

Preschoolers' Physical Activity and Time on Task During a Mastery Motivational Climate and Free Play

Actividad Física y Tiempo en la Tarea Durante un Clima Motivacional Autónomo y el Juego Libre en Preescolares

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Abstract

The purpose of the present study was to determine the effect of a structured, mastery motivation physical education climate and an unstructured physical activity climate on time spent on task in a small sample of preschool children. Children enrolled in a public, federal-subsidized childcare center (N= 12) participated in two 45 minute physical activity programs within the school day. The structured climate consisted of a biweekly program of motor skill instruction that was based upon the key principles of a mastery motivational climate. The unstructured program was a daily 45 minute free play environment. Actigraph accelerometers monitored children's participation in physical activity and time-on task was observed by a momentary time sampling technique. Results showed that time on-task significantly improved following a mastery motivational climate, and children spent 36% of their time in moderate-to-vigorous activity in this climate. In contrast, time on-task did not significantly improve following participation in a free play environment and participants spent a majority of their time in sedentary behavior and accumulated no vigorous physical activity. Our results indicate that participation in physical activity impacts a preschooler's ability to stay on task and the amount of physical activity accumulated during physical activity programming is dependent upon the climate delivered.

Key Words: Mastery climate, physical education, time on task, young children

Resumen

El propósito de este estudio fue determinar el efecto de un clima motivacional autónomo en educación física y un clima de actividad física no estructurado, sobre el tiempo empleado en las tareas de aprendizaje, en una pequeña muestra de niños en edad preescolar. Los niños de un centro de atención infantil subsidiado (N=12) participaron en dos programas de actividad física de 45 minutos dentro del horario lectivo. El ambiente estructurado incluyó dos sesiones semanales de instrucción de destrezas motoras, basado en los principios fundamentales del clima motivacional autónomo. El programa no estructurado consistió en 45 minutos de juego en un ambiente libre. Se utilizaron acelerómetros ActiGraph para monitorear la participación de los niños en la actividad física, así mismo el tiempo utilizado en las tareas de aprendizaje fue observado mediante el muestreo de tiempo momentáneo o de intervalos. Los resultados mostraron que el tiempo utilizado en las tareas de aprendizaje mejoró significativamente siguiendo el clima motivacional autónomo y los niños emplearon el 36% de su tiempo en actividades físicas de moderada a vigorosa intensidad. En contraste, el tiempo empleado en las tareas de aprendizaje no mejoró significativamente después de la participación en un entorno de juego libre, en este, los niños mostraron mayormente un comportamiento sedentario, además de la ausencia de actividad física vigorosa. Estos hallazgos indican que la participación en actividad física impacta positivamente la habilidad de los preescolares de permanecer en las tareas de aprendizaje propuestas y la cantidad de actividad física acumulada, durante el tiempo estipulado para la misma, depende del clima motivacional generado.

Palabras Claves: clima motivacional autónomo, educación física, tiempo en la tarea, preescolares

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Introduction

Participation in regular physical activity is important for the health of young children. United States national initiatives suggest that preschool children participate in at least 60 minutes of structured (e.g., physical education, afterschool sports clubs) physical activity and 60 minutes of unstructured (e.g., free-play during recess and afterschool) physical activity every day (National Association for Sport and Physical Education, 2009).

A review on physical activity participation concluded that only 23% of preschoolers between the ages of 2 – 5 years engage in the recommended 120 minutes of daily physical activity (Tucker, 2008). In a study of over 400 children in 24 preschools, only 3.3% of time is spent in moderate-to-vigorous physical activity (MVPA) during the school day (Pate, McIver, Dowda, Brown, & Addy, 2008). A study examining physical activity during preschool physical education found that in random sample of 573 preschoolers (288 boys; M age = 5.4 years, $SD = 0.4$) from 35 preschools accumulated 12 min (33%) of MVPA, 5 min (13%) of light PA, and 20 min (54%) of sedentary behavior during physical education (van Cauwenberghe, Labarque, Gubbels, de Bourdeaudhuij & Cardon, 2012). Furthermore, longitudinal data suggest that physical activity levels decline between the ages of 3 and 5 years (Taylor et al., 2009), and that physical activity levels established during the preschool years are similar to physical activity levels during the childhood years (Pate, Baranowski, Dowda, & Trost, 1996). Thus, it is imperative that research focus upon effective strategies to encourage preschoolers to establish and maintain adequate amounts of physical activity.

