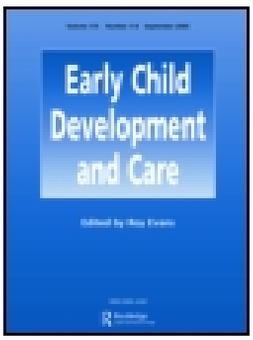

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Does Batman™ affect EF because he is benevolent or skilful? The effect of different pretend roles on pre-schoolers' executive functions

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ABSTRACT

Previous research has indicated that young children's executive functions (EFs) can be bolstered through role-play [e.g. the 'Batman™ effect'; White et al.]. However, what is not clear is whether it is the role-playing of another's perspective, or something about the role played, which is responsible for the Batman™ effect. The current experiment investigated the effects of role-play of different roles (protagonist, villain, and sage) with different traits (benevolence, malevolence, skill) on 80 five- to six-year-old children's EF performance. Results indicated significantly improved cold – but not hot – EF scores for the Sage and Control groups. Consistent with Vygotsky's theory that children transfer imagined content into real-world applications, this study provides preliminary evidence that pretending to be someone with EF skills can bolster young children's cold EF performance.

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Executive functions; inhibition; cognitive flexibility; motor persistence; pretend play; imaginary play

One of the most important aspects of preschool child development is the use of executive functions (EF). EF evade definition, but may broadly be viewed as those 'cognitive processes that are required for the conscious, top-down control of action, thought, and emotions, and that are associated with neural systems involving the prefrontal cortex' (Müller & Liben, 2015, p. 271), particularly under continuously changing multiple task demands (Röthlisberger, Neuenschwander, Cimeli, Michel, & Roebers, 2012). Recent studies suggest that early EF is a strong predictor of academic achievement (Gashaj, Oberer, Mast, & Roebers, 2019; Jacobson, Williford, & Pianta, 2011) including language (Emerson & Miyake, 2003; Follmer, 2018; Whitebread et al., 2017) and numeracy development (Mercader, Miranda, Presentación, Siegenthaler, & Rosel, 2018; Ribner, Willoughby, & Blair, 2017). There is also empirical evidence to support the notion that individual differences in EF have an impact on children's ability to regulate emotions (Zelazo, Qu, & Kesek, 2010), theory of mind (Korkmaz, 2011) and peer communication (Lensing & Elsner, 2018). Thus, a major challenge for early childhood education is to create the educational conditions which will facilitate the development of children's EF (Diamond, 2012).

Executive functions and pretend play

EFs are often divided into 'cool' (related to abstract thinking) and 'hot' (related to emotion and motivation) EFs, and encompass working memory, inhibitory control, and cognitive flexibility

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(Friedman & Miyake, 2017). Working memory is the temporary storage of information, which allows individuals to manipulate information as they cognitively process it. Inhibitory control refers to individuals' ability to suppress an automatic response. Cognitive flexibility is the ability to shift one's attention back and forth between two different domains.

Fein (1987) is widely-cited (e.g. in Russ, 2014) as defining pretend play as symbolic behaviour in which one thing is treated 'as if' it is another. Vygotsky emphasized that the basis of pretend play is the existence of an imaginary situation: 'Play is a peculiar attitude to reality, which is characterized by the creation of imaginary situations or the transfer of the properties of one object to another' (Vygotsky, 1984, p. 348). In other words, a playing child who has taken on a certain role (e.g. a firefighter) extends the imaginary situation to the real situation in which the playing action takes place (e.g. the living room). A dual objectivity arises: the child takes into account the real properties of things (e.g. furniture) and, at the same time, acts in accordance with the imaginary role, that is, with the meanings that are set by the role's relationships and the plot of the play (e.g. not going near 'fire'; Winther-Lindqvist, 2019). Vygotsky (2004) argued that the child playing with this imaginary situation can use it to inform her/his real-world actions (e.g. imagining herself as a wise woman may enable a child to enact some of these characteristics in real life; Vygotsky, 2004). This ability to transfer skills from the imaginary to the real world is supported by research indicating that children's play activity contributes to the development of an understanding of the social relations, thinking and emotional states of other people (Harris, de Rosnay, & Pons, 2005; Taylor, Carlson, Maring, Gerow, & Charley, 2004).

