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MOTOR PERFORMANCE

Exploring the Effect of Gender and Disability on Gross Motor Performance in Kindergarten Children

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Abstract

Background: *Gross motor movement is a vital part of the growing process and ultimately plays a role in a person's ability to lead a physically active life. Researchers have analyzed the different ways in which individuals develop skills. At the heart of that discussion has been gender. Most recently, researchers have focused on the differences among various forms of disability. However, little has been done to understand how these variables interact with each other in the development of gross motor skills.* ***Objective:*** *Therefore, in this study I sought to explore the interaction of disability and gender on gross motor performance.* ***Method:*** *Utilizing a national dataset, the Early Childhood Longitudinal Study - Kindergarten Class of 1998–99 dataset (ECLS-K), I utilized a 2 × 2 factorial ANOVA to understand the effects of gender and disability on gross motor score.* ***Results:*** *A large sample (N = 16,960) was utilized to indicate a significant interaction effect of gender and disability, as well as significant main effects. Results suggest that both gender and disability have an effect on gross motor performance; specifically, boys with disabilities are at a higher risk for having low gross motor skills.* ***Conclusion:*** *The significant re-*

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sults from this analysis demonstrate that gender and disability have an effect on the gross motor ability of young children. In contrast to other literature, in this study female participants performed slightly better than male participants did, and in line with other research, in this research the group without disabilities demonstrated a better gross motor score than the group with disabilities.

Gross motor movement stems from large muscle groups and whole body movement and is essential for all locomotor movement such as walking and running and for object-control movements such as throwing and kicking. These skills are typically attained and developed through early childhood and mastered as children age into adolescence (Davies & Rose, 2000). Gross motor movement is essential for daily functioning and for physical activity. Without proper development of these large muscle movements, future advancement to more complex motor movements or development of motor competence is difficult. Individuals with a limited or lower motor competence have been shown to have lower fitness levels when compared with individuals with an average motor competence (Fransen et al., 2014; Stodden et al., 2008). Early development of gross motor skills is vital to increasing the likelihood of continued physical activity.

Understanding individual difference in development is the best way to understand how to improve the development of skills. Motor deficits among various populations with disabilities are apparent with the research literature, when these individuals are compared with their peers without disabilities. In recent research, children with autism spectrum disorder (ASD) have shown significant delays in motor skill performance when compared to typical peers (Liu, Hamilton, Davis, & ElGarhy, 2014), as tested with the Test of Gross Motor Development (TGMD-2; Ulrich, 2000). Additionally, individuals with mild intellectual disabilities (ID) have been shown to perform poorly on fitness measures (muscular strength, muscular endurance) when compared with peers without ID (Frey & Chow, 2006). Limited muscular strength and endurance needed for gross motor activities can lead to a limitation of gross motor movements and therefore is concerning for the future possibility of lifetime physical activity. Furthermore, gross motor issues have been documented even in children with learning disabilities who have demonstrated similar development patterns, although behind their typical peers

(Westendorp et al., 2014). Outside of cognitive and developmental disabilities, children who are blind have shown lower locomotor ability and object control skills when compared to their sighted peers (Wagner, Haibach, & Lieberman, 2013). With individual evidence of the deficits of groups with disabilities, it is necessary to look broader to gain a better understanding of how individuals with disabilities vary from those without disabilities.

On the other hand, gender differences among boys and girls have not been as clearly defined. The recent literature has demonstrated differences between genders in locomotor and object control skills (Butterfield, Angell, & Mason, 2012; Crespo et al., 2013; Venetsanou & Kambas, 2011), as well as limited or no differences in locomotor skills (Goodway, Robinson, & Crowe, 2010). Early development of motor ability is dependent on the interaction between environmental and biological factors (Saraiva, Rodrigues, Cordovil, & Barreiros, 2013; Thomas & French, 1985; Valentini, Clark, & Whitall, 2015). Barnett, van Beurden, Morgan, Brooks, and Beard (2010) demonstrated that boys performed better on object control skills than did similarly aged girls. This was further evidenced in a study of 3–6-year-old children in which boys performed better in throwing for distance (du Toit & Pienaar, 2002). Du Toit and Pienaar (2002), in the same study, conversely demonstrated that girls performed better in hopping and balance on one leg. Furthermore, Kakebeeke, Caflisch, Locatelli, Rousson, and Jenni (2012) demonstrated girls performed higher than boys on a majority of balance-type gross motor tasks such as standing on one leg, walking on a beam, hopping on one leg, rising, running, and jumping up and down. Gender differences are evident across a magnitude of motor skills; however, there appears to be a trend that girls perform better on locomotor-type skills and boys on object control skills (Goodway et al., 2010; Lorson, Stodden, Langendorfer, & Goodway, 2013).

