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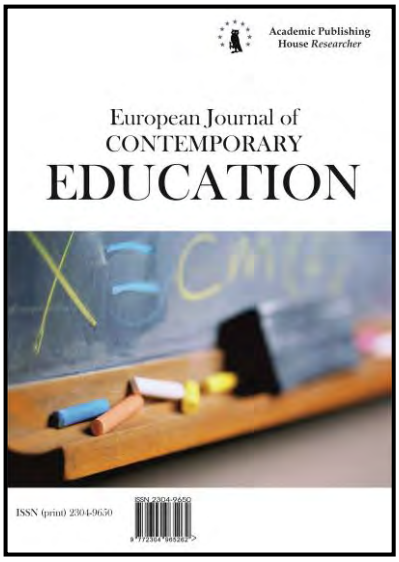

The Relationship between Play Repertoire and Inhibitory Control in Preschool Children

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Abstract

Numerous studies argue that inhibitory control could be successfully enhanced in play activities during preschool age. Previous studies showed that fantasy significantly associated with inhibitory control and cognitive flexibility. It was also shown that inhibitory control is related to symbolic play (imagination of absent objects, attributing imaginary properties to objects, accepting the role). The primary aim of the current study was to investigate the association between children's play repertoire and inhibitory control in preschool age. Two research questions were addressed in this study. First, we hypothesized that reducing play activity to one favourite play and character could be associated with poorer inhibitory control, probably due to decreasing variability of roles, actions, possible choices. Second, we hypothesized that play duration correlates with the level of children's inhibitory control performance: the more time is devoted to role-play, the higher the level of inhibitory control would be. Participants were 228 children aged 6-7 years. Child's play preferences and play duration were examined with a parental questionnaire. Results indicate that children who had a favourite play were significantly more impulsive while dealing with the tasks which required inhibitory control. A similar result was obtained in the analysis of how having a favourite character relates to the inhibition process: a group of children who had favourite characters showed significantly lower score of inhibition control than groups of children who had no favourite characters or had multiple ones. This study did not show any significant differentiation among groups of children with different play duration per day. These findings contribute in several ways to our understanding of the relevance of play in terms of inhibitory control development.

Keywords: inhibition, inhibitory control, impulsiveness, play, scenario play, role play, inner speech, preschool age.

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1. Introduction

There is a growing body of literature that recognizes the importance of inhibitory control in preschool age. Inhibitory control is an ability to inhibit spontaneous actions and thoughts in order to execute goal-directed actions (Dowsett, Livesey, 2000; Sira, Mateer, 2014; Zelazo et al., 2000). Previous research has suggested that inhibitory control plays an important role in the development of intelligence (Lee et al., 2015), mathematics ability and approximate number system (Fuhs, Mcneil, 2013) successful adaption to classroom rules and positive peer social interaction (Troller-Renfree et al., 2019; Utendale et al., 2011). Furthermore, deficits in inhibitory control tend to co-occur with poor emotion regulation and anxiety (Troller-Renfree et al., 2019; Carlson, Wang, 2007; Paulus et al., 2014).

Inhibitory control (Durston et al., 2002; Zelazo, Carlson, 2012) and play activities (Bodrova et al., 2013; Carlson et al., 2014; Diamond, 2012; Pietto et al., 2018; Whitebread, 2012) develops rapidly in the preschool period. Vygotsky emphasized that play could be an effective instrument for internalizing cultural tools required for goal-directed behaviour (Vygotsky, 1967). As Vygotsky states, in a play situation rules are alienated and set as a role so that a child observes his or her behavior and controls it through the role as some kind of a mirror and therefore learns to be consciously aware of his or her actions and to ignore distractions (Vygotsky, 1967). In addition, play allows to create an exciting learning situation (Rozhina, Baklashova, 2018), involves peer-interaction where children begin to take into account the wishes and actions of others, to control their behavior and to implement joint plans. In this regard, playful activities are traditionally seen as important for the development of executive functioning (Vygotsky, 1967).

Previous studies, e.g., the study carried out by Perucci and colleagues showed that fantasy (e.g., imaginary friends, an imaginary game, etc.) significantly associated with inhibitory control and another component of executive function such as cognitive flexibility (Pierucci, 2014). The results indicate the importance of fantasy for the development of self-regulation. Similar results were obtained in a study conducted by Kelly and Hammond (Kelly, Hammond, 2011). It was shown that inhibitory control is significantly related to symbolic play (imagination of absent objects, attributing imaginary properties to objects, accepting the role). However, a small sample of the study does not allow to make confident conclusions about this relationship.

