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Relationships of self-efficacy beliefs to executive functions, hyperactivity-impulsivity and inattention in school-aged children

Abstract:

Executive function deficits, hyperactivity-impulsivity, and inattention can have a negative impact on a child's self-efficacy beliefs. Forty-eight children with high intensity ADHD symptoms and 56 children with low intensity symptoms in ages 8 to 10 years completed the Self-Efficacy Scale for Children and executive function tests. Rating Scales for Teachers and Parents were completed for each child to measure the ADHD symptoms. ADHD symptoms and executive function deficits were associated with lower self-efficacy beliefs especially in two spheres: academic achievement and self-control. Implications of these findings for child therapy are discussed.

Keywords:

self-efficacy beliefs, executive functions, inattention, hyperactivity-impulsivity

Streszczenie:

Niska sprawność funkcji wykonawczych, impulsywność-nadaktywność oraz nieuwaga oddziałują negatywnie na funkcjonowanie dziecka w różnych sferach życia i w związku z tym mogą mieć negatywny wpływ na rozwój przekonań o własnej skuteczności. 48 dzieci z wysokim nasileniem objawów ADHD oraz 56 dzieci z niskim nasileniem objawów w wieku 8-10 lat wzięło udział w badaniu Skalą Przekonań o Własnej Skuteczności oraz testami funkcji wykonawczych. Skale Obserwacji dla Nauczycieli oraz Rodziców zostały wypełnione dla każdego dziecka, aby ocenić nasilenie objawów ADHD. Objawy ADHD oraz deficyty funkcji wykonawczych były związane z niższymi przekonaniami o własnej skuteczności przede wszystkim w dwóch sferach: osiągnięć szkolnych oraz samokontroli. Zaprezentowane są wnioski z tych wyników dla terapii dzieci z ADHD.

Słowa kluczowe:

przekonania o własnej skuteczności, funkcje wykonawcze, nieuwaga, impulsywność-nadaktywność

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Introduction

Self-efficacy, the central construct of Bandura's (1997, 2001) social cognitive theory, refers to the perceived ability to produce a desired action. Self-efficacy beliefs play an important role in children's self-development, adaptation and change. Efficacy beliefs affect whether people think optimistically or pessimistically, how well they motivate themselves and persevere when facing difficulties (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001), the quality of their emotional well-being, and their vulnerability to stress and depression (Bandura, Pastorelli, Barbaranelli, & Caprara, 1999; Muris, 2002), the amount of effort they invest, and the choices they make at crucial points in their life (Bandura, et al., 2001). They play a particularly important role in schoolchildren by influencing their aspirations, motivation levels, and academic accomplishments (Bandura, 1997, 2001). Self-efficacy beliefs are developed and strengthened through mastery experiences, social modeling, verbal persuasion, and in observing one's own physiological state. Self-control abilities play a crucial role in the developing self-efficacy beliefs (Zimmerman & Cleary, 2006). They influence the gaining of experiences from all the above-mentioned spheres: facilitating mastery experiences, learning from observing other people, and regulating arousal and emotion in stressful situations. Thus, we can assume that developing self-efficacy beliefs can be endangered in children with self-control difficulties, especially in children with poor executive functions and with high intensity inattention, hyperactivity and impulsivity. Tabassam and Grainger (2002) demonstrated that self-efficacy beliefs in academic achievement of children with learning disabilities (with and without co-morbid ADHD) are lower than in control children. Moreover, Major (2011) showed that girls with ADHD have lower self-efficacy beliefs in academic achievement in comparison with girls without ADHD and that self-efficacy beliefs in this sphere are related to symptoms of inattention and not hyperactivity-impulsivity. However, these two studies investigated self-efficacy beliefs in only one sphere of life: academic achievement. Moreover, we did not find studies in the literature concerning relationships between self-efficacy beliefs and executive functions. Our study aims to explore relationships of self-efficacy beliefs in four spheres: academic achievement, self-control, regulating negative emotions and managing positive emotions in executive functions (inhibition, planning and working memory), and hyperactivity-impulsivity and inattention symptoms.