Few researchers have looked at how the interaction of gender and disability affect gross motor performance. Evidence suggests how the individual variables may affect gross motor performance; however, it is not clear how they work together. Therefore, the aim of this study was to explore the relationship of gender and disability on gross motor performance, in order to understand (1) How do gender and disability affect gross motor performance? and (2) If an interaction effect is occurring, which variable is accounting for the effect?

Method

Dataset

A sample from the Early Childhood Longitudinal Study - Kindergarten Class of 1998–99 dataset (ECLS-K; U.S. Department of Education, National Center for Education Statistics, 2001) was utilized in this analysis. This dataset provides a substantial amount of information on the children's status at entry to school, their transition into school, and their progress through eighth grade. The ECLS-K recruited children from public and private schools and from diverse socioeconomic and racial/ethnic backgrounds. Information was recorded on information from reading and math skills, to social/emotional skills, to fine and gross motor skills. Trained evaluators assessed children in their schools and collected information from parents over the telephone. Teachers and school administrators were contacted in their schools and asked to complete questionnaires. (Rock & Pollack, 2002). The original dataset contained over 18,000 variables and around 22,000 child participants (Rock & Pollack, 2002).

For this study, three variables were chosen for analysis: gender, disability, and gross motor score. A sample of 16,960 cases was used in this analysis. The sample included 58% White, 14.7% Black/African American, 17.5% Hispanic, 4.2% Asian, 1.7% American Indian or Alaskan Native, and 2.8% identifying as more than one race. Data were taken at the initial entry into school.

Independent Variables

Two grouping variables, gender and disability, were used to break the sample into comparable groups. Each variable contained two levels. Gender was labeled as male (n = 8620) or female (n = 8340), roughly 50.8% and 49.2% of the sample, respectively. The disability group was designated as "yes" a disability is present (n = 2299) or "no" the child has no disability (n = 14,661), for 13.6% and 86.4% of the sample, respectively. In the case of the disability variable, project staff asked schools whether the child had an individual education plan (IEP), an individualized family service plan (IFSP), or a 504 plan; once children were identified as receiving special education assistance due to disability, project staff identified what accommoda-

tions were needed to be made to administer the direct child assessment batteries appropriately (Rock & Pollack, 2002). Considering the difference in sample size between the group with a disability and the group without, and considering the U.S. population as a whole, this sample is fairly representative of what would be expected. In this dataset, disability is a very dichotomous simplification of a heterogeneous group; however, the use of this variable allows for a global understanding of the differences of those with and without disabilities. Additionally, this was the only indication of this population within the dataset. The original collectors of this data did not go into depth into what specific disabilities the included children had. The sample for this study was limited to cases in which both independent variables were known; data were considered missing completely at random, as data was being analyzed secondarily, and missing data were independent of observed variables.

Dependent Variable

The gross motor score of participants was utilized as the dependent variable. The gross motor score is a summative score of a multitude of tests taken from outside assessments and utilized in aggregate for the dataset; assessment items combine jumping, balancing, hopping, skipping, walking backward, and a bean bag catch. Maximum scores for individual tests were between 1 and 2. Total scores ranged from a minimum of 0 to a maximum of 8 (see Tables 1 and 2). Only an aggregated gross motor score was included in the dataset; individual assessment items scores were not included. Individual testing items were taken from a multitude of assessment batteries; these focused predominantly on body control and coordination (e.g., balancing on one foot, hopping on each foot, skipping, and walking backward on a line; West, Dento, & Germino-Hausken, 2000).