Although the importance of physical activity for overall health is well known, the positive impacts of physical activity on increasing concentration, mental cognition, and academic performance, as well as reducing self-stimulatory behaviors (e.g. fidgeting) and school-related stress are not as well understood. A positive association between physical activity and cognitive functioning in children has been found in several studies (Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Shephard, 1997) and meta-analyses (Erwin, Fedewa, Beighle, & Ahn, 2012; Sibley & Etnier, 2003). However, these studies were conducted with elementary and secondary age school children. One behavioral outcome that has received empirical consideration is the effect of physical activity on attention (i.e. on-task behavior) in the classroom. Currently the literature has not fully investigated the effect of physical activity on time on-task in a preschool population. Further, we do not know which type of physical activity (i.e. light, moderate, vigorous, structured or unstructured) has the greatest effect on time on task for this age group. Therefore, the primary purpose of the present study is to determine the effect of a structured, mastery motivation physical education climate aimed at increasing gross motor skills and physical activity and an unstructured physical activity climate on time spent on task in a small sample of preschool children.

Method

Participants and setting.

This study included preschool children from one early childhood center. The sample consisted of 12 preschoolers (2 females, 10 males, M age = 4 years 6 months) from a subsidized early childcare center located in a rural town in the southeast United States. Eleven of the participants were black and one participant was white. The mean height was 110.03

centimeters and weight was 45.63 pounds. The center provides instruction and services from 7:30 AM until 2:00 PM. Instruction and services include individual, group, and center activities in arts, crafts, reading, writing, arithmetic, and gross movement. The gross movement program occurred daily, with two days (Tuesday and Thursday) a week in a mastery motivational climate and three days a week (Monday, Wednesday and Friday) in a free play environment.

Procedures.

Upon obtaining permission from the center director, classroom teachers and the Institutional Review Board for Involving Human Subjects, parental consent and participant assent were procured. Through the use of Actigraph GT3X triaxial accelerometers, objective measures of physical activity and time on-task were observed 4 times: two times before and after the implementation of a structured physical activity climate and two times before and after a free play physical activity climate. The Actigraphs were placed on the participants 15 minutes prior to the pre-observation period. This allowed the participants to acclimate to the accelerometer and to the researcher in the classroom. The Actigraphs were removed after the post-observation period.

Climates Procedures.

Structured climate – Mastery Motivational Climate.

The structured climate consisted of a biweekly program of motor skill instruction that was based upon the key principles of a mastery motivational climate. A mastery motivational climate in physical education refers to a high autonomy learning environment that emphasizes learning and skill mastery based on exerting maximal effort and self-referenced criteria for determining success. Within the specific field of physical education, Hastie, Rudisill and Wadsworth (2012) conducted a review of research that examined interventions at pre-school, primary and secondary school levels. These authors reported that providing students with opportunities to become self-directed leads to higher levels of skill attainment (Martin, Rudisill & Hastie, 2009; Valentini & Rudisill, 2004a,b), physical activity (Wadsworth, Robinson & Rudisill, 2013), adaptive cognitive and affective responses (Morgan, Sproule, & Kingston, 2005), as well as increased perceptions of ability and effort in physical education (Tessier, Sarrazin, & Ntoumanis, 2010).

This program was housed in a large indoor room with a grassy outdoor area located outside the space. Each session was scheduled for 45 minutes and consisted of six stations in which children could practice various motor skills. Selected skills were designed to match the elements of the Test of Gross Motor Development (TGMD-2; Ulrich, 2000), namely the locomotor skills of running, galloping, hopping, leaping, horizontal jumping, sliding, as well as the object control skills of striking a stationary ball, dribbling a ball, kicking, catching, overhand throwing, and underhand rolling. Each session consisted of a two to three minute warm-up activity, followed by 40 minutes of motor skill instruction, and a two to three minute closure. The implemented program was designed in an attempt to maximize the children's autonomy with respect to the six areas of a classroom environment described by Epstein (1989). Following the well accepted acronym of TARGET (representing the six task structures: task, authority, recognition, grouping, evaluation, and time), the researchers organized all lessons in station format. The key goal in station design was to include sufficient flexibility so that the lowest skilled student and the highest skilled student were able to

achieve success. Participants managed their own time and were allowed to make decisions on what skills they practiced.