One of the main components of play is the child's acceptance of a role. Through pretend to play children learn new skills and control their actions according to that role (Whitebread et al., 2017). The role contains rules and ways of behaving and the child should know, remember and enact these rules in order to play successfully. These rules may, in turn, be applied to real-world contexts. In the play, children must frequently inhibit real-world desires and rules as they take on the rules associated with an imaginary situation, so it is intuitive that role-play would practice the skills associated with many EF tasks. Accordingly, play activity frequently involves many of the EF components: cognitive flexibility (switching from a real-world role to another, imaginary one), inhibition control (inhibiting instinctive reactions in order to maintain the imaginary role and acting according to the play rules), and working memory (as one maintains imagined rules and narratives).

Recent research suggests that children are capable of more in role-play than in real life (Pierucci, O'Brien, McInnis, Gilpin, & Barber, 2014; Thibodeau, Gilpin, Brown, & Meyer, 2016; Whitebread et al., 2017). For example, a child may restrain his or her own impulsive reactions more effectively in a game with rules than in a real-life situation (Whitebread et al., 2017). Research by Vygotsky's follower Elkonin (1999) showed that, when assuming an imaginary role, a child to exhibits more self-control than when not assuming one.

Specifically, several studies have suggested pretence and pretend play are associated with EF skills (e.g. Carlson, White, & Davis-Unger, 2014; Pierucci et al., 2014; Thibodeau et al., 2016; White & Carlson, 2016). For example, in a five-week intervention study by Thibodeau et al. (2016), 110 three- to five-year-olds were divided into fantastical play, non-imaginative play and control groups. The two former groups engaged in either fantastical and non-imaginative play and the control group engaged in typical classroom activities during the intervention period. Results showed that only the fantastical play group had significant improvement in working memory, with no other EF measures improving for the other two groups. Similarly, Pierucci et al. (2014) investigated the features of EF development depending on whether 106 four- to five-year-olds were more reality-oriented or more fantasy-oriented in play, as assessed through conversations with children, teacher and parent reports. The researchers found that fantasy-oriented children were significantly better in attention shifting and inhibition.

Moreover, one experimental study (White & Carlson, 2016) evaluated the relationship between EF and pretend role-taking with varying levels of psychological distancing in three- and five-year-olds. They found that five- but not three-year-olds had higher EF abilities the more psychologically distant

the role was. The researchers also found evidence that theory of mind may have mediated the effect, suggesting that it was the ability to take on another's perspective which was instrumental in the EF gains. An innovative aspect of their experiment was that a pretend role perspective (e.g. Batman™ or Dora the Explorer™) was differentiated from the third-person (i.e. the participant's name) perspective. While this experiment showed that taking on a fictional role appeared to have a stronger influence on EF, the mechanism by which perspective-taking impacted EF was not clear. A later experiment (White et al., 2017) suggested impersonation of a skilful role resulted in greater perseverance, but it was not clear whether if it was the benevolent behaviours children associated with the role that afforded the heightened EF, or the skilful ones. Vygotsky's writing would suggest that not only do children bring their real-life experience into their imaginary play, but the rules they must follow to construct the imaginary situation may, in turn, be brought into the real-world experiences (Vygotsky, 2004). Within this theory, we could expect that only children impersonating imaginary roles with strong EF skills (e.g. wisdom, forbearance, inhibition) would experience the bolstered EF that has been found in this previous research.

