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Study Uses Wearable Devices to Examine 3- to 6-Year-Olds' Impulsivity, Inattentiveness

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PRESS RELEASE

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Leveraging an Intensive Time Series of Young Children's Movement to Capture Impulsive and Inattentive Behaviors in a Preschool Setting

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Wearable Technology Gives Caregivers Insight to Help Children Control Their Attention and Behavior

Why do some young children struggle to sit through a story one day but not the next? Why do they rush impulsively into one activity but not another? Parents and teachers often focus on individual differences as they prepare children for formal schooling, but traditional measurement approaches make it difficult to study fluctuations in children's behavior.

In a new study, researchers sought to understand children's impulsive and inattentive behaviors in early education classrooms by having students use wearable devices called accelerometers to collect an intensive time series of their movement at school. The study found that children modulated their behavior across periods of the school day and their self-regulation declined across the school week. In addition, children with greater self-regulation were more consistent in applying it across school days.

The study, by researchers at the University of Pennsylvania and the University of Texas at Austin, appears in *Child Development*, a journal of the Society for Research in Child Development.

"When a child has difficulty sustaining attention or sitting still, it disrupts their learning and can disrupt the classroom," explains Andrew Koepp, a postdoctoral scholar in psychology at the University of Pennsylvania and the study's lead author. "Research has consistently found that difficulties controlling attention and behavior in childhood predict more difficulties later in life, such as lower educational attainment and more financial problems."

Parents' and teachers' reports of children's behavior are subjective and general, rather than specific. Observations in schools and the lab require substantial time and resources, and usually fail to capture ranges of behavior. Wearable devices record data continuously and unobtrusively over a period of days, making them useful in collecting repeated observations.

In this study, researchers sought to capture children's behavior directly rather than relying on teachers' recall of that behavior, hypothesizing that impulsive and inattentive behaviors would be identifiable through intensive observations of their gross motor activity at school.

By having the children wear accelerometers, researchers collected 2.7 million observations of about 60 children (ages 3 to 6, primarily white and of high socioeconomic status) enrolled in five preschool or kindergarten classrooms at a university laboratory school in central Texas in the fall of 2021; they also asked teachers about children's behaviors and movement. Machine learning analyses indicated that children's typical forward acceleration correlated strongly with lower teacher-reported inhibitory control and attention.

Impulsivity and inattention are believed to emerge from a lack of self-regulation—a broad term for a set of dynamic processes that facilitate the adaptive control of thoughts, emotions, and behavior through both central nervous systems and physiological systems. Using forward movement intensity as a proxy for self-regulation, researchers partitioned the intensive time series to find that:

- Children modulated their behavior across periods of the school day,
- Children's self-regulation declined across the school week, supporting the idea that self-regulation is a resource that can be depleted through repeated use in everyday settings like school, and
- Children with greater self-regulation showed greater consistency in applying it across days.

In addition, the study found that the onset, intensity, and duration of children's gross-motor, full-body movement through space was strongly associated with teachers' reports of children's self-regulatory behavior in the classroom. The best predictor was one that captured sustained acceleration (combining onset, duration, and changes in intensity). Surprisingly, sustained acceleration was more strongly related to inhibitory control and attention than to impulsivity.

"Our study showed that wearable technology can automate the detection of impulsive and inattentive behaviors, facilitating within-child investigations of children's self-regulation," says Elizabeth Gershoff, professor of human development and family sciences at the University of Texas at Austin, who coauthored the study. "We also showed that children's motor actions reveal mental processes that are not directly observable."

The authors suggest that tools like the ones they used can yield insights to assist parents and teachers in helping children develop the skills to control their attention and behavior so they can pursue goals and interests. For example, it may be useful for educators to understand that young children may be most calm and ready to learn earlier in the school week and encourage them to adopt a strengths-based approach that focuses on times when children can regulate behavior.

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