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Putting a negative spin on it: Using a fidget spinner can impair memory for a video lecture

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Summary

Fidget spinners have experienced a rapid rise in popularity, at least partially because they are marketed as attentional aides with the potential to enhance student learning. In the current study, college-aged students watched educational videos while either using a fidget spinner or not. Using a fidget spinner was associated with increased reports of attentional lapses, diminished judgments of learning, and impaired performance on a memory test for the material covered in the video. The adverse effect on learning was observed regardless of whether the use of fidget spinners was manipulated between-subjects (Experiment 1) or within-subjects (Experiment 2), and was observed even when the sample and analysis were limited to participants who came into the study with neutral or positive views on the use of fidget spinners. These results suggest that if fidget spinners are beneficial for learning, such benefits are relatively limited or at least do not extend to the conditions present in the current study.

KEYWORDS

attention, fidget spinner, fidgeting, learning, memory

1 | INTRODUCTION

According to a timeline compiled by Williams (2017), companies have marketed toys designed for fidgeting as therapeutic devices for people with conditions such as attention-deficit/hyperactivity disorder (ADHD), anxiety, and autism since the 1990s. In 2017, fidget toys grew suddenly popular with a broader range of the population. The most popular of these devices is the fidget spinner, which can be held and rotated between a user's fingers (Williams, 2017). By mid-2017, over 200 million fidget spinners were sold (Libassi, 2017), and by mid-2018, fidget spinners accounted for 17% of all toy and game units sold online. Although children's use of fidget objects has dominated news coverage, they have also become popular with adults. In one sample, it was shown that millennials accounted for 23% of total sales (Plewman, 2018). Another device, the fidget cube, an office toy with six different surfaces designed for particular hand motions, raised over $6 million in advance orders and crowdfunding (Williams, 2017). Much of the controversy surrounding fidget devices concerns their purported effectiveness for focusing attention and enhancing learning in classroom settings. As noted in a review of relevant research, however, these claims have yet to be substantiated (Schecter, Shah, Fruitman, & Milanaik, 2017).

Retailers claim that fidget spinners promote focus and performance in the classroom. The most relevant study used to support this claim is a small intervention study conducted by Stalvey and Brasell (2006), which provided a middle-school classroom with stress balls. When allowed to use the stress balls, students demonstrated improved self-reported attention, reduced distraction behaviors (e.g., making faces and moving around), and improved scores on a written assessment. The researchers speculated that using the stress balls gave students an activity to engage in when they were bored that did not disrupt class for their peers. They also suggested that using the stress balls could have allowed students to calibrate their physical state to their optimal level of arousal, thus leading to higher levels of performance (Zuckerman, 2014). If the small hand movements associated with using a fidget spinner allow students to

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self-modulate their arousal, then fidget spinners could, as promoted, enhance learning and attention in the classroom.

Using a fidget spinner could also prevent boredom, and with it, instances of mind-wandering. Mind-wandering has been associated with impaired performance on attentional, aptitude, and comprehension tasks (Mooneyham & Schooler, 2013), and activities that allow people to cope with boredom, such as fidgeting or doodling, could help them focus. Indeed, when participants were randomly assigned to shade in shapes (a proxy for doodling) while listening to a mock telephone message designed to induce boredom, they outperformed nondoodling participants on a surprise memory test (Andrade, 2010). As such, fidget spinners could be particularly useful in learning environments in which students report high rates of mind-wandering and boredom.

Rather than reflecting a compensatory behavior, however, fidgeting could constitute a manifestation or even trigger of mind-wandering. Observed fidgeting behaviors correlate positively with self-reported inattentiveness and mind-wandering in a lecture (Carriere, Seli, & Smilek, 2013; Farley, Risko, & Kingstone, 2013), and encouraging fidgeting with fidget spinners could potentially disrupt rather than boost memory and attention. Using a fidget spinner could cause task-unrelated thoughts by providing the source material for task-unrelated thoughts themselves, drawing focus away from the lecture and toward operating the fidget spinner.

Graziano, Garcia, and Landis (2018) recently reported an intervention-style study in which they assigned fidget spinners to elementary-school students with ADHD across two week-long sessions separated by baseline-recorded weeks. Independent coders were assigned to watch and report when students engaged in distracted behaviors, like leaving their assigned seats. Students with fidget spinners were initially more likely to sit still than before being given a spinner—an effect confirmed by data from accelerometer belts measuring gross motor movement—but this effect did not persist during the second session of fidget-spinner use. Critically, observers also reported more instances of inattention when students used fidget spinners.

These findings are consistent with the idea that using a fidget spinner can serve as a distracting secondary task. Performing a secondary task is usually associated with divided attention and impaired performance on the primary task (Broadbent, 1958; Pashler, 1994). Performing a secondary task can disrupt performance on the primary task by diverting limited attentional resources or overloading attentional limits (Tombu & Jolicœur, 2004). As such, adding the secondary task of using a fidget spinner could disrupt attention in class. Indeed, even small motor movements like finger tapping have been shown to disrupt performance on a primary task (Mioni et al., 2016). Although some students could perhaps learn to use fidget spinners in classrooms without suffering the costs of multitasking, they would likely need incentives and training beyond those present in typical classrooms (Schumacher et al., 2001).