The aim of the current study was to investigate the specific influence that role-play of different roles could have on children's EF performance. Our hypothesis was that the type of role a child plays can affect her/his success in EF tasks. We created one control and three experimental conditions in order to observe the influence of a specific role on EF performance: a protagonist, villain, and sage. The first possessed benevolent characteristics, the second, malevolent, and the third, skill (in this case, skills most pertinent to EF). These conditions aimed to differentiate the characteristics of the pretend role in order to examine if certain roles may confer different EF abilities. Because we anticipated the imaginary role of a sorcerer to possess the skills most pertinent to EF tasks, we hypothesized that the Sage condition would outperform all others. We also hypothesized that the Protagonist and Villain conditions would improve EF significantly more than controls, which would represent an accurate baseline for practice effects.

Method

Participants

Participants were 80 typically developing 5–6-years old (M = 62.8 months, SD = 4.87) children (58% boys) from primarily medium-income families. Children were attending four various pre-kindergarten classrooms located in Moscow. This study was approved by the Ethics Committee of the Russian Psychological Society and all parents provided informed consent for their child's participation in the study.

Procedure

Children were assessed three times during September through October in 2018, hereafter referred to as Time 1 (pre-test), Time 2 (pretend play test) and Time 3 (post-test), each delayed by two weeks. Identical measures were used to assess EF on all assessments. Testing sessions were conducted individually for 10–15 min per session in a quiet area away from classrooms.

Children were divided equally into four groups based on results of the inhibitory control performance at Time 1 (above or below an overall Inhibition Combined Scaled Score (ICSS) of 10). Equal numbers of children with high and low levels of inhibitory control were included in each group. All participants were tested at Time 1 and Time 3 without a pretend play condition. At Time 2, there were three experimental and one control groups. Children from the experimental groups were asked to imagine that they were (a) protagonists (b) sages or (c) villains (based on their emotional appraisal from their exposure to books, films, etc). Based on parents' accounts of the most widely-known fictional characters among the children, different roles were assigned for boys and girls: 'protagonists' where Batman™ for boys and an unnamed princess for girls. 'Villains' were

the most well-known in Russian folklore: Koschey the Immortal for boys and Baba Yaga for girls. Finally, 'sages' were a wise wizard for boys and a wise sorceress for girls. The researchers showed each experimental child a picture of the protagonist, villain or sage, giving the following instructions: 'Now you are [role name] and I ask you to perform these tasks the way [the role you play] would'. Children were provided costumes and objects to assist them to step into a role: clothes and recognizable artefacts associated with the heroes. Children from the Control group were not instructed to role-play and were simply assessed at Time 2.

Measures

At Time 1 (pre-test), Time 2 (pretend play) and Time 3 (post-test), all children were administered the identical EF measures: The Dimensional Change Card Sort (DCCS) task (Zelazo, 2006), Statue (NEPSY-II), and Inhibition (NEPSY-II) (Korkman, Kirk, & Kemp, 2007). These measures were chosen to measure inhibition (Keller & Libertus, 2015; Treit, Chen, Rasmussen, & Beaulieu, 2014), motor persistence (Jacobson, Schneider, & Mahone, 2017; Shaul & Schwartz, 2014), and cognitive flexibility of EF (Ramscar, Dye, Gustafson, & Klein, 2013; Pierucci et al., 2014).

DCCS is a cold EF task aimed at measuring cognitive flexibility and inhibition. In the DCCS task, a child is asked to sort cards in three rounds, according to different rules. The first sorting is based on the picture's colour (pre-switch trial), the second on shape (switch trial), and the third on conflicting rules: on colour or shape of card depending on the presence of frame on the card or not (post-switch trial).

The *Inhibition* task is a cold EF task that assesses the child's ability to inhibit automatic cognitive responses. It includes two series of shapes (circles/squares, and arrows). Firstly, the child is asked to name the shape or direction (Naming trial). In the second part of the task, a child is asked to name the shape or direction conversely: to name circles when squares are presented and squares when circles are presented (Inhibition trial). The Inhibition Combined Scaled Score (ICSS) is calculated using total errors for both trials, and total competition time.

