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RESEARCH ARTICLE

The Effect of the Fidget Cube on Classroom Behavior among Students with Perceived Attention Difficulties

Kelsi E. Croley[1] · Daniel D. Drevon[1] · Dawn M. Decker[2] · Michael D. Hixson[1] · Keith C. Radley[3]

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Abstract
Fidget toys, one class of sensory-based interventions, enjoy favorable coverage in popular media outlets supporting their impact on attention, memory, and stress. However, there is minimal data supporting their use in the classroom. The present study used an ABAB withdrawal design to investigate the impact of noncontingent access to a commercially available fidget toy, the Fidget Cube, on academically engaged behavior, off-task behavior, Fidget Cube engagement, math problems attempted, and math problems completed accurately during independent seatwork. Participants were three 3rd-graders referred for having attention difficulties. Results indicated that noncontingent access to the Fidget Cube during independent seatwork did not improve study outcomes. Participants engaged with the Fidget Cube less in the second intervention phase than the first. Results suggest school personnel should consider alternative strategies for students with perceived attention difficulties. Limitations of the study are discussed, along with future directions for research.

Keywords sensory-based interventions · fidget toys · academically engaged behavior · academic productivity

Utility of the Work for Clinicians and/or Researchers of Behavior Analysis

- Fidget toys, one class of sensory-based interventions, enjoy favorable coverage in popular media outlets supporting their impact on attention, memory, and stress. Behavior analytic clinicians and researchers are likely to encounter noncontingent applications of fidget toys in classroom settings.
- There is currently minimal empirical data supporting fidget toy use in classroom settings. We extended existing research on fidget toys in the classroom by measuring their effect on both classroom behavior (i.e., academically engaged behavior, off-task behavior) and academic productivity (i.e., math problems attempted, math problems correct).
- Three participants with perceived attention difficulties were provided noncontingent access to a commercially available fidget toy, the Fidget Cube, during independent seatwork. None of the participants showed improvements on study outcomes.
- Results suggest behavior analysts should consider alternative, evidence-based strategies for students with perceived attention difficulties in classroom settings and consider deimplementation strategies for fidget toys.

Research suggests approximately 10% of children ages 2–17 have been diagnosed with attention deficit/hyperactivity disorder (ADHD) in the United States (Danielson et al., 2018). Children with ADHD are more likely to exhibit decreased academic achievement and poorer educational outcomes compared with peers without ADHD (Loe & Feldman, 2007). Sensory-based interventions (SBIs) are often implemented for students with attention difficulties, including ADHD and autism spectrum disorder (ASD). SBI refers to auditory, kinesthetic, or visual

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✉ Daniel D. Drevon
drevo1dd@cmich.edu

[1] Department of Psychology, Central Michigan University, Mt Pleasant, MI 48859, USA

[2] Department of Counseling & Special Education, Central Michigan University, Mt Pleasant, MI, USA

[3] Department of Educational Psychology, University of Utah, Salt Lake City, UT, USA

stimulation added to a child's environment to increase or decrease target behaviors. Case-Smith et al. (2015) defined SBIs as "adult-directed sensory modalities that are applied to the child to improve behaviors associated with modulation disorders" (p. 135). For example, sitting on therapy balls and doodling have been used to target task accuracy and completion for students with attention difficulties (Kercood & Banda, 2012), and wearing weighted vests have been used to target stereotypy for students with ASD (Case-Smith et al., 2015). One theory is that the characteristics of ADHD are due to hypoarousal, which may result in children with ADHD seeking excessive stimulation because they are less alert than their counterparts without ADHD (Weinberg & Brumback, 1990; Zentall & Zentall, 1983). To compensate for this under arousal, children with ADHD might use motor activity in excess in order to stay alert (Rapport et al., 2009). Adding stimulating activities, such as SBIs, to classrooms may therefore improve academic and behavioral outcomes of these children (Kercood & Banda, 2012).

SBIs are commonly used in schools and most often associated with the practice of occupational therapy (Worthen, 2010). The popularity of SBIs among parents and practitioners may be attributed to the general simplicity of their implementation, such as letting a student fidget with a manipulative. However, these interventions can be expensive and might be used in place of other empirically supported interventions (Barton et al., 2015). Thus, it is crucial that SBIs are backed by substantial research evidence for their effectiveness before adopting them in place of other empirically supported interventions that may provide greater benefit (Barton et al., 2015).

Several systematic reviews examining the effectiveness of SBIs have been conducted, in particular in examining their effectiveness with children with various disabilities (Barton et al., 2015; Case-Smith et al., 2015; Vostal et al., 2013; Wan Yunus et al., 2015; Watling & Hauer, 2015). In a 30-year systematic review of 30 studies, Barton et al. (2015) examined the effects of SBIs for 856 children with multiple diagnoses including sensory integration disorder, ASD, developmental delay, Down syndrome, cerebral palsy, other motor impairments, and ADHD. The types of SBIs that were examined included materials such as therapy balls, specialized swings, chewy tubes, and weighted vests. Results suggested that SBIs are more likely to be ineffective than effective for children with disabilities. However, it is important to note that all of these reviews voiced caution in drawing conclusions based on the current literature because many studies had weak experimental designs or a high risk of bias. For example, some studies were found to lack treatment fidelity, maintenance data, and a standard outcome battery (Barton et al., 2015). Further, none of these studies examined the use of fidget toys.