Method

Participants

The study included children, aged 8–10 years, drawn from 12 schools in Warsaw and four schools in the suburban areas surrounding Warsaw. In the first stage, 450 parents completed rating scales concerning hyperactivity-impulsivity and inattention symptoms. From this group, 48 children with high intensity hyperactivity-impulsivity and inattention

symptoms assessed by parents and teachers and 56 children with low intensity symptoms were chosen and participated in further in the study. The high intensity group included children whose scores in the hyperactivity-impulsivity and/or inattention subscales of the Rating Scales for Parents and Teachers were more than one standard deviation higher than the population mean. The second group comprised those whose scores on the hyperactivity-impulsivity and/or inattention subscales of the Rating Scales for Parents and Teachers were more than one standard deviation below the average for the population. One standard deviation cutoffs above the mean for results by other rating scales was shown to have good predictive value for diagnosing ADHD (Biederman, 1993; Geller, et al, 2004). Thus, we assumed that using this cutoff we would identify children with both clinical and subclinical intensity ADHD symptoms. Permission to conduct this investigation was provided by respective school principals, individual classroom teachers and the University of Warsaw Institutional Review Board. All parents gave their written, informed consent prior to their child's participation in the study. Descriptive statistics (age and gender) for the two groups are presented in Table 1.

Table 1. *Descriptive Statistics.*

	Groups with high ADHD symptoms	Group with low ADHD symptoms
Females (n)	12	27
Males (n)	36	29
Age (in months)	108	107.5
Mothers with primary education	9.00%	3.00%
Mothers with vocational education	13.00%	10.00%
Mothers with secondary education	31.00%	28.00%
Mothers with higher education	40.00%	43.00%
Fathers with primary education	10.00%	3.00%
Fathers with vocational education	20.00%	18.00%
Mothers with secondary education	30.00%	36.00%
Mothers with higher education	40.00%	43.00%

Measures

Self-efficacy Scale for Children (SESC; Gambin & Świącicka, 2012) was constructed at the University of Warsaw and had four subscales: (1) self-efficacy for academic achievement (four items, $\alpha = .73$); (2) self-efficacy for self-control in social and school situation (seven items, $\alpha = .86$); (3) self-efficacy for regulating negative emotion (five items, $\alpha = .86$); and (4) self-efficacy for management of positive emotion (four items, $\alpha = .62$; Table 1). The children were tested individually using the scale by the experimenter who read aloud all the items to the child and asked the child to rate how well he or she could do different things.

Each item is accompanied by a scale from 0 to 10 on which the child pointed to the answer. Adequate psychometric properties have been established for SESC.

The Rating Scales for Teachers and Parents (RST and RSP; Gambin & Swiecicka, 2009, 2012; Świącicka, Matuszewski & Woźniak, 2008) were constructed at the University of Warsaw. We applied an empirically-based, bottom-up approach (Achenbach, Dumenci & Rescorla, 2003) to their construction, in which the researcher did not make any initial assumptions concerning the existence of certain diagnostic categories. Therefore, the initial items included in the scales came not from a diagnostic manual but from actual comments by teachers and parents who were describing the behavior of their children as they displayed hyperactivity-impulsivity and inattention symptoms.

The RST includes 22 items and consists of four subscales that were extracted through factor analysis. The hyperactivity-impulsivity subscale (eight items, $\alpha = .94$) measures impulsive and hyperactive intensity. Two more subscales concern the intensity of two inattention dimensions. The attention withdrawal subscale (seven items, $\alpha = 0.94$) assesses the tendency to withdraw attention and carelessness. The distractibility-fatigability subscale (10 items, $\alpha = 0.90$) measures the tendency to be easily distracted and tire quickly from mental activities. The low emotional control subscale (four items, $\alpha = 0.91$) assesses the tendency toward uncontrolled emotional outbursts.

The RSP includes 22 items comprising two subscales extracted through factor analysis. The hyperactivity-impulsivity subscale (11 items, $\alpha = .90$) measures impulsive intensity, hyperactive behaviors and low emotional control. The inattention subscale (11 items, $\alpha = .92$) assesses the child's tendency to become easily distracted, to tire quickly from mental activities, to withdraw attention, and to be careless. Parents and teacher are asked to rate on a four-degree scale the extent to which the behavior described in the item matches the child's behavior.