The costs of multitasking in the classroom are well-documented. Using a mobile phone during class or while studying can impair learning (Chen & Yan, 2016). Using a laptop computer to answer emails or browse online can cause students to attend to and subsequently remember a lecture less well than they would have otherwise (Risko, Buchanan, Medimorec, & Kingstone, 2013). Indeed, laptop multitasking can disrupt not only the learning of laptop users but of individuals seated near laptop users (Sana, Weston, & Cepeda, 2013). Similarly, the use of fidget spinners could distract not only fidget spinner users but others in the vicinity. Fidget spinners can be noisy, and their movements seem to capture attention. They could draw the eyes and ears of nearby students, perhaps even more so than the emails of a classmate on their laptop. Such a possibility is one of the reasons fidget spinners have been banned in many schools (Davis, 2017).

Interestingly, students are often unaware of the costs of multitasking. Students who believe they are effective multitaskers typically still suffer deficits to attention and performance while media multitasking (Bannister & Remenyi, 2009; Ophir, Nass, & Wagner, 2009). These findings are unsurprising given that students are often unaware of the effects of various manipulations on learning. Thus, it is possible that students might not be metacognitively aware of the costs (or at least lack of benefits) of using fidget spinners. Indeed, considering the entire scope of the theory and evidence available in the literature, it seems likely that despite people's beliefs about fidget spinners, using them should harm, rather than help, attention and memory.

2 | LOGIC OF THE CURRENT STUDY

The current study sought to examine the impact of using a fidget spinner on learning and attention during a video lecture. In Experiment 1, participants were asked to watch an educational video lecture while either using a fidget spinner or not using a fidget spinner. Half of the participants not using a fidget spinner were randomly assigned to watch the lecture while sitting near someone using a fidget spinner, whereas the other half were not. After the video, participants were asked to self-report attentional lapses and take a fill-in-the-blank memory test for the lecture material. If fidget spinners aid learning by providing relief from boredom or allowing participants to engage in an activity to self-regulate their arousal, then participants who use fidget spinners should outperform participants who do not use fidget spinners. If using a fidget spinner causes distraction associated with multitasking, however, then fidget spinners should impair the learning of participants who use them. If it is the movement, noise, or novelty of fidget spinners—rather than the act of using them per se—that is the source of distraction, then participants seated in the same room as participants using a fidget spinner should show a similar impairment.

3 | EXPERIMENT 1

3.1 | Method

3.1.1 | Participants

Ninety-eight undergraduates from the University of California, Santa Cruz (UCSC; M_{age} = 20.0) participated for partial course credit.

Because relevant data were not available, a power analysis was conducted using the data from the first 15 participants. The power analysis indicated that a sample of at least 26 participants per group was necessary to provide 90% power to observe a significant difference between the spinner and no spinner conditions (α = .05). Because participants were run in groups, data collection ceased as soon as all conditions had at least 26 participants, and each had a similar number of participants, resulting in 33 participants each in the Spinner and Spinner Present conditions and 32 participants in the No Spinner condition.

3.1.2 | Design

The experiment included three levels of a single between-subjects independent variable: No Spinner, Spinner, and Spinner Present. Participants in the No Spinner condition were run in groups in which none of the participants used fidget spinners. Participants in the Spinner and Spinner Present conditions were run in groups in which half of the participants used fidget spinners (participants in the Spinner condition used fidget spinners; participants in the Spinner Present condition did not). Two dependent variables were measured: performance on a memory test for the material covered in the lecture and self-reported attentional lapses.

3.1.3 | Materials

Typical fidget spinners were used in the study. The fidget spinners were made primarily from brightly painted metal with a plastic-covered ball bearing in the center of the device that allows it to spin. Attached to the center axis were three rounded arms with metal weights on each end. All participants watched a recorded lecture (15:35) about the stages of baking bread. We chose this topic because most participants in our sample did not have formal education in the culinary arts. If fidget spinners benefit learning by reducing boredom or mind-wandering, a relatively unengaging lecture should create the most likely conditions for detecting such a benefit. As such, the lecture was chosen because it did not contain pauses for questions or activities that might prevent lapses in attention. Attentional lapses were assessed using a four-item survey (shown in Appendix A) that included a 1–5 Likert scale with higher values indicating more lapses of attention. Learning was assessed using a 20-item fill-in-the-blank test about the content of the video (e.g., *The sugars in the dough ________________ to form a crust when it bakes*; Answer: *caramelize*).

3.1.4 | Procedure

Participants were run in a large lab room in groups of no more than six. The No Spinner group was run with all participants belonging to the No Spinner condition. The Spinner and Spinner Present conditions were run together, and participants in sessions involving fidget spinners were randomly assigned to the Spinner or Spinner Present condition after all participants arrived. Sessions alternated between groups with and without the use of fidget spinners.