A series of experiments were conducted to evaluate the use of the game as a condition for the development of executive functions, including control. A study by Carlson and colleagues examined the impact of the role taken by a child on the success of executive function tasks (White, Carlson, 2016). The assessment was performed under three experimental conditions: (a) typical, (b) when the child imagined himself to be another child ("Where does John think this card belongs?"), and (c) when the child performed tasks as an imaginary character ("Now you are Batman! Where will Batman put this card?"). Analyses revealed that performing a third person's task significantly improves the accuracy of the tasks performed. At the same time, the role of imaginary character was more successful compared to the third person's role. The results suggest that taking on the role of another person or imaginary character has a positive impact on the executive functioning in preschool age and are probably may be an important development factor of it.

Consideration of the possible mechanism of influence of play on inhibitory control and other components of executive functions can be carried out from the point of view of cultural-historical approach. According to Vygotsky one of the fundamental features of children's consciousness is the unity of affective and intellectual processes (Vygotsky, 1967). Play activity provides emotional involvement while at the same time setting a rule-dependent situation. On the one hand, due to the changing narrative, roles and rules play provides a highly variable context which allows a child to determine his or her actions intentionally and arbitrarily (Howard et al., 2017). In play children learn to plan, self-monitor and evaluate their own actions: are they appropriate to the play situation, rules or play-role? (Smirnova, 2019). On the other hand, as play activity requires following certain rules it provides necessary conditions for the development of the executive functions and specifically inhibitory control (Dowsett, Livesey, 2000; Bodrova et al., 2013; Shahar, Avital, 2020).

Numerous studies argue that inhibitory control can be successfully enhanced in play activities (Carlson et al., 2014; Howard et al., 2017; Diamond et al., 2007; Nicolopoulou et al., 2015; Kelly et al., 2011). However, developmental impact of play may vary depending on several parameters. Previous results point towards the existence of a significant correlation between duration of playing at home and the ability to deny impulses in favor of intentional actions (Cemore, Herwig, 2005; Elias, Berk, 2002). Some studies also show that the effect of play increases

if there's a sophisticated play scenario (Elias, Berk, 2002; Nader-Grosbois, Vieillevoye, 2012), supposedly since the play requires psychological distancing through stepping into various roles (White, Carlson, 2016). Thus, the assumption can be made that long-duration role-playing promises the most significant impact on inhibitory control development.

The primary aim of the current study was to investigate the association between children's children's play repertoire and inhibitory control development in preschool age. Two research questions were addressed in this study. First, we hypothesized that reducing play activity to one favourite play and character could be associated with poorer inhibitory control, probably due to decreasing variability of roles, actions, possible choices. Second, we hypothesized that play duration correlates with the level of children's inhibitory control performance: the more time is devoted to role-play, the higher the level of inhibitory control would be.

2. Materials and methods

A random sample of participants was recruited from classrooms located in Moscow. Participants were 228 typically developing children (58 % boys) and their parents. The age of children was 6-7 years (M = 79,27 months, SD = 8,21). All parents provided informed consent for their children participation in the current study. The research was conducted in 2019.

Individual psychological assessments were conducted in a quiet, bright room in a kindergarten by experienced research psychologists. Each diagnostic session took about 15-20 minutes. Child's play preferences and play duration were examined with a parental questionnaire. The study was approved with the Ethical Committee of the Russian Psychological Society (the approval No: 2018/27).

Inhibitory control

The subtest Inhibition of NEPSY-II was used to assess the ability to inhibit automatic responses (Korkman et al., 2007). A child looks at a series of black and white shapes (circles/squares, and arrows) and names either the shape or the direction. First, child is asked to name the shape or the direction (Naming part). In the second part of the task a child is asked to name the shape or direction conversely: specifically, to name circles when presented with squares and to name squares when presented with circles (Inhibition part). For each part three parameters are considered: uncorrected errors, self-corrected errors, time. The benefit of the Inhibition task is that inhibitory control is being assessed in terms of two different variables (reaction time and accuracy). Uncorrected errors score is the number of instances when a child names a figure incorrectly while performing the task. Self-corrected errors score is the number of instances when a child names figure incorrectly, having the mistake noticed and corrected right away. Time is counted in seconds and allows to estimate the processing speed.

Play preferences

The questionnaire proposed to children's parents focused on the specifics of children's play preferences and play duration was administered. The following questions were asked:

- Does your child have any favourite play? (Parents had to choose one of three answers: «Yes»; «No, my child prefers (has) various plays»);
- Does your child have any favourite characters? (Parents had to choose one of two answers: «Yes»; «No»);
- How much time does your child spend playing every day? (Parents had to choose one of six answers: "0-30 min"; "From 0.5 to 1 hour"; "From 1 to 1.5 hours"; "From 1.5 to 2 hours"; "Over 2 hours"; " My child does not have time for playing").