Stop signal task

The computerized stop signal task (Logan, 1994; Logan & Cowan, 1984) measures executive inhibitory control that was developed based on Logan's 'race model' of inhibition (1994). On primary task trials, the letters X or O are presented with the instruction to press a corresponding key as quickly as possible, creating a prepotent tendency to respond in most trials. In a randomly selected 25% of the trials, a tone is presented that indicates that the participant should stop the response. The stop signal task applied in our current study utilizes a tracking procedure in which the delay between the the visual stimulus and the onset of the stop signal changes after every trial with a stop signal. It allows participants to successfully inhibit their responses to the signal in roughly 50% of the stop signal trials during the experiment. This was necessary in order to estimate the stop signal reaction time (SSRT) by subtracting the stop-signal delay from the mean go-signal reaction time.

Longer SSRT scores indicated deficits in inhibition. All participants in our study were asked to individually complete the stop signal task.

Tower of Hanoi

The procedure used in this study was based on that developed by Borys, Spitz and Dorans (1982) and described by Bishop, Aamodt-Lepper, Creswell, McGurk and Skus (2001). The apparatus consisted of a board containing three upright rods and four discs of varying sizes. One apparatus was designed for the participant. The second apparatus arranges the discs according to a model, which the participant must duplicate using a minimum number of moves while obeying the following rules: (1) only one disc may be moved at a time; (2) a larger disc must not be placed on top of a smaller one; (3) discs may not be placed on the table. The participant was given problems of increasing complexity, starting with 3-move problems and increasing up to 9-move problems, until the participant failed two consecutive problems. There were two problems for each number of moves. To be credited as having passed a given problem, the child had to solve it once in the minimum number of moves. The child's final score was the highest level they successfully completed in terms of move numbers, with an additional half point added if both tasks at this level were completed.

The Digit Span Backward subtest from the Wechsler Intelligence Scale for Children (Wechsler, 1991) was used to measure working memory abilities.

Results

Categorical Analysis

T-test for independent samples indicated significant differences between the two groups in self-efficacy beliefs: the group with ADHD symptoms had significantly lower self-efficacy beliefs in self-control, academic achievement and regulation of negative emotions in comparison to the group without ADHD symptoms. No significant differences in self-efficacy beliefs in managing positive emotions were revealed (Table 2).

Table 2. Comparison of groups – *T*-test.

	Groups with high ADHD symptoms	Group with low ADHD symptoms	<i>t</i>	<i>p</i>
	M(SD)	M(SD)		
Self-efficacy – academic achievement	27.95 (8.92)	34.16(4.93)	4.29	<.001
Self-efficacy – self-control	56.22 (10.02)	67.92(14.70)	4.66	<.001
Self-efficacy – regulation of negative emotion	35.17 (11.91)	39.68 (6.95)	2.31	.023
Self-efficacy – management of positive emotion	35.83(5.61)	36.98 (4.12)	1.17	.244
Inhibition	444.58	329.70	-5.18	<.001
Planning	5.49	6.13	2.03	0.04
Working memory	3.62	4.87	4.28	<.001

Dimensional Analysis

Spearman correlations were used to examine the relationship between self-efficacy beliefs, ADHD symptoms and executive functions (Table 3).

Table 3. Correlations between self-efficacy beliefs, ADHD symptoms and executive functions.

	Self-efficacy – academic achievement	Self-efficacy – self-control	Self-efficacy – regulation of negative emotion	Self-efficacy – management of positive emotion
Hyperactivity-Impulsivity (M)	-.23*	-.37**	-.13	-.04
Inattention (M)	-.49**	-.38**	-.15	-.11
Hyperactivity-Impulsivity (T)	-.21*	-.35**	-.01	-.02
Distractibility-fatiguabilityy (T)	-.47**	-.35**	-.14	-.15
Withdrawal of attention (T)	-.37**	-.30**	-.07	-.11
Low emotional control (T)	-.11	-.26*	.02	.05
Inhibition	-.32**	-.28**	-.11	-.23*
Planning	.19*	.21*	.02	-.03
Working Memory	.36**	.14	.12	.10

Note. T – teacher, P – M - mother.

We found negative hyperactivity-impulsivity correlations with inattention to self-efficacy beliefs in self-control and academic achievement, and low emotional control to self-efficacy beliefs in self-control. Moreover, self-efficacy in academic achievement is associated with higher efficiency in all executive functions; and self-efficacy in self-

control is correlated with two executive functions: inhibition and planning. Significant correlations between inhibition and self-efficacy beliefs in managing positive emotions were revealed. Self-efficacy in managing positive emotions is not associated with other executive functions and ADHD symptoms. Self-efficacy in regulating negative emotions is not correlated with any of these variables.