The *Statue* task is a hot EF task aimed at assessing the child's motor persistence and inhibition. It requires child to silently maintain a static body position with eyes closed for 75-seconds. The child is instructed to inhibit the impulse to respond to sound distracters, which the experimenter makes four times. Four scores are available for the Statue subtest – Statue, Body Movement, Eye-Opening, and Vocalization Total scores. The types of errors can help to determine the patterns of uninhibited responses demonstrated by the child.

Analytic Strategy

Descriptive statistics were used to outline the results of the Time 1, 2 and 3 assessments. One-way ANOVA on ranks was applied to verify that there were no condition interaction effects between conditions at pre-test. One-way ANOVA on ranks was then used to evaluate the effect of the role enactment on EF differences within the four experimental conditions for Time 1, Time 2 and Time 3. The use of this non-parametric one-way ANOVA on ranks test is justified by the small size of each group ($n = 20$) because they were not normally distributed. Statistical analysis was performed using SPSS version 23.0 (IBM, SPSS Software, Armonk, New York, U.S.A.). Differences were deemed significant when $p < 0.05$.

Results

Descriptive statistics

One-way ANOVA on ranks did not reveal any significant differences between conditions at pre-test of each test (DCCS $F = 7.31$, $p = 0.63$; Inhibition total combined score $F = 0.461$, $p = 0.93$; Statue task total

score $F = 0.69$, $p = 0.87$). This confirms an important condition that there were no interaction effects between conditions at pre-test of each test. Table 1 provides an overview of descriptive statistics, including the mean scores for each EF measure at Time 1, 2, 3 for each of the four conditions (Protagonist, Sage, Villain and Control groups).

DCCS task

One-way ANOVA on ranks was used to understand which roles were more effective for EF tests between four conditions (Protagonists; Sages; Villains; Control groups). As can be seen from Table 1, significant differences between DCCS measures at Time 1, 2 and 3 were found in Sage ($F = 6.13$, $p = 0.047$) and Control ($F = 10.36$, $p = 0.006$) conditions. There were no significant differences between DCCS measures at Time 1, 2 and 3 in Protagonist ($F = 5.30$, $p = 0.071$) and Villain ($F = 0.353$, $p = 0.838$) conditions. Children made significant progress in the DCCS test performance in two conditions: Sage and Control Group. Children in Protagonist and Villain conditions did not show any significant progress in the DCCS between Time 2 and 3 (Figure 1).

Inhibition task

Significant differences between Inhibition measures at Time 1, 2 and 3 were found in Inhibition (Total Combined Score) in Sage ($F = 6.13$, $p = 0{,}047$), Villain ($F = 10.36$, $p = 0.006$), and in Control groups ($F = 10.36$, $p = 0.006$). There were no significant differences between Time 1, 2 and 3 for the Protagonist condition ($F = 10.36$, $p = 0.006$) (Figure 2).

Statue task

As shown in Table 1, there were no significant differences between measures from Time 1 to Time 2 and from Time 2 to Time 3 for the Statue, Body Movement, Eye-Opening, and Vocalization total scores from the Statue task.

Discussion

The goal of the current study was to evaluate whether different pretend play roles would enhance children's EF performance differently. We created three experimental and one control group in order to observe the hypothesized influence of different roles on EF performance. As such, we selected three categories of roles which would differ significantly one from another on benevolence and skill: protagonists (benevolent), villains (malevolent/non-benevolent), and sages (skill related to EFs). The hypotheses made were that the pretend role a child plays could significantly affect EF

Table 1. Descriptive statistics of each EF measure at Time 1, 2 and 3 ($N = 80$, Mean ± SD).