Empirical Examination of Fidget Toys to Improve Classroom Behavior

Though not explicitly included in existing systematic reviews of SBIs, the use of fidget toys to improve academic and behavioral performance of students with disabilities in the classroom appears to meet the Case-Smith et al. (2015) definition of SBIs. Fidget toys have enjoyed favorable coverage in popular media outlets like *The Atlantic* (Beck, 2015) and *National Public Radio* (Kamenetz, 2015). However, there has been little empirical examination of their effectiveness in supporting students in the classroom, in particular for children with attention difficulties.

Kercood et al. (2007) investigated the effect of noncontingent access to a fidget toy during task demands on number of math story problems attempted, number of math story problems correct, and percent of intervals with off-task behavior using an alternating treatments design. Participants were four 9-year-old students with attention difficulties. Twenty-min observations were conducted in an analogue classroom setting within the participants' school. Results were mixed with two participants attempting and correctly completing more problems compared to baseline. The other two participants attempted and correctly completed fewer problems during the intervention. All participants exhibited lower levels of off-task behavior with access to the fidget toy. Differences on dependent variables were modest across conditions. Although this study supported the use of fidget toys in reducing off-task behavior, it did not support their use in improving academic skills. One of the limitations to this study was that the students were told the toys could help them focus; thus, it is possible that instructions, rather than the toy itself, led to decreases in off-task behavior.

A study conducted by Hulac et al. (2020) evaluated the effects of fidget spinners on math performance using curriculum-based measures for 54 third-grade students. Results showed lower performance when the students had access to the fidget spinner than when the fidget spinner was removed; thus, this suggests that fidget toys are not effective in increasing academic performance. In this study, the outcomes were only measured during the completion of four 5-min curriculum-based measurement (CBM) probes administered by an examiner, and data were not collected within the naturalistic context of class instruction.

Likewise, Graziano et al. (2020) examined the effects of fidget spinners on gross motor activity and attention of 60 children with ADHD within an analogue classroom environment at a university summer treatment program. Using an ABAB design, students were given fidget spinners to use during the day. They measured the students' gross motor movement, out of area violations, and attentional functioning. Results showed the use of fidget spinners was associated with a decrease in the students' gross motor activity levels and students had fewer violations for being out of their assigned area (only in the initial phase). In contrast, the use of the fidget spinners hurt the students' attention during both phases of the fidget spinner use. This suggests that the use of fidget toys was not effective in improving attention.

In contrast, a recent study conducted by Aspiranti and Hulac (2021) found greater on task rates for students with ADHD when using a fidget spinner than its nonuse. The study was conducted within a general education classroom with three 2nd-grade students diagnosed with ADHD from an outside mental health provider. Students were selected based on teacher report of the students' inattention during class. A concurrent multiple-baseline across-students design was used to evaluate the effects of the fidget spinner on on-task behavior. Momentary time sampling was used to record on-task behavior, and visual analysis was used to evaluate the results. Results showed large, immediate, and sustained increases in on-task behavior during fidget spinner use.

Although Aspiranti and Hulac's (2021) results suggested that the use of fidget spinners may be effective in increasing on- task behavior for students diagnosed with ADHD, it is challenging to differentiate what effect the instructions regarding the fidget spinners' purpose had on the results apart from the effect of the toy itself. It is possible that rule statements introduced during the intervention phase related to doing work and keeping eyes on the teacher accounted for the intervention's effectiveness. Even though the results showed increased on-task behavior during the intervention, it is unclear what to attribute the positive effect to (i.e., fidget spinner vs. directions given).

At present, the research on fidget toys is mixed. In the majority of studies, fidget toys did not improve students' academic skills and attention. However, more studies are needed that are conducted within naturalistic classroom environments, use designs that control for confounding variables, and eliminate high risk of bias. Until such issues are addressed empirically, fidget toys cannot be established as evidence-based practice.