Table 1
Descriptive Statistics of Gender

Gender	*n*	Gross motor *M*	Gross motor *SD*	Kurtosis	Skewness
Male	8620	6.13	1.918	0.461	-1.016
Female	8340	6.64	1.645	1.116	-1.247
Total	16960	6.385	1.782		

Table 2
Descriptive Statistics of Disability

Disability category	*n*	Gross motor *M*	Gross motor *SD*	Kurtosis	Skewness
Yes	2299	5.97	2.014	0.131	-0.901
No	14661	6.45	1.764	0.932	-1.177
Total	16960	6.21	1.889		

Data Analysis

The relationship of gender and disability on gross motor score was explored utilizing a two-way factorial ANOVA to analyze the interaction. The factorial ANOVA tested for any differences of between-subject effects of gender, disability, and the interaction of gender and disability. Prior to analysis, data were analyzed for univariate outliers through analysis of the histograms, skewness, and kurtosis as well as the standardized values ($M < 3.29$) within groups. No outliers were identified; therefore, all 16,960 cases were used in the analysis.

Results

Descriptive analysis revealed female participants both with and without disabilities ($M = 6.64$, $SD = 1.645$) scored slightly higher than male participants ($M = 6.13$, $SD = 1.918$; see Figure 1). Similarly, the group without disabilities (M = 6.45, SD = 1.764) demonstrated a higher mean gross motor performance, than the group with disabilities (M = 5.97, SD = 2.014) (See Figure 1). Each of the groups demonstrated scores very close to the maximum possible of 8, demonstrating a potential ceiling effect.

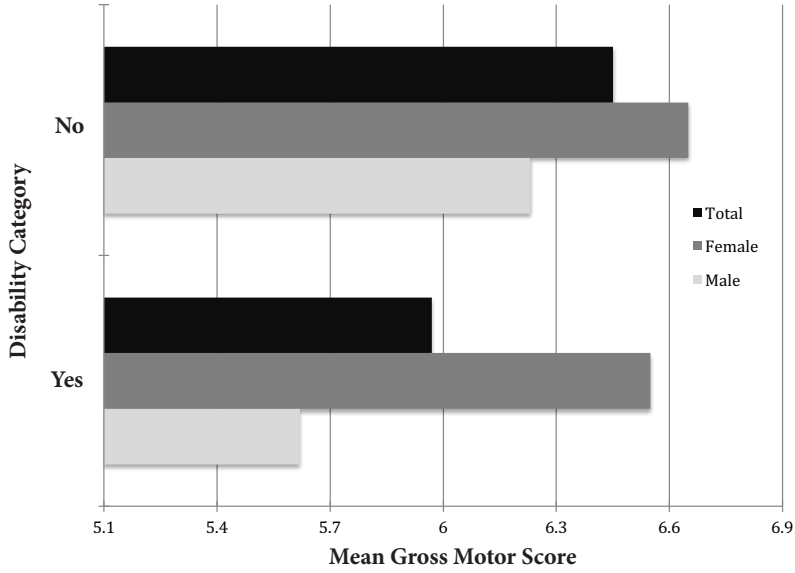

Figure 1. Difference within gender and disability.

The factorial ANOVA resulted in a significant result within the interaction between gender and disability on gross motor score, $F(1, 16956) = 39.424$, $p < 0.001$, $\eta^2 = 0.002$, demonstrating a significant interaction effect of both gender and disability on gross motor ability. Furthermore, significant results were shown in the main effects between the gender groups, $F(1, 16956) = 272.895$, $p < 0.001$, $\eta^2 = 0.016$, and between the disabilities groups, $F(1, 16956) = 75.672$, $p < 0.001$, $\eta^2 = 0.004$, further showing a significant difference between each of the levels of both gender and disability. However, each of the eta-squared effect sizes reveals that gender and disability account for a very small amount of the variance.

