize emotion in prosody and in cross-modal tasks where they were required to match that emotion with the appropriate facial expression. In the face recognition tasks, children with ADHD achieved very similar results to those of the typical population [38]. Corbett and Glidden [39] also found in their study mild to moderate difficulties in recognizing emotions in prosody. Based on such results, many studies supported the thesis that the right cerebral hemisphere correlates with the emotion recognition deficit [39–41].

Children with ADHD were significantly more likely to recognize joy over all other emotions and in relation to threat and command. A significant difference was still present in the better recognition of the fear and sadness in relation to the threat. In the typical population, a significant difference appeared only in the better recognition of sadness in relation to the command, while all other emotions and affective attitude threat were equally well recognized. Most studies that dealt with emotion recognition support the result of this research, which indicates that positive emotions are better recognized than negative ones in children with ADHD [17, 23, 42]. Some authors explain this difference in recognition of different emotions by deficits in verbal and nonverbal attention, which may contribute to incorrect or incompletely processed labels of speech stimuli. Based on their opinion, children with ADHD generally pay attention to the most prominent features of speech impulse from the environment, while subtle information does not come into their focus and thus remain unrecognized [39].

However, the question arises as to why children with ADHD successfully recognize joy (positive emotion) rather than, for example, anger (negative emotion), although both emotions are strong and usually emphasized through speech prosody. These results cannot be fully explained by attention deficit such as brevity, selectivity, poor focus etc. Consideration should also be given to the possible altered patterns and mechanisms of processing the emotional cues in speech primarily due to the lack of recognition of its own anger and fear [43] or as a result of unconsciously ignoring such emotions. This interpretation can be substantiated by the result that children with ADHD were the least sensitive in recognizing anger, and threats, which, despite carrying a strong message, remain poorly recognized.

Interestingly, emotions were better recognized than affective attitudes in both groups of children. This is important information for all significant persons from the child's environment: parents, educators, teachers as well as professionals involved in the treatment and rehabilitation of children with ADHD. Affective attitudes are usually used to warn of the danger, inhibition and interruption or to control children's negative behavior. The command and threat are clearly not adequate speech patterns through which the child can recognize the information conveyed to them from the environment. This is an important finding that needs to be considered in an educational and therapeutic context when it comes to determining approaches for working with this population of children.

The association between age and recognition of emotion and affective attitudes was much more pronounced in the typical population than in children with ADHD. In this study, growing up has been shown to improve overall outcomes, overall affective attitudes, and command recognition. However, this influence was not recorded on the indi-

vidual emotion recognition results as in the typical population. This means that with age, children with ADHD have not made significant progress in recognizing individual emotions in speech, but significant improvement has been observed in recognizing threat and command. Over the years, children seem to learn patterns of behavior that stem from command and threats, but they still do not rely on the truly recognized and experienced emotions that underlie those affective attitudes (such as anger, fear). It would be very interesting to focus future research on exploring the relationship between primary emotions and affective attitudes, as well as exploring mechanisms for recognizing and understanding affective attitudes in children with ADHD.

The limitations of this research are related to a relatively small sample, especially when it comes to the population of girls. Also, a dilemma was raised regarding the language corpus, which was filmed with actors and objectively represented the played emotional roles. It is certain that real situations would give a better emotional expression, but this is questionable approach since it touches the intimacy of the people who would be filmed.

Conclusion

Hyperactivity, impulsivity, and attention deficit disorder are certainly key factors contributing to the difficulties of children with ADHD. However, the results of this study suggest that deficits in understanding the emotional information may also be another critical factor affecting the problems that occur in the daily functioning of children with ADHD. One consequence of these difficulties is the avoidance or inappropriate response to social situations that require recognition of emotional information. Also, understanding and accepting the fact that children with ADHD have objective impediments to the processing of emotional voice messages and affective orders will contribute to better acceptance of these children by the loved ones and the social environment, as well as by the professionals involved in the treatment and education of these children.

Conflict of interest

None.

R E F E R E N C E S

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Received on October 4, 2019
Accepted on February 19, 2020
Online First March, 2020