Purpose of This Study

The purpose of the current study is to determine the effect of a commercially available fidget toy, the Fidget Cube, on classroom behavior and academic productivity among students with attention difficulties. Fidget Cubes have sensory tools on all sides: a switch, gears, a rolling metallic ball, a thumbstick, a spinning disk, a worry stone, and five buttons. In 2019, Fidget Cubes were ranked 14th in the top 20 highest funded and most backed Kickstarter Projects of all time with over $6 million pledged and over 150,000 backers (Mitchell, 2019). Fidget toys are thought to help boost productivity by reducing wandering thoughts (Beck, 2015), and Fidget Cubes in particular are claimed to be designed for anxiety relief (Kickstarter, 2020). Because their use as an intervention has been gaining in popularity and because of claims of their effectiveness on increasing productivity, their effectiveness should be examined. This study was designed to answer the following research questions

1. Does noncontingent access to a Fidget Cube during independent seatwork increase academically engaged behavior and decrease off-task behavior in elementary school students with perceived attention difficulties?
2. Does noncontingent access to a Fidget Cube during independent seatwork increase math problems attempted and math problems correct for elementary students with perceived attention difficulties?

Method

Participants and Setting

Participants included three 3rd-grade students at a suburban elementary school in the Midwestern region of the United States. The teacher nominated students she perceived to have the most difficulties with attention to be included in the study. Parent consent and participant assent were obtained following nominations.

Participants included two females and one male within the same classroom. All three participants were white and were not receiving individualized behavioral support, special education support, or free or reduced lunch. The participants' ratings on the ADHD-5 rating scale (DuPaul et al., 2016) by their teacher resulted in standard scores at the 88th percentile, 75th–80th percentile, and 50th–75th percentile for participants M, O, and J, respectively. Higher percentiles indicate more characteristics of ADHD. In general, the 80th–90th percentiles of subscales represent optimal cutoff scores for diagnosing and ruling in ADHD (DuPaul et al., 2016). Table 1 provides a summary of participant demographics.

The teacher was a 47-year-old white female who had been teaching for 24 years. Her highest level of education obtained is a master's degree, and she taught all subjects at the 3rd-grade level to approximately 25 students. She had not previously used fidget toys in her classroom. The school included 500 students in kindergarten through 5th grade. The racial/ethnic breakdown of the school is 93.1% white, 1.7% Asian origin, 0.6% Black, 0.4% Native American, 2.1% Hispanic/Latinx, 0.2% other Pacific Islander, and 1.9% two

Table 1 Demographic Information

Participant	Grade	Gender	Race	Received FRL	Received IBS	Received SPED	ADHD-5 Percentile
J	3	M	White	No	No	No	50–75
O	3	F	White	No	No	No	75–80
M	3	F	White	No	No	No	88

Note. FRL = free or reduced lunch; IBS = individualized behavior support; SPED = special education services; ADHD-5 = *ADHD Rating Scale, Fifth Edition* (DuPaul et al., 2016)

or more races. About 18% of students in this elementary school received free or reduced lunch.

Response Measurement

The dependent variables for this study were academically engaged behavior, off-task behavior, Fidget Cube engagement, math problems attempted, and math problems correct. The first author and school personnel unobtrusively collected data in a consistent setting for each participant during 15-min sessions.

Academically Engaged Behavior and Off-Task Behavior

Academically engaged behavior was the primary dependent variable. Academically engaged behavior was defined as any behavior that was directly related to independent seatwork. This included visual orientation toward the worksheet or the teacher's verbalizations, and appropriate verbal interaction with the teacher and peers, such as answering questions or asking questions. Off-task behavior was the secondary dependent variable. Off-task behavior was defined as any behavior that was not directly related to independent seatwork. This included loss of visual orientation to the worksheet or the teacher's verbalizations, leaving their seat, and failure to respond to a question. A nonexample of off-task behavior was an incorrect response to a question.

Academically engaged behavior and off-task behavior were mutually exclusive and exhaustive behavioral definitions. At the end of the 15-s interval, the observer recorded whether the child was engaging in academically engaged or off-task behavior using momentary time sampling.

Fidget Cube Engagement

Fidget Cube engagement was defined as any touching or manipulation of the Fidget Cube, and it was measured by partial interval recording. The observer recorded whether the child engaged with the Fidget Cube at any point during each 15-s interval.

Math Problems Attempted and Math Problems Correct

The percent of math problems attempted was defined as the sum of all problems with a written answer divided by the total number of math problems on the sheet and multiplied by 100%. The percent of math problems correct was defined as the number of math problems completed accurately, as indicated by the teacher's answer key, divided by the number of math problems attempted and multiplied by 100%.

Interobserver Agreement

Interobserver agreement data were collected to ensure reliable measurement of the dependent variables. Observers consisted of the primary investigator and secondary observers—two special education staff members at the elementary school. Secondary observers were trained on the definitions of each dependent variable and recording methods before collecting baseline data. A minimum of 90% interobserver agreement was required before data collection. This criterion was met after three practice sessions in the classroom.

Interobserver agreement was collected during one session per phase per participant for a total of 22%, 20%, and 21% of sessions for participants J, O, and M, respectively. Interobserver agreement was calculated on a point-by-point basis and was evaluated by dividing the total number of intervals with agreements by the total number of intervals with agreements plus disagreements and multiplying by 100%.