Unstructured climate.

The unstructured climate was a free play climate consisting of one 45-minute block of unstructured free-play outside on a playground. This type of activity is typical for preschools. The playground is equipped with typical early childcare equipment (e.g., swings, balance beams, slides, and sand boxes). The free play program did not incorporate formal instruction with motor learning goals or objectives. Childcare teachers interacted with the children on the playground and prompted children to participate in activities.

Instruments.

Physical activity participation.

Physical activity was measured with the Actigraph GT3X triaxial accelerometer (Mini-Mitter Co., Inc. Bend, OR, USA). Accelerometers were worn on the right hip and attached with an elastic belt. Accelerometers were programmed with a 15-s epoch. Minutes of sedentary behavior, light physical activity and moderate-to-vigorous physical activity were quantified on the basis of calibration studies by the Butte (2014) cut point equation.

On-task behavior.

Two researchers were trained to observe and classify children's behavior as on- or off-task according to an established protocol (Mahar, Murphy, Rowe, Goden, Shields & Raedeke, 2006). Researchers attended a two-hour training session and inter- and intra-rater reliability was established (>90%). Researchers practiced observing in each classroom one week prior to data collection. This served as an acclimation period for the researchers, teachers, and students. One researcher observed and recorded behavior immediately before and after the two play conditions. The researcher listened to a prerecorded mp3 audio file to follow the observation protocol. The researcher systematically observed behavior during a 10-second interval and recorded behavior during a 5-second interval. This protocol yields four observations per minute and each child was observed for four minutes. On-task behavior was defined as verbal or motor behavior that followed the class rules and was appropriate to the learning situation. Children's behavior was recorded on an observation sheet as one of the following: on-task (e.g., listening to the teacher read to the class), motor off-task (e.g., out of seat and not attending while teacher is reading), noise off-task (e.g., talking with others and not attending while teacher is reading), or passive/other off-task (e.g., staring into space or sleeping while teacher is reading).

Data-analysis.

Descriptive statistics were generated for the sample in terms of on-task behavior and time spent in MVPA. Paired-samples *t*-tests were calculated for the sample to determine if significant differences existed in time on task from pre to post observation for each physical activity condition. Rather than using the Bonferroni method for controlling Type I error inflation, the Holm's sequential Bonferroni method was applied as it is less conservative and has greater power (Maxwell & Delaney, 2000).

Results

Physical activity participation. Table 1 shows the number of minutes and percent of time spent in sedentary behavior and light, moderate and vigorous physical activity. Participants spent approximately 16 minutes or 36% (of their time in MVPA during the mastery condition and 15 minutes or 33% of their time in light physical activity. During the free play condition participants spent 3 minutes or 7% of their time in moderate physical activity and 3 minutes or 7% of their time in light activity. The participants spent a majority of their time during the free play condition in sedentary behavior and accumulated no vigorous physical activity over the 45 minute period.

Table 1
Time and Percent of Time Spent in each Physical Activity Category by Condition

	Sedentary		Light		Moderate		Vigorous	
	Min	% of time	Min	% of time	Min	% of time	Min	% of time
Mastery	14	31	15	33	11	24	5	12
Free Play	39	86	3	7	3	7	0	0

On-task behavior. Table 2 shows the mean percentage of time spent in on-task behavior during the pre- and post-observation periods. During the mastery condition, children spent an average of 57.42% ($SD = 22.7$) of the pre-observation period and 87.89% ($SD = 10.88$) in the post-observation period in on-task behavior. Time spent in on-task behaviors was significantly higher after the mastery condition [$t(7) = -3.65$, $p = .008$]. The most common off-task behavior was passive/other. During the free play condition, children spent an average of 60% ($SD = 20.3$) of the pre-observation period and 71% ($SD = 22.6$) in the post-observation period in on-task behavior. A paired samples t -test indicates that this difference was not statistically significant [$t(7) = -1.024$, $p = .340$]. The most common off-task behavior was motor.