Further, the effect sizes of the main and simple effects were measured with the guidelines outlined by Cohen (1977), and each group demonstrated a small effect. Main effects between the female and male group (ES = 0.285) and the group without disability and with disability (ES = 0.254) were small, demonstrating about a quarter standard deviation difference between the groups. The simple effect analysis of the female group without disabilities and the male group without disabilities revealed a small effect size (ES = 0.262). A moderate effect size (ES = 0.492) was shown in the difference of the

female group with disabilities and the male group with disabilities, demonstrating a relatively large difference between girls and boys with disabilities.

Discussion

In this study, I sought to explore the relationship of the interaction between gender and disability on gross motor score. A factorial ANOVA demonstrated significant although very small main effects and a significant interaction effect. Results indicate that gender and disability play a role in the differences revealed in this analysis. Through this analysis, it can be suggested that both gender and disability have a factor in how a child develops motor skills. This result in itself is not surprising or overtly contrary to the commonly held beliefs that (1) boys and girls perform skills differently and (2) individuals with disabilities would have gross motor scores less than those of their peers without disabilities, but it does provide sufficient foundational evidence to warrant an inquiry into which gross motor skills are hindered because of the disability.

Moreover, these results provide contrary evidence to the previous research on gender, but more important provide a unique look at a young, large sample of boys and girls with and without disabilities. Results from this study suggest that gender and disability have some type of mitigating effect on the development of gross motor skills, but the exact effect within this analysis is difficult to ascertain. Furthermore, in this analysis the small effect sizes for the ANOVA suggest that other factors (e.g., age, race, or socioeconomic status) may explain the differences, as gender and disability account for less than 2% of the results. Previous research (Saraiva et al., 2013; Thomas & French, 1985; Valentini et al., 2015) has suggested that the differences in gender groups are caused by an interaction of social and biological factors, which often favor boys (Crespo et al., 2013). However, results from this analysis are taken from a sample of prepubescent children, so biological factors should be limited.

In a recent analysis of parent and child perceptions of fundamental movement skills, Liong, Ridgers, and Barnett (2015) found that parents' perceptions of girls' locomotor skills were significantly and positively associated with girls' actual locomotor scores ($r = .48$). Parents had similar perceptions with boys' scores for object control skills ($r = .58$). Evidence from this study suggests that par-

ents' judgment of skills indicates some level of stereotyping (Liong et al., 2015). Perhaps differences seen in young children are a factor of what children are expected to do, as well as encouraged to do. If young boys are encouraged to perform more stereotypical activities such as soccer and baseball, then they will likely be more proficient in the fundamental motor tasks associated with those skills. If girls are encouraged to participate in activities such as jump roping and hopscotch, then they will likely have a higher affinity to activities using balance and locomotion. These differences are evident within these results, as well as in previous research (Barnett et al., 2010; du Toit & Pienaar, 2002; Kakebeeke et al., 2012), as the motor assessment battery chosen for this assessment contained a majority locomotor and balance–type skills, with one singular object control task (catching a tossed bean bag). Within the assessment battery there were no other throwing or object control items, which, based on previous research, would favor boys. A lack of object control activities in the assessment likely attributed to the girls having a greater mean score regardless of disability. It also does not completely capture the skills necessary to be proficient in all gross motor movement.

Considering the differences shown between the group with and without disabilities, the results in this analysis are, again, what would be expected. This analysis allows for global understanding of the differences between those with and without disabilities; however, the effect of the disability is difficult to understand fully because all children labeled "with a disability" were included in this group based on the presence of an IEP. An IEP is not a detailed enough record when trying to understand why there are differences between these groups. Children with an IEP have this for a multitude of reasons, which stem from physical, cognitive, or behavioral disabilities, all of which have drastically different effects on the their ability to learn and utilize knowledge. The database used for this study, by defining disability based on the presence of an IEP, may indicate the presence of limited opportunity, as with stereotyping between gender groups. The pressures to provide services within the IEP process and for schools to prioritize services (Whitby, Marx, McIntire, & Wienke, 2013) may lead to some children being given certain services (e.g., speech) over others (e.g., adapted physical education [APE] or occupational therapy [OT]). When schools prioritize and place more

emphasis on certain services, the child may have a limited opportunity to learn motor skills. Further, there may be a misunderstanding of the items taught in OT versus APE, with a belief that services are similar and therefore both are not needed. Research has demonstrated that deficits exist among children with disabilities in regard to motor ability; therefore, what may be evidenced in this result is that although biological factors may exist, perhaps it is also a limited accessibility (e.g., environmental factor) to learn tasks that is causing a difference.