See Table 2 for interobserver agreement data. Interobserver agreement was above 90% during each session it was collected. For participant J, interobserver agreement averaged 93.0% (range: 91.6%–93.6%). For participant O, interobserver agreement averaged 96.0% (range:

Table 2 Interobserver Agreement by Participant and Phase

Participant	Phase			
	Baseline 1	Intervention 1	Baseline 2	Intervention 2
J	91.6	93.0	93.6	93.6
O	95.3	96.0	96.3	96.3
M	96.3	96.6	98.6	100.0

95.3%–96.3%). For participant M, interobserver agreement averaged 97.9% (range: 96.3–100.0%).

Materials

ADHD-5 Rating Scale

The ADHD-5 (DuPaul et al., 2016) is a rating scale of ADHD symptomology that was completed by the teacher on the participants in their classroom. The scale includes 18 items on a 4-point Likert scale: *never or rarely*, *sometimes*, *often*, *very often*. Items tap behaviors such as being easily distracted, having difficulty organizing, losing items, etc. Higher percentiles indicate more characteristics of ADHD.

The standardization of the ADHD-5 rating scale included 1,070 teachers who completed the scale for two students on their class rosters. The coefficient alpha for teacher ratings on the School Version: Child was .97 for the overall score. Test/retest reliability of teacher ratings on the School Version: Child was .93 for the overall score, using a retest interval of about 6 weeks. Teacher ratings on the ADHD-5 were found to correlate significantly with other rating scales of behavioral functioning as well as off-task motor and off-task passive behavior measured via classroom observations. Further, teacher ratings were found to accurately predict the diagnosis of ADHD in clinic and school-based assessments (DuPaul et al., 2016). For this study, the ADHD-5 was used descriptively, rather than for inclusion or exclusion in the study.

CBM Math Worksheets

CBM math worksheets were used to measure the percent of attempted and correct math problems during the observation periods. Participants were administered a mixed-skill CBM math probe that was selected in consultation with their teacher and included 25 addition and subtraction problems (InterventionCentral, n.d.).

Fidget Cube

A Fidget Cube was provided to each participant. A Fidget Cube is a six-sided toy measuring about 1 in x 1 in x 1 in with different elements on each side: a switch, gears, a rolling metallic ball, a thumbstick, a spinning disk, a worry stone, and five buttons. Fidget Cubes are available in many colors, but the ones provided in this study were black with some chrome elements. Photos are available at https://www.kickstarter.com/projects/antsylabs/fidget-cube-a-vinyl-desk-toy.

Social Validity Survey

The *Behavior Intervention Rating Scale* (BIRS; Elliott & Treuting, 1991) was given to the teacher to evaluate the teacher's perception regarding the acceptability of the intervention. The BIRS includes questions that ask the rater to judge how effective the intervention was at changing behavior, how willing they are to use it, how quickly it improves behavior, etc. There is evidence for the internal consistency of the BIRS. The coefficient alpha for the total BIRS was .97. The coefficient alphas for the Acceptability, Effectiveness, and Time factors were .97, .92, and .87, respectively. There is also evidence for the content and construct validity of the BIRS. For example, a factor analysis of the BIRS found three distinct factors: Acceptability, Effectiveness, and Time (Elliot & Treuting, 1991).

Procedure

Data were collected unobtrusively by the first author and two school personnel during 15-min sessions. Observers sat toward the back of the classroom. Data were collected while the class was completing independent seatwork, though there were a few occasions the participants completed independent seatwork while classmates were completing group work or the teacher was delivering class-wide instruction. For participant J, data were collected across 5 different weeks for an average of 3.8 days per week. Data were collected for participant O across 6 different weeks for an average of 3.3 days per week. For participant M, data were collected across 6 different weeks for an average of 3.2 days per week.

Baseline

This conditions allowed us to learn how the participants usually behaved during independent seatwork. The teacher was asked to conduct her classroom routine as usual. One of the observers gave the math CBM worksheets to the teacher each session. The teacher then handed out the worksheets to the participants and briefly commented that they were to work on this before other classwork. Once all of the students had a worksheet, the observers started the timer and recorded academically engaged behavior and off-task behavior during the 15-min observation period. At the end of 15 min, the observers collected the worksheets and left the room. The first author scored the CBM worksheets.

Preliminary Training

After baseline, participants were given instructions by the first author on the use of the Fidget Cube using a script. This training lasted about 5 min, and it included instruction on what each side of the cube does, appropriate use (i.e., manipulation during independent seatwork), and inappropriate uses (i.e., throwing, sharing, or being disruptive). Participants were not told that the goal of the Fidget Cube was to help them stay academically engaged.

Intervention

After baseline data were obtained and the participants were trained on using the Fidget Cube, the participants began to have access to their Fidget Cubes during independent seatwork. When the observers came to the classroom, they handed the worksheets to the teacher. The teacher then handed out the worksheets and Fidget Cubes to the participants, and the observers started the timer. The observers recorded academically engaged behavior, off-task behavior, and Fidget Cube engagement on the coding sheet for 15-min sessions. Participants completed the math CBM worksheets provided by the researcher. At the end of 15 min, the observers collected the worksheets, and the students returned their Fidget Cubes to their teacher until the next session.