Bivariate correlation analysis was conducted to show the relations between the inhibitory control measures and demographic variables investigated in this study. The tests used for comparison of means: Mann–Whitney U-test and Kruskal–Wallis H-test, depending on difference the of SD in each comparative group and the number of comparative groups. All values for quantitative variables in each group were expressed as means and SD. Statistical analysis was performed using SPSS version 19.0 (IBM, SPSS Software, Armonk, New York, USA). Differences were deemed significant when $p < 0.05$.

3. Discussion and results

Most parents had higher education (79.2 %) or college education (12.2 %), a small number of parents had secondary and incomplete higher education (7 %), a few parents had a scientific degree

(1.6 %). The majority of parents described their families as belonging to the middle-income social class (79.9 %), some to the low-income and insufficient well-to-do social class (16.4 %), and a small number of parents to the high-income social class (3.6 %). The number of children in the families participating in the study was as follows: one child (41.1 %), two children (40.7 %), three children and more (18.2 %). Table 1 shows an overview of descriptive statistics for the demographic variables and the Inhibition task measures of all participants. Bivariate correlation analysis was conducted to show the relations between the inhibitory control measures and such demographic variables investigated in this study (see Table 1).

Table 1. Demographic variables, and Inhibition task measures: Correlations and descriptive statistics (N = 228)

	M	SD	1	2	3	4	5	6
1. Age	79.27	8.21	–					
2. Siblings	1.77	.74	-.053	–				
3. Mother's education	3.65	.82	-.104	-.180**	–			
4. Family income	2.83	0.55	.013	.011	.230**	–		
5. Uncorrected Errors	3.50	6.79	.055	.039	**-.159***	.073	–	
6. Self-corrected Errors	2.20	1.91	.031	-.004	.123	.047	-.175**	–
7. Time	64.4	18.83	.035	**.162***	-.025	.068	.062	.220**

[1] Mother's education: 1 = secondary and incomplete higher education, 2 = college education, 3 = higher education, 4 = scientific degree. [2]Family income: 1 = insufficient class, 2 = low-income class, 3 = middle-income class, 4 = high-income class. * p < 0,05 (2-tailed); ** p < 0,01 (2-tailed).

Child's age, gender and family income were not significantly correlated with child's inhibitory control measures. By contrast, having siblings was significantly and positively correlated with processing time in the Inhibition task. Mother's education level was significantly and negatively correlated with the amount of Uncorrected Errors.

Table 2 outlines descriptive statistics for inhibitory control measures among groups of children who have different play preferences and duration of play.

Table 2. Descriptive statistics for inhibitory control measures (subtest Inhibition, NEPSY-II)

Groups	Uncorrected errors	Self-corrected errors	Time (in seconds)
Does your child have any favorite play?			
«Yes» (N = 108)	3,88±7,28	2,41±1,97	65,56±19,78
«No» (N = 110)	3,45±6,71	1,88±1,76	62,83±19,28
Does your child have any favorite characters?			
«Yes» (N = 93)	3,91±6,83	2,75 ±2,03	68,33 ±21,51
«No» (N = 131)	3,44±7,04	1,78 ±1,75	61,23 ±16,02
How much time does your child spend playing every day?			
0-90 min per day (N = 80)	3,69±7,07	2,09±1,82	66,06±21,91
90-120 min per day (N = 71)	4,07±7,15	2,45±1,89	63,52±18,39
> 120 min per day (N = 77)	3,08±6,50	2,09±2,05	63,49+16,50

[1] Data were presented with SD.

Responses were distributed evenly between two groups: children who had a favourite play and those who didn't. Mann–Whitney tests showed significant differences in amount of Self-corrected Errors between these groups (U = 5044,50; p = 0,05). Children who had a favourite play had bigger amount of self-corrected errors (M = 2,41, SD = 1,97) in dealing with the Inhibition task, than children who had no favourite play (M = 1,88, SD = 1,765). This result may indicate that children who have a favourite play are able to recognize mistakes having already given an incorrect answer. In this case the self-monitoring of one's performance is occurring on an external level, not on internal one. This result indicates that children who had a favourite play demonstrated significantly more impulsive behavior, nevertheless they had the ability to recognize their own mistakes due to external speech.

Parents' responses allow us to divide the sample into two parts: children who have a favourite character and children who don't. Mann–Whitney tests showed significant differences between groups in amount of Self-corrected errors (U = 4341,50; p < 0,001) and Inhibition Time (U = 4905,50; p < 0,013) depending on whether a child did or did not have a favourite character. Children who do not have the favourite character did significantly less amount of self-corrected errors and showed higher processing speed than children who preferred a single favourite character.

Analyses didn't reveal any significant differences in Uncorrected errors time (U = 2884,50, p = 0.470), Self-corrected errors (U = 3009,50, p = 0.800) or processing speed between groups with different amount of daily playing time (U = 2925,500, p = 0.587).