First, participants were seated around a conference table in front of a large television. Participants were seated such that they all had a clear view of the television as well as one another. If they belonged to the No Spinner condition, they watched the lecture as a group once all scheduled participants had arrived. Fidget spinners were not mentioned. Participants in a group with fidget spinners present were given face-down playing cards, which randomly assigned them to the Spinner and Spinner Present conditions. Once all participants arrived, they returned their playing cards and were then either provided a fidget spinner or not according to the card they received thus making it clear that whether they received a fidget spinner was determined randomly. Once fidget spinners were dispensed, participants were shown how they are typically used (by holding between the thumb and index finger of one hand and spinning with the other) but told that they could use their spinner however they liked as long as they kept it in their hands while watching the lecture, which according to the subjective observations of the experimenter they had no trouble doing. Participants were instructed to watch the lecture as they would in one of their classes and were warned beforehand that they would be tested on the lectured content.

After watching the lecture, participants in the Spinner condition turned in their fidget spinners, and then all participants completed the attentional-lapses survey. When a participant completed the survey, they were given the memory test, which they were given up to 5 min to complete. Once finished, participants were given a demographic survey, debriefed, and dismissed.

3.2 | Results and discussion

3.2.1 | Memory performance

Performance on the memory test was scored using an answer key by an experimenter blind to participant condition (see Table 1 for descriptive statistics). These data were analyzed using a one-way between-subjects analysis of variance, which indicated significant differences between the three conditions $F(2,95)$ = 4.514, p = .013, and η^2 = .09. Planned comparisons revealed that participants in the Spinner condition performed significantly worse than participants in the No Spinner condition, $t(63)$ = 2.927, p = .005, d = 0.73, 95% CI of d = [0.22, 1.24], as well as participants in the Spinner Present condition, $t(64)$ = 2.175, p = .033, d = 0.54, 95% CI of d = [0.04, 1.04]. No significant difference was detected between the No Spinner and Spinner Present conditions, $t(64)$ = 0.825, p = .412, d = 0.19, 95% CI of d = [−0.30, 0.69].

TABLE 1 Descriptive statistics for Experiment 1

Condition	Memory	Attentional lapses
No spinner	33.6% (22.1%)	3.27 (1.13)
Spinner	18.9% (18.1%)	3.39 (0.90)
Spinner present	29.2% (20.4%)	2.99 (0.82)

Note. Means based on condition and dependent measure; standard deviations appear in parenthesis.

3.2.2 | Attentional lapses

An average attentional-lapse score was calculated for each participant by taking the average of the three questions that asked about task-unrelated thoughts (questions 2–4 in Appendix A). A one-way between-subjects analysis of variance was run to detect differences in attentional lapses between the three conditions and failed to find a significant difference, $F(2,95) = 2.019$, $p = .138$, $\eta^2 = 0.04$. The same analysis was run for each question individually, which also indicated no statistically significant differences between conditions. Attentional lapses did, however, negatively correlate with memory performance $r(96) = -.439$, $p < .001$, 95% CI of $r = [-0.59, -0.26]$.

The results of Experiment 1 failed to provide evidence that fidget spinners prevent lapses of attention or improve learning. Instead, participants who used fidget spinners performed significantly worse than participants who did not use fidget spinners, and they failed to show even a numerical decrease in reported lapses of attention. On the contrary, reported lapses of attention were numerically highest in the condition in which participants used fidget spinners. Interestingly, we also failed to find evidence of a significant detriment in attention and learning in the condition in which participants did not use fidget spinners but watched a lecture as others nearby used fidget spinners, a finding that is consistent with those observed by Graziano et al. (2018). Performance was at least numerically worse in the Spinner Present condition than in the No Spinner condition, so we hesitate to make strong claims about this particular result.

4 | EXPERIMENT 2

One potential limitation of Experiment 1 is that the participants included in the sample may not have represented the population of individuals who would be likely to use fidget spinners in educational settings. Specifically, because participants were sampled from a broad undergraduate subject pool, many of them may have come into the study disliking fidget spinners and assuming they would not enhance learning. Fidget spinner users in everyday settings, however, would by definition seem more likely to enjoy using fidget spinners and potentially see value in their use for enhancing learning and attention. The primary goal of Experiment 2 was to replicate the effect observed in Experiment 1 (focusing specifically on the Spinner vs. No Spinner conditions) while limiting the sample to individuals who held neutral or positive views of fidget spinners. Specifically, a prescreening questionnaire was given to all participants in the subject pool, and any potential participant who reported a negative view of fidget spinners was not invited to participate.

Another goal of Experiment 2 was to examine whether participants are aware of the negative effects of using fidget spinners. It is possible that participants with generally positive views of fidget spinners suffer from a sort of metacognitive illusion in which they perceive a learning benefit from using a fidget