Treatment Integrity

The first author completed a treatment integrity form that included a checklist of all steps expected in the baseline and intervention conditions (seven or nine steps, respectively). Treatment integrity was assessed for 85% of the sessions. Treatment integrity was calculated by dividing the number of steps implemented correctly by the number of steps expected and multiplying by 100%. Treatment integrity was 100% across observation sessions.

Experimental Design

An ABAB withdrawal design was implemented to assess the effects of the Fidget Cube on academically engaged behavior, off-task behavior, Fidget Cube engagement, math problems attempted and math problems correct. Phase changes were driven by visual analysis of academically engaged behavior data. Baseline to intervention phase changes were made after the collection of at least 4 data points and stable or countertherapeutic trend. Intervention to baseline phase changes were made after the collection of at least 4 data points.

Data Analysis

To determine whether there were functional relations between noncontingent access to the Fidget Cube and study outcomes data were visually analyzed within and between phases according to guidance from Kratochwill et al. (2010). Level, trend, and variability were assessed within phases. Level refers to the mean score for the data within a phase. Trend refers to the slope of the best-fitting straight line for the data within a phase. Variability refers to the fluctuation of the data around the mean. Visual analysis between phases was completed by studying the immediacy of effect, data overlap, consistency of data patterns across similar phases, and similarities between the observed and projected patterns of the outcome variables (Kratochwill et al., 2010).

Results

Academically Engaged Behavior

Figure 1 represents the percentage of academically engaged behavior and Fidget Cube engagement across phases for

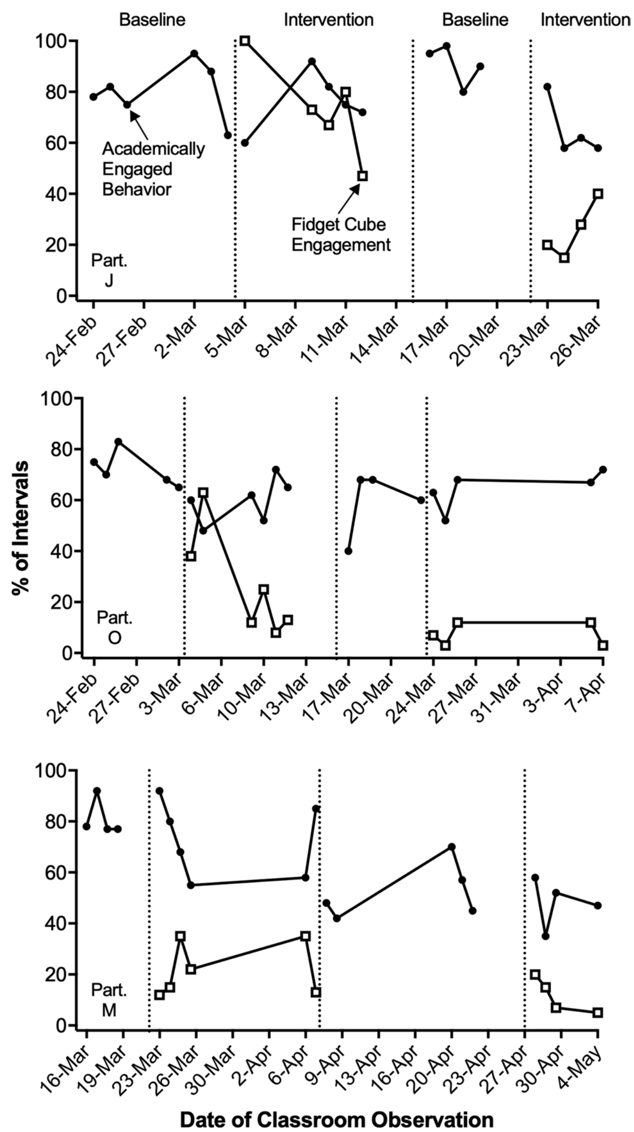

Figure 1 Percent of Intervals with Academically Engaged Behavior and Fidget Cube Engagement

each participant. Because academically engaged and off-task behavior were mutually exclusive and exhaustive behavioral definitions, only academically engaged behavior was graphically depicted and visually analyzed to avoid including redundant information in Figure 1 and Results.

Academic engagement baseline data for participant J ranged from 63% to 95% with an average of 80% of intervals observed. Data from the intervention condition were similar to baseline. The average percent of academic engagement during the intervention was 76% of intervals. An increase in academically engaged behavior was observed in the second baseline condition with an average of 90% academic engagement. Reintroduction to the Fidget Cube was associated with a decrease in the percent of academic engagement at 65%.