	Time 1	Time 2	Time 3	*K-W* (Times)
DCCS				
Protagonist group ($n = 20$)	18.59 ± 2.55	19.67 ± 2.84	20.85 ± 2.13	
Sage group ($n = 20$)	18.50 ± 2.94	19.63 ± 2.75	20.58 ± 2.71	$F = 6.13$ $p = 0.047$*
Villain group ($n = 20$)	20.00 ± 2.16	20.29 ± 2.49	19.92 ± 2.46	
Control group ($n = 20$)	18.42 ± 1.86	19.76 ± 2.13	20.81 ± 2.17	$F = 10.36$ $p = 0.006$*
Inhibition (Total combined score)				
Protagonist group	8.91 ± 3.77	10.43 ± 3.57	11.08 ± 4.27	
Sage group	8.95 ± 2.44	10.89 ± 2.77	12.68 ± 3.51	$F = 12.77$ $p = 0.002$*
Villain group	9.21 ± 2.27	11.41 ± 2.15	13.58 ± 3.12	$F = 15.94$ $p < 0.001$*
Control group	8.79 ± 2.88	11.00 ± 3.02	12.44 ± 3.74	$F = 9.10$ $p = 0.011$*
Statue task (Total score)				
Protagonist group	23.00 ± 4.19	23.57 ± 4.76	23.85 ± 6.40	
Sage group	23.65 ± 5.39	23.37 ± 3.91	22.26 ± 7.84	
Villain group	22.47 ± 6.65	22.76 ± 7.75	22.92 ± 7.10	
Control group	23.16 ± 6.15	23.94 ± 4.93	24.75 ± 4.20	

*Significant differences between measures at Time 1, 2 and 3 in the same experimental conditions using one-way ANOVA on ranks.

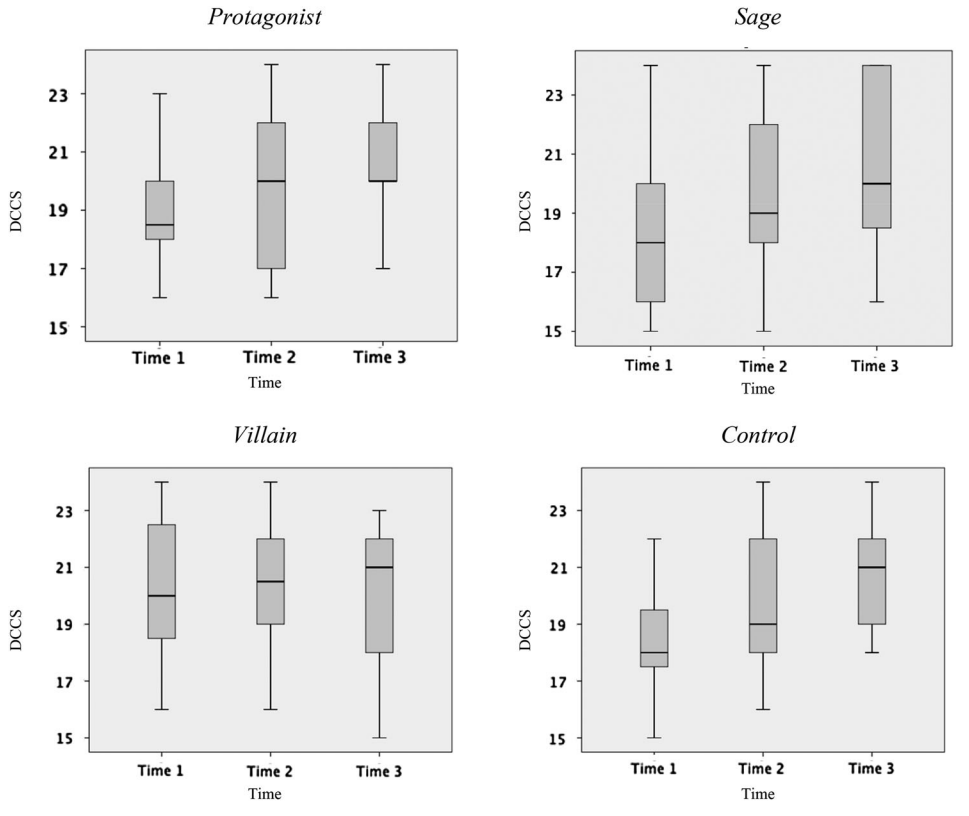

Figure 1. Chart of DCCS total scores at Time 1, 2 and 3 for four experimental conditions.

performance, and that the skilful (sage) role would see increases in EF that were not seen in children's enactment of benevolent (protagonist) and malevolent (villain) roles.