Table 2
Percent of Time Spent in On and Off Task Behaviors

	Pre-observation				Post-observation			
	On-task	Off-task Motor	Off-task Noise	Off-task Passive/other	On-task	Off-task Motor	Off-task Noise	Off-task Passive/other
Mastery	57	33	2	7	88	2	2	8
Free Play	60	24	2	14	71	15	4	10

Discussion

Increasing children's participation in physical activity is a global health priority and implementing effective programming for preschoolers to participate in adequate daily MVPA is necessary. Current recommendations for preschool children state that preschoolers should accumulate 60 minutes of structured physical activity, 60 minutes of unstructured physical activity and should not be sedentary for more than 60 minutes at a time (expect when

sleeping) (Clark et al., 2002). For the purpose of this project we compared the effect of a structured and unstructured play environment on a preschooler's ability to remain on-task in the classroom. Our results showed that preschooler's time on task increased significantly following a structured physical activity climate and that preschoolers were active in MVPA for 36% of the time. In contrast, during the free play climate the preschoolers spent a majority of their time in sedentary pursuits and although time on-task did increase after free play, it was not significant.

In order for physical education and physical activity programming to become a greater concern for early childhood educators, evidence must link participation in these tasks with positive academic outcomes. The measure of time-on task quantifies a preschooler's ability to maintain adequate attention, body control and engagement. For our study, time on task increased after both play periods, although only significantly in the structured movement period. These results indicate that participation in MVPA is a critical factor for a preschooler's ability to stay on-task in the classroom. One concern in implementing physical activity programs for preschool educators is that children will not be able to quickly and efficiently transition from being active to engage in academic activities. Our study provides initial evidence that this is not the case, as time on-task did not decrease after either physical activity program and children can transition from physical activity to academic instruction.

Currently, in the state of Alabama preschool teachers have no formal training in physical activity programming, but they are responsible for promoting and implementing physical activity programs for their classrooms. Most often, a free play or playing on playground structures is the most common form of physical activity at local preschools. Based on our results this type of activity does not elicit physical activity at a moderate or vigorous level. An additional study concluded the same results when examining outdoor playtime (i.e. free play) and indicated that 89% of the time was spent in sedentary pursuits and only 3% was spent in MVPA (Brown et al., 2009). Free play is a time period where educators and teachers expect children to acquire physical activity during the day however; this data indicates that more time is spent in sedentary behavior.

The structured physical activity program was grounded in mastery motivational climate. This climate appears to be an effective approach for children to accumulate MVPA. Other studies show that additional physical education offered at preschools does not elicit sufficient time in MVPA (van Cauwenberghé et al., 2012). These studies as well as ours suggest that the delivery of quality, structured physical education programs is a concern that needs to be addressed in early childhood education.

While preschoolers typically engage in low amounts of MVPA they typically acquire high amounts of sedentary behaviors. The NASPE (2009) guidelines indicate that preschooler's should not be sedentary for more than one hour at a time (except while sleeping). Obviously, the more amount of time spent in sedentary pursuits draws away availability for physical activity participation. In a study of over 400 children in 24 preschools, results indicated that over 80% of the day is spent in sedentary activity (Pate et al., 2008). Another study by Cardon & de Bourdeaudhuij (2008) found that preschoolers spent 85% of their time during the school day in sedentary activities measured by accelerometers. Others have found similar results reporting high levels of sedentary behavior in preschool settings and additionally low levels of MVPA (Fisher et al., 2005; Reilly et al., 2004). This is

supported by earlier reports from this age group, which indicate that children in day care settings do not participate in the recommended amounts of activity (Seefeldt, 1980). In terms of our results, sedentary time was higher in the free play condition versus the mastery condition, and these differences appear to be related to a child's ability to stay on-task.

There were a few limitations of the present study. The sample size was relatively small. However, significant differences were still found suggesting the salience of the findings. Another limitation is that physical activity was only measured during the morning hours. It is possible that children accumulated more physical activity during the afternoon and/or outside of the childcare center that was not captured in the present study. This limitation prevents speculation on how much participation in the physical activity climates contributes to meeting the daily physical activity recommendations.

Exposing preschoolers to a quality, structured physical education experience results in increased amounts of physical activity and on task behavior in the classroom when compared to a free play physical education experience. Efforts should be made to ensure that young children are exposed to movement opportunities that promote MVPA related positive health outcomes as well as adequate amounts of physical activity to promote classroom learning.

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