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# Preschooler's Motor Development and Executive Function Skills

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## ABSTRACT

Previous research has shown that executive function (EF) skills and motor skill ability develop during the early preschool years. Children from lower socioeconomic status (SES) homes tend to score lower than middle to upper SES children but no research has been done to explore the connection between EF skills and motor skill ability in this population. If a connection is discovered then there will be possibilities of creating motor interventions that could be used in order to increase development of executive function abilities. In the current study, 3-5 year old children from low SES areas were tested to look at the relationship between executive function skills and motor skill abilities to benefit disadvantaged children.

## INTRODUCTION

Motor development and executive function skills rapidly improve during the preschool years (Hartman et al., 2010). Executive function skills include problem solving, self-control and planning (Diamond & Lee, 2011). Past research has discovered a relationship between executive function (EF) skills and motor development in young children from middle and upper socioeconomic statuses (SES) (Diamond & Lee, 2011). Little research has explored this connection in children from lower SES backgrounds. Children from economically disadvantaged backgrounds have lower EF skills (Blair and Razza, 2007). Therefore, discovering a relationship between motor and EF skills may enable researchers to create motor interventions that could be used to improve EF abilities in children from lower SES environments.

The current study is a continuation of research that has been looking at the relationship between EF and motor skills in preschool age children who are from low SES households. It was hypothesized that EF and motor skills would be positively correlated.

## METHODS

**Participants:** 19 (11 male) children between 3-5 years of age ( $M= 45$  mo.) from a local CT preschool program

**Materials:** The Movement Assessment Battery for Children-2 (M-ABC2) and The Expressive One Word Picture Vocabulary Task (EOWPVT).

The executive function tasks included two pencils, cards with different images on them, and a gift bag with a toy inside.

- The M-ABC2 assessed 8 motor skills, divided into 3 subscales: Manual Dexterity (posting coins, threading beads and drawing trails), Aiming & Catching (catching and throwing a bean bag) and Balance (one leg balance, walking with heels raised, and jumping on mats).
- Executive Function was studied using four tasks: Peg Tapping, Head-Toes-Knees-Shoulder (HTKS), Dimensional Change Card Sort (DCCS) and Gift Wrap.

**Procedure:** Children were brought into a separate room in the preschool and the M-ABC2 and EF tasks were administered. Each child was also given the EOWPVT to assess verbal IQ.

## RESULTS

### Age & Gender

The Motor Skills Assessment scores were normalized for age, so as would be expected, there were no significant age differences for these measures. There were no significant age or gender differences in EF or motor scores (Table 2).

### Relation between EF and Motor Abilities

In order to compare EF ability to motor skills ability, we created an EF composite score by averaging the four Z-scores of the EF tasks from each child. Table 1 displays the partial correlations (when controlling for age in months and expressive IQ) among the EF composite measure and motor ability. There was a significant positive correlation between the EF composite score and overall motor ability. There was also a positive correlation with EF scores and all three motor subscales (manual dexterity, aiming and balance).

Table 1: *Partial Correlations between Executive Function and Motor Skill Measures*

	EF Comp	Overall Motor	Manual Dexterity	Aiming	Balance
EF Comp		0.74**	0.49*	0.56*	0.54*
Overall Motor			.73**	.62**	.68*
Manual Dexterity				.18	.14
Aiming					.3

Note. Partial correlations controlled for age and verbal IQ.

\*\*  $p < .01$  \*  $p \leq .05$

All tests 2-tailed

Table 2: *Means and (SDs) of Motor Skills Categories According to Gender*

	Aiming	Balance	Manual Dexterity	Motor Total
Male	23.00 (5.23)	31.45 (7.30)	25.36 (6.83)	79.82 (12.98)
Female	24.13 (4.82)	33.25 (4.68)	22.00 (6.32)	79.38 (13.85)

## DISCUSSION

The current findings indicate that there is a relationship between EF skills and motor skill ability in children from lower SES environments, which is similar to what previous studies have shown for middle and upper SES populations (Diamond & Lee, 2011). This relationship may occur due to the fact that both skill sets develop during the preschool years and it takes planning and problem solving to accomplish certain tasks such as moving from place to place, throwing a ball, or walking on a straight line. Increased brain development of the prefrontal cortex during this time may also play a role in both abilities. EF skills are typically linked to the prefrontal cortex while motor skill abilities are usually linked to the cerebellum (Hartman, et al., 2010). Subsequently, the connection between EF skills and motor skill abilities leads to the assumption that EF skills are also linked to the cerebellum which is supported by recent neuroimaging studies (Diamond & Lee, 2011).

The discovery of a relationship between EF and motor skills opens up the possibility of creating new interventions that target both of these areas at the same time or focusing on motor development, something young children usually find enjoyable, to enhance executive function abilities. This is significant because these skills will influence behavior and these children's outcomes into adulthood.

## REFERENCES

- Blair and Razza, (2007)  
 Diamond and Lee, (2011)  
 Hartman, E., Houwen, S., Scherder, E., and Visscher, C. (2010)