The results of the analysis demonstrated that by Time 3, the children in the Sage and Control conditions showed significantly improved performance on cognitive flexibility tasks. Children who were asked to play protagonists and villains did not show any significant improvements in cognitive flexibility from Time 1 to Time 3. Previous research (Veraksa & Veraksa, 2016) showed that the imaginary situation can reflect the reality of the task that is child solving or it can be irrelevant to it. In the current study, some children assumed either benevolent or malevolent roles that had no connection to the EF tasks fulfilment in their content, while others assumed a wise role much more connected to the EF tasks at hand. The Sage condition represented a wise role (a sorcerer) who was likely to be skilful in inhibition, cognitive flexibility and self-control. These results are of special interest to White and Carlson's (2016) study, in which the original concept of self-distancing was proposed. Our study suggests that not all self-distancing roles have the same effectiveness in EF tasks fulfilment, implying that the imaginary situation enacted through pretence may provide enhanced cognitive abilities peculiar to the imaginary content (e.g. sages versus protagonists). Previous work (Kelly, Dissanayake, Ihsen, & Hammond, 2011) has also shown symbolic play is associated with certain inhibitory but not generativity tasks, suggesting that different EF skills are implicated by the imaginary components of play, which may be explained by the different imaginary content enacted.

The current study also found that all the groups except Protagonists made significant progress in inhibitory control. Namely, children from the control group and those who played villains and sages demonstrated significant improvements in speed and accuracy from Time 1 to Time 3 in the Inhibition subtest. Our observations were that children favoured protagonists as a role, which, in light

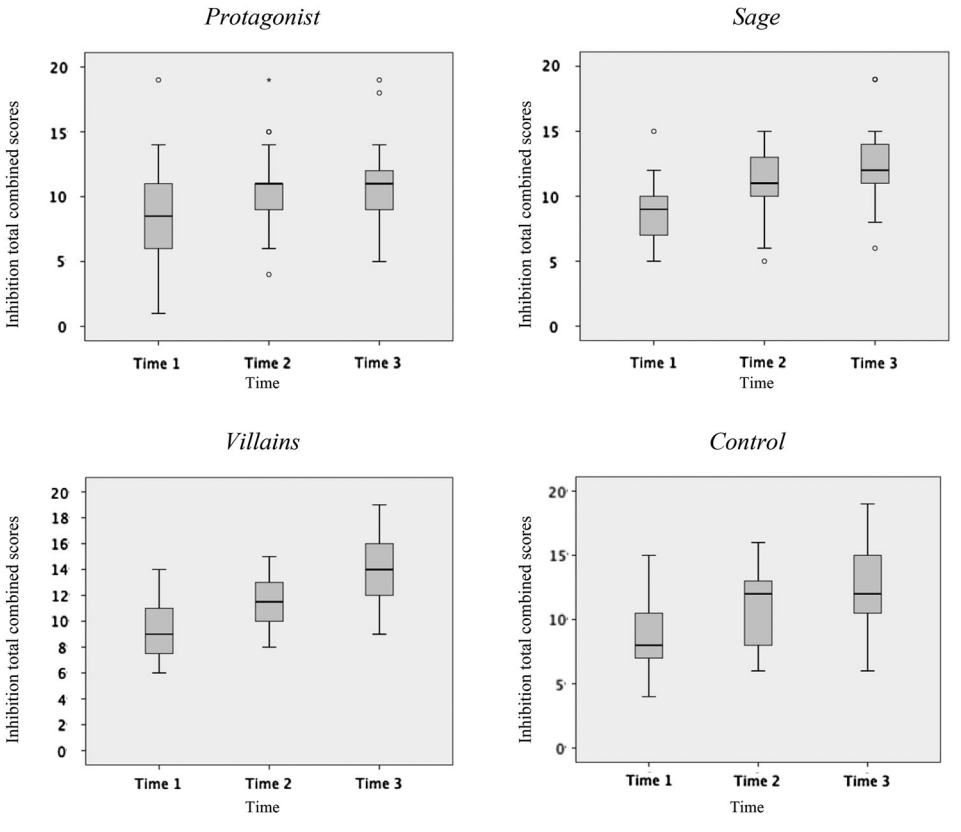

Figure 2. Chart of inhibition total combined scores at Time 1, 2 and 3 for four experimental conditions.