The goal of this study was to investigate children's inhibitory control development in preschool period and to clarify its possible associations with child's preferences in playing. Drawing on Vygotsky's theory we suggested that play could be an effective tool for the inhibitory control development due to the fact that play engages a child emotionally so that he or her is inclined to submit to the rules and constraints imposed by the play roles (Vygotsky, 1967). We then theorized that children with more diverse play experience (playing various plays and taking on various roles) would show better results in the inhibitory control performance.

As anticipated, children who had a single favourite play had significantly higher amount of self-corrected errors than those who had no favourite play. This result indicates that children who had a favourite play were significantly more impulsive while dealing with the tasks which required inhibitory control. They recognized mistakes after having already given an incorrect answer significantly more often than children who had no favourite play and varied their plays. Our assumption is that this result might indicate that self-monitoring of one's actions could occur both on external and internal levels depending on the extent of internal speech development. The ability to register an error before saying it out loud requires inner speech skills to be developed enough. Children who prefer a single play are possibly more impulsive while dealing with tasks demanding inhibitory control due to the lack of experience adapting to the variability of play rules which could have enhanced their internal speech skills. It's thus possible that the diversity of plays a child engages in is one of the factors influencing the development of the inhibitory control. These findings support other studies in this area linking inner speech development with the back-ward inhibition effect (Emerson, Miyake, 2003; Mayr, Keele, 2000). Back-ward inhibition effect suggests that dealing with changing tasks is more challenging for a child, as he or she has to inhibit the processing of the previous task. Authors make an assumption that the inhibition of the reaction to the previous task happens faster and easier for those children who have previous experience managing changing tasks. This accords with our results showing that children who prefer a single favourite play turn out to be less successful at tasks which require inhibitory control than those who have the experience dealing with different play rules.

A similar result was obtained in the analysis of how having a favourite character relates to the inhibition process. A group of children who had favourite characters showed significantly lower score of inhibition control than groups of children who had no favourite characters or had multiple ones. These findings are consistent with the results of White and Carlson (2016) study which demonstrated that 5 years old children showed better results at executive development-oriented tasks if they were distancing themselves from the egocentric perspective and dealing with the task as a play character would do (White, Carlson, 2016). It is reasonable to expect that changing play characters might contribute to the inhibitory control development since in play children learn to control their actions according to various roles. Each role dictates rules and a range of possible

ways of action, and therefore a child is required to recognize, remember and implement these rules in order to stay within the role. Recent research suggest that children are capable of better inhibitory control performance in role-playing than in real life (Jewkes et al., 2007; Pierucci et al., 2014; Thibodeau et al., 2016; Whitebread et al., 2017). It means that an impulsive child may restrain his or her own reactions more effectively in a play situation limited by play rules than in real-life situation (Whitebread et al., 2017).

Contrary to the expectations, this study did not show any significant differentiation among groups of children with different play duration per day. This suggests that the content of a play bears greater significance than its duration: if the child spends a lot of time playing, but changes the roles and thus the rules rarely, his or her ability to inhibit spontaneous reactions will not necessarily be progressing substantially. The findings of the current study do not support the previous results which point towards the existence of a significant correlation between play duration (at home) and the ability to deny one's impulses in favour of intentional actions (Cemore, Herwig, 2005; Elias, Berk, 2002).

Additionally, current study revealed that having a sibling was significantly associated with lower processing speed of doing the inhibitory control test, what corresponds to previous study results (Rolan et al., 2018). In contrast to earlier findings, however, no evidence of inhibitory control differs among children by variables such as socio-economic status was detected (Natalia, 2018).

4. Conclusion

The aim of the current study was to investigate the association between children's preferences in play and inhibitory control development in preschool age. We hypothesized that reducing play activity to one favourite play and to one favourite character could be associated with poorer inhibitory control. We also hypothesized that play duration correlates with the level of children's inhibitory control performance. The study revealed that children whose play preferences were limited by one play or one character have shown significantly poorer inhibitory control, than children who had more diverse preferences. The hypothesis that there is correlation between play duration and inhibitory control hasn't been confirmed. In this study there was no significant statistical evidence that the amount of daily time spent playing correlates with child's inhibitory control performance.

There were at least two limitations of this study. First, as we were unable to observe children's play directly, we had to use data obtained from the parents concerning play duration and children's preferences in plays and roles. Second, in terms of this study we focused on the analysis of particular aspects of playing while at home. Thus, the preferences in playing while attending preschool during the day weren't taken into account in this study even though that's where children have the opportunity to play with peers which could significantly increase variety of their plays. Meanwhile one should not underestimate the contribution of home environment as a home remains the place where a child has enough time to play freely because of the dense day schedule at preschools. Observations show that children have time for unstructured play or the « choice time» for 30 minutes or less a day (Miller et al., 2009; Nicolopoulou, 2010).

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