Baseline data for participant O ranged from 65% to 83% for an average of 72% of the intervals observed. Introduction of the Fidget Cube was associated with an average academic engagement of 60%. Academic engagement during the second baseline averaged 59%. Returning to intervention showed similar academic engagement to its preceding baseline and initial intervention phase. The average percent of student academic engagement in the second intervention condition was 64%.

Baseline academically engaged behavior for participant M was relatively stable compared to the other participants with the student academically engaged for an average of 81% of the intervals observed. When the Fidget Cube was introduced, there was a decrease in academic engagement to an average of 73% of intervals observed. Academic engagement further decreased with the return to baseline with academic engagement averaging 52%. With the reintroduction of the Fidget Cube during the final condition, academic engagement averaged 48% of the intervals observed.

Within and across participants considering overlap of data across conditions, the immediacy of effect, and consistency of effect, academic engagement did not systematically improve upon the introduction of the Fidget Cube. However, the academic engagement of the participants during the baseline conditions, especially the first baseline, approximated the academic engagement of typical students, which is around 85% (Rhode et al., 2010). Therefore, we might not expect the Fidget Cube to improve performance beyond that of typical students, but participants O and M's academic engagement was much lower in the final three phases. In addition, in these phases the introduction or removal of the Fidget Cube appeared to have no effect on academic engagement.

Fidget Cube Engagement

Participant J's use of the Fidget Cube showed a decreasing trend over the course of the first intervention condition, starting with 100% engagement and ending with 47% engagement. His average use of the cube during the first intervention condition was 73% of intervals. Engagement with the Fidget Cube was lower in the second intervention condition averaging 26% of intervals.

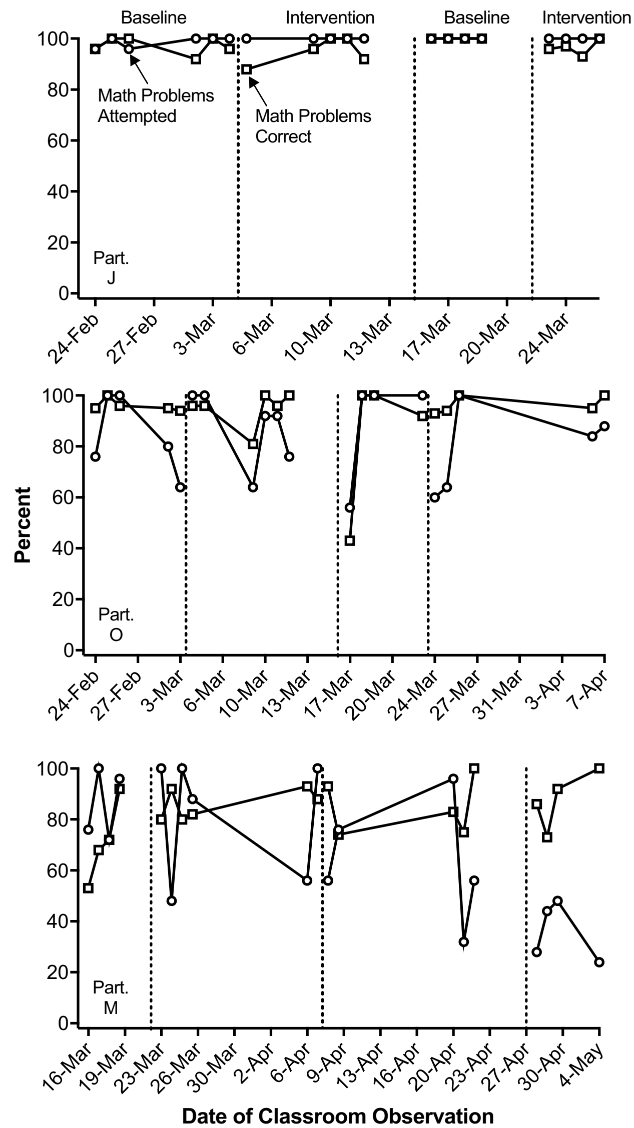

Figure 2 Percent of Math Problems Attempted and Percent of Math Problems Correct

Participant O's engagement with the Fidget Cube also decreased over the course of the first intervention condition averaging 27% of intervals during this phase. Her level of engagement with the cube stayed low during the second intervention phase with an average of 7% of engagement intervals.

Participant M's use of the Fidget Cube during the first intervention condition was lower than the other participants averaging 22% of the intervals. During the second intervention phase, her use of the cube averaged 12% of the intervals.

Math Problems Attempted and Math Problems Completed

Figure 2 represents the percent of problems attempted and the percent correct on the CBM worksheets during the sessions for each participant. Participant J's data for percent of problems correct out of attempted and percent attempted were at or near 100% across conditions. As such, most of the data is overlapping, and Participant J's math performance did not change throughout the study. Participant O's performance was more variable, but with the majority of percent accuracy scores above 90% across conditions. The percent of total problems completed ranged from 60% to 100% across conditions with substantial overlap of data across conditions. Participant M's percent of problems correct and percent attempted tended to be lower than the other participants. This lower performance provided a greater opportunity to demonstrate an improvement with the introduction of the intervention, but there does not appear to be a reliable change in performance with the introduction and removal of the intervention.