Stepwise linear regression was used to predict self-efficacy beliefs in academic achievement and self-control with ADHD symptoms and executive functions. Variables that significantly correlated with self-efficacy beliefs were included in the regression model. Symptoms of inattention reported by parents were the best predictors of self-efficacy beliefs in academic achievement ($t = 23.39$, $p < .001$, $R = .26$) and self-control ($t = 22.7$, $p < .001$, $R = .17$).

Discussion

This study demonstrates that high level self-efficacy beliefs in academic achievement and self-control are associated with lower ADHD symptoms. Children with high intensity ADHD symptoms are characterized by lower self-efficacy beliefs in these spheres in comparison to their peers. These results are consistent with previous findings on self-efficacy in academic achievement of children with ADHD (Tabassam and Grainger, 2002; Major, 2011). We can assume that children with ADHD symptoms experience difficulties in key factors that take part in building and strengthening self-efficacy beliefs. They experience less often than their peers mastery experiences in learning, controlling their own behaviour and dealing with parental and teacher expectations. They receive more negative feedback concerning their behaviour, skills and achievement from other significant people: teachers, parents and peers. Finally, they may experience difficulties in concentration on learning from observing other people. On the other hand, basing on social cognitive theory (Bandura, 1997, 2001) we can assume that low self-efficacy beliefs have an inverse negative impact on these spheres.

Moreover, this study shows that self-efficacy beliefs are associated with efficiency of executive functions; however, patterns of relationships differ depending on certain executive functions and areas of self-efficacy. Working memory, which is particularly essential for experiencing mastery experiences in learning (Gathercole & Alloway, 2006), is associated with self-efficacy in academic achievement. Planning, which plays an important role in both learning and controlling one's own behaviour (McCormack & Atance, 2011), is associated with self-efficacy in academic achievement and self-control. Inhibition is related to self-efficacy in academic achievement, self-control and management of positive emotions, and these relationships are stronger and more significant than with

planning. Since according to Barkley's theory, inhibition is the most crucial executive function, then poor abilities to stop one's own behaviours and impulses can affect various spheres. Thus, children characterized by poor inhibition can experience less mastery experiences in learning, in controlling their own behaviour, and in emotion regulation.

The best predictor of self-efficacy beliefs in academic achievement and self-control is inattention observed by parents. Since inattention is strongly associated with various self-control difficulties (especially executive and cognitive deficits) (Chhabildas et al., 2001; Gambin & Świącicka, 2009), high intensity of these symptoms may have a negative impact on developing strong self-efficacy beliefs. Interestingly, the best predictor of self-efficacy in these areas is inattention reported by parents, not by teachers. We can assume that both parents and teachers who perceive children as inattentive give them negative feedback on their behavior and learning abilities. However, parents, who are usually the most significant persons for a child, may have an essential influence on his/her self-efficacy.

Moreover, this study reveals that children with high intensity ADHD symptoms display lower self-efficacy beliefs in regulating negative emotion in comparison to the group with low intensity symptoms. However, correlations of self-efficacy beliefs in this sphere to ADHD symptoms and executive functions are not significant. Moreover, children with high and low intensity ADHD symptoms did not differ in self-efficacy in managing positive emotions. Self-efficacy in this sphere is associated with only one of the included in this study variables concerning self-control: inhibition. We can assume that factors other than self-control play more important roles in developing of self-efficacy in regulating negative emotions and managing positive emotions such as relationship characteristics with other significant people, especially the attachment pattern characteristic (Sroufe, 2005).

Our study has some important limitations. It is limited by small numbers and thus replication in a larger sample is required before firm conclusions can be drawn. The children included in this study were selected to participate based on the Rating Scales for Parents and Teachers, not on psychiatric diagnoses.

These results have important implications for research on therapy and educational methods for children with ADHD. The greatest emphasis is placed on modified undesired behaviours and appropriate enforcement behaviours in therapy for these children (Chronis, Jones & Raggi, 2006). Little attention is paid to developing personality and social cognitions (such as self-efficacy beliefs, self-esteem, mentalizing abilities) for this group. More research on therapeutic and educational approaches enhancing self-efficacy beliefs and developing other social cognition aspects of this group of children is needed.

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