There were simple effects with each group, and again, in this study girls outperformed boys in both groups regardless of having or not having a disability. However, what is prevalent is how much better the girls with disabilities performed than the boys with disabilities. The girls' mean gross motor score was nearly one half a standard deviation (ES = 0.492) higher than the boys', indicating that not only is the presence of a disability having an effect on the motor ability of children, but gender is also having an effect. Results indicate that boys with disabilities are at a higher risk for having lower motor skills. It is difficult to discern whether the lower motor tasks are due to the type of assessment used or the type of disability. It can be discerned, however, that boys with disabilities are at risk; therefore, educators should be aware that this could occur and provide ample opportunity for practice so that these boys can reach the level of their peers.

Considering the practical application of these results, it is important to understand that although there are specific differences among boys and girls with and without disabilities, boys with disabilities performed lower than any other group. Further, children with disabilities demonstrated lower scores than did those without disabilities. The differences, however, are only accounted by a small amount from gender and disability, especially in young children. These differences may be further affected by variables not accounted for in this analysis. The race, age, or socioeconomic status of individuals may account for a greater amount of difference than gender or disability. Similar to Liong et al.'s (2015) results, these results indicate that parents and teachers should advocate and encourage the growth of all skills necessary for gross motor movement and provide opportunities for practice and development, especially for those with dis-

abilities. Moreover, teachers and parents can ensure that they focus on all skills sets, as the development of gross motor tasks allows for children to progress to the more complex movement needed to lead physically active lives. Future research should analyze the specific differences in gross motor skills of those with disabilities, to understand better what skills are hindered more by the disability.

Limitations

The data included in this study were a selected sample from a much larger dataset and therefore outside of my control. Two practical issues limit the application of these results. The first is that limitation is the restricted factor of the disability category. The data provide a global look at the effect of disability, but they do not provide specific detail to understand individual differences in children. When the data were collected, no specific diagnosis was collected, which could encompass a variety of diagnoses. In the future, researchers should collect a variety of diagnoses to allow for a deeper analysis.

The second limitation was the gross motor assessment utilized. First, the assessment items were collected from a variety of other validated assessments and not validated on their own merit. Future research in which data are collected should include a validated assessment battery to ensure that the construct is covered by the associated test. This would ensure that the scores collected are a fair representation of the participants' gross motor ability. Additionally, the only data included were the aggregated gross motor composite scores. Including the scores for each item would allow for a deeper analysis of locomotor and object control skills. Although the scores demonstrated a significant result, the result provided little practical application because it did not allow for an in-depth analysis. Moreover, the variety of gross motor items were a collection from a variety of other gross motor assessments and may have favored the girls in this analysis because of the lack of object control–type skills. To gain a better understanding of how gross motor skills develop and to find how those skills appear in different groups, researchers should use large datasets that include a validated measure. By doing so, they will have the potential to understand how motor skills relate to other skills such as academics.

Conclusion

The significant results from this analysis demonstrate that gender and disability have an effect on the gross motor ability of young children. Contrary to other literature, female participants performed slightly better than did male participants, and in line with other research, the group without disabilities demonstrated a better gross motor score than the group with disabilities. However, the grouping factors only accounted for a small amount of the variance between each group. Researchers should include other factors that may play a more vital role in the differences between these groups. Additionally, future research should include the individual testing items to allow for the ability to analyze which gross motor skills are having the greatest effect as a result of gender or disability. However, these results suggest that educators and parents can work to alleviate some of this difference by providing equal opportunities to practice all types of skills involved in gross motor movement. Further review of this interaction is needed, with a more sensitive gross motor measurement, as well as including diagnosis of each participant.

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