Social Validity

The participants' teacher completed the BIRS before and after the intervention to determine how effective and useful she expected it to be and how effective and useful she found it to be. The rating scale included 24 items on a 6-point Likert scale with choices ranging from *strongly disagree* to *strongly agree*. Higher scores represent higher acceptability for the intervention. The preintervention rating scale results suggest acceptability for the intervention with an average item rating of 4.6. Every item was marked either *slightly agree* or *agree* except for one that asked if the intervention would produce negative side effects, to which the teacher selected *disagree*. Postintervention results were similar, though overall lower in acceptability. The average item rating was 3.6. Most items were rated *slightly agree* except for two that were rated *slightly disagree,* including the items "the intervention should prove effective in changing the child's problem behavior" and "the child's behavior will remain at an improved level even after the intervention is discontinued."

Discussion

This study was designed to provide empirical data on the effectiveness and acceptability of fidget toys in the classroom, adding to a relatively lean literature base. The current study used an ABAB withdrawal design to investigate the impact of noncontingent access to the Fidget Cube during independent seatwork on academically engaged behavior, off-task behavior, Fidget Cube engagement, math problems attempted, and math problems completed accurately among three 3rd-graders referred by their teacher as having attention difficulties. The participants' teacher also completed a scale measuring perceptions of treatment acceptability before and after the intervention.

This study set out to answer two research questions. The first was whether noncontingent access to a Fidget Cube during independent seatwork would increase academically engaged behavior and decrease off-task behavior. Data were not suggestive of a functional relation between access to a Fidget Cube and these outcomes. None of the three participants showed meaningful increases in academically engaged behavior between baseline and intervention conditions. In fact, the average percent of intervals with academically engaged behavior was higher in the baseline condition than the intervention condition for each participant.

The second research question asked whether noncontingent access to a Fidget Cube during independent seatwork would increase math problems attempted and math problems completed accurately during independent seatwork. Again, data were not suggestive of a functional relation between access to a Fidget Cube and math problems attempted or math problems completed accurately. None of the three participants showed meaningful increases in math problems attempted or math problems completed accurately between baseline and intervention conditions. It should be noted that this research question was more difficult to answer because of near-ceiling level performance on these variables during numerous sessions in the baseline condition. This suggests that too few math problems were included or they were too easy for participants.

Although the current study and the study conducted by Aspiranti and Hulac (2021) have many similarities, a few key differences may have caused differing results. Unlike the current study, Aspiranti and Hulac found large, immediate, and sustained increases in on-task behavior after the introduction of the fidget spinner. The study conducted by Aspiranti and Hulac had a notable procedural difference from the current study: instruction was provided when the fidget spinners were introduced. Students were instructed to keep two fingers on the fidget spinner at all times, to only use the fidget spinner when they are doing work or listening to the teacher, to keep their eyes on the teacher or work when using the fidget spinner, to use it without distracting others, and not to share it. It is possible that these instructions played an important role in the intervention's effectiveness. The current study's training suggested students may choose to manipulate the Fidget Cube during independent seatwork and asked them to not throw, share, or disrupt others with the Fidget Cube. There were no rule statements about academically engaged behavior or Fidget Cube engagement in the current study.

Graziano et al. (2020) also examined the effects of fidget spinners among children with ADHD, but they found negative effects on attention. The activity level of the students did decrease, however. Aspiranti and Hulac (2021) noted that teachers reported that the devices still interfered with work completion, and that students were often given verbal reminders by their teachers to stay on task. This, combined with telling students that the device should help them focus, may have contributed to an increase in on-task behavior. Without data on the students' differences in active and passive on-task behavior and the effects of prompting, it is difficult to conclude that the devices positively affected their productivity. This is consistent with results from Kercood et al. (2007) who found that introducing a fidget toy reduced off-task behavior but did not increase accuracy and with the results of Hulac et al. (2020) who found lower performance when the students had access to the fidget spinner.

Taken together, the results of the current study indicate that access to Fidget Cubes did not help elementary general education students increase their productivity or engagement while completing math worksheets. The current study did not find increases in accuracy or work completion on in-class work with a fidget toy which is consistent with other studies that also examined these variables. The current study also did not find an increase in academically engaged behavior with the device's introduction, which is consistent with some studies and inconsistent with others. Some of the differences may lie in part to whether participants were diagnosed with ADHD versus nominated by teachers as having attention difficulties. In general, the students in the current study had high levels of academically engaged behavior during baseline, which is different from other studies and may contribute to the lack of noticeable difference between phases. The current study did not track activity level, but the participants were not observed to have high levels of physical activity throughout data collection, so this may also be a reason for small differences noticed between phases as other studies noted high levels of physical activity in their participants that dropped during intervention.