of current results, could be interpreted to mean that emotional involvement with the protagonist role negatively impacted children's EF performance. These results are also consistent with Carlson and Wang's (2007) assertion that individual differences in inhibitory control were significantly correlated with child's ability to regulate their emotions. We propose that strong emotional involvement may weaken children's ability to regulate emotions and consequently to diminish inhibitory control. This result is also consistent with Vygotsky's (1984) views on the unity of affect and intellect. Being interconnected, emotional and cognitive processes affect each other's functioning. Thus, interpreting the results using the framework of the cultural-historical approach, we can assume that high emotional involvement may have contributed to the reduction of the level of inhibitory control.

One possible explanation of why the Control group performed significantly better on cognitive flexibility and inhibitory control tests is because undertaking the same assessments exactly the same way three times may have acquired practice effects that the experimental groups (which conducted the tasks both in and out of character, at Times 1–3) did not. Perhaps, for this reason, children from the control group learned the tests better than the other three groups.

The analysis revealed no significant improvements in results related to child's hot EF. None of the groups showed any significant improvements in motor control and self-monitoring between Time 1 to Time 3. It is likely that motor control improvements require more observation time than current tests allowed. However, the fact that there were no significant differences between groups at Time 2 is of great interest. In Elkonin (1999), it was shown that role-taking has a dramatic positive effect on hot executive functions: preschoolers were first asked to stand still in the corner as long as they can and then to do the same in the role of a soldier. Role-taking made it possible for preschoolers to stand 10 times longer, which, according to Elkonin, shows impact of play on child

development. Some 55 years later, an experiment replicated Elkonin's work with relevant roles and showed only small boosts in performance from role-play (Smirnova & Gudareva, 2005). These authors argued that their results could be explained by a general decline in role-play development in modern children. As our results also suggest that pretence did not affect hot EF skills, future research would need to investigate Smirnova and Gudareva's (2005) assertions.

Limitations

Several limitations of this study must be acknowledged. Although we controlled for demographics such as children age, gender, and testing interval, we did not consider potential effects of parent education and ethnicity. In line with Smirnova and Gudareva's (2005) conclusions, future replications of the current study may also need to control for differing levels of children's play development (e.g. Elkonin, 1999; Lewis & Boucher, 1997). Future research should also use different forms of each test to reduce practice effects. Finally, the current results are limited to children attending a pre-kindergarten programme, and may therefore not generalize to children outside such programmes.

Conclusion

Much research has indicated the importance of young children's EFs to current and later development. Previous experimental work has suggested that assuming the role of an imaginary character such as Batman™ can improve a young child's EF performance, but it was unclear which traits associated with the role (e.g. benevolence, skill) would impact EF the most. The current experiment sought to investigate if five- to six-year-olds playing out a benevolent (i.e. protagonist), malevolent (i.e. villain) or skilful (i.e. sage) role would confer EF advantages. Results from two cold (DCCS and Inhibition) and one hot (Statue) EF tasks indicated significantly improved cold EF scores for the Sage and Control conditions. The Villain condition showed improvements only in the Inhibition task. The current experiment provides preliminary indications that pretending to be characters with high EF skills may be transferred to real-world EF performance, but those roles with benevolent or malevolent traits may not exert the same influence. It suggests that it is not pretence or psychological distancing per se which is conferring the EF performance boost, but rather the traits of the particular role imagined, consistent with Vygotsky's (2004) theory that children transfer cognitive skills and content from the imaginary to real-world contexts.

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