Although data were not collected regarding how often the student's Fidget Cube engagement correlated with academically engaged vs. off-task behavior, general observations from the observers suggest that only one student used the device and completed work simultaneously. The other two students' use of the device was always off-task. This further indicates that introducing a fidget toy may reduce class disruptions, including those involving gross motor activity, as the students were silent and nondisruptive during their off-task use of the Fidget Cube, but fidget toys did not promote work completion or accuracy. Thus, the Fidget Cube appears to have successfully promoted quietness and stillness (Winett & Winkler, 1972), yet was unsuccessful in promoting educationally meaningful behavior change.

Fidget Cube engagement overall was low for the participants, especially during the second intervention phase. This is different from the study conducted by Aspiranti and Hulac (2021) whose participants did not appear to habituate to the devices. However, data on their engagement was not collected, so the true difference is unknown. Although the Fidget Cubes were not meant to act as reinforcement, it is interesting that the students appeared to lose interest in them. This is a possible reason for the lack of differences in behavior across phases—students did not use the Fidget Cube often, so intervention functioned similarly to baseline. Perhaps another fidget toy would have been preferred by the students and thus have a more noticeable effect on behavior during intervention phases.

Limitations

There are a few limitations to the current study that should be noted. First, the study did not specify a level of off-task behavior to qualify for the study. Instead, participation was based on teacher nomination. The students in this study had relatively high levels of academically engaged behavior during baseline, but compared to others in the class, their academically engaged behavior was low, based on teacher perception. Teachers' judgements of attention difficulties can vary, and in this case, her definition of attention difficulty may have been lower than others due to the classroom climate and strong classroom management. This led to participants who did not have a low level of academically engaged behavior, which made the possibility for notable improvement minimal. A predetermined requirement for percent of academic engagement to qualify for the study may have helped eliminate this limitation.

Second, the task required of the students was a mixed probe addition and subtraction CBM. This was used in order to keep the task consistent for data analysis purposes; however, the general skills needed to complete them were already mastered. This made the task difficulty low which may have made the task more desirable and thus contributed to the high levels of academically engaged behavior. It may have been interesting to see how the percentages of off-task behavior correlated to the difficulty of the task at hand.

Of interest was the lack of Fidget Cube engagement seen especially in the second intervention phase. Although the Fidget Cube was not meant to be used for reinforcement, if it is not of interest to the students, then the intervention is less likely to be effective. Thus, it may have been helpful to present multiple fidget toy options to the students in order for them to use a device that is of interest to them. This would make the results of the intervention more valuable as the engagement with the intervention would be higher.

During the study, data collection was interrupted by spring break and a classroom quarantine mandate due to possible exposure to COVID-19. Although these breaks did not appear to have a meaningful impact on the data, the disruption to classroom routine may still have impacted the results.

Lastly, the classroom activities were not always the same despite data collection occurring at 9:00 A.M. each session to maximize consistency. Class activities varied from independent seat work to group work to class-wide instruction. The participants were always given their CBM worksheet to complete regardless of the class activity. Data to differentiate the percent of academically engaged behavior between class activities were not collected, so the impact of the surrounding students' activity on the participants' behavior is unknown.

Future Research

Future researchers should collect data on how often the use of a SBI is correlated with academically engaged versus off-task behavior. At present, research shows that the introduction of a fidget toy can decrease disruptions and possibly increase on-task behavior, but students' productivity on classroom assignments may decrease. Thus, collecting data on how often the fidget toy is used in conjunction with completing an assignment would provide specific data on the impact of the intervention on work completion.

Although the current study did not involve an occupational therapist, future research studies on SBIs would benefit from collaborative efforts between behavior analysts, occupational therapists, and other school-based personnel (e.g., school psychologists). Doing so would allow representatives from each discipline to bring their respective expertise to the design, execution, and interpretation of studies on SBIs. This may help practitioners and researchers further understand the conditions under which SBIs are or are not effective (Gasiewski et al., 2021; Whiting & Muirhead, 2019).

Future researchers may also consider conducting a preference assessment with multiple fidget toy options to evaluate the impact of reinforcing properties on engagement with the intervention and subsequent engagement with the assignment. Lastly, future researchers should evaluate the impact of task difficulty with a fidget toy on on-task behavior and work completion. This will allow differentiation of the effects of the sensory device and task difficulty on productivity and engagement.

Conclusion

The results from the current study indicate that access to a Fidget Cube was not effective in changing classroom behavior or academic productivity. Thus, teachers should use caution in using fidget toys as an intervention if the goal is to change classroom behavior or work productivity. Moreover, fidget toys applied noncontingently in classroom settings might be best thought of as a low-value practice requiring deimplementation (Farmer et al., 2021).

Declarations

Conflicts of Interest The authors declare that they have no conflicts of interest.

Research Involving Human Subjects and/or Animals All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from parents of all individual participants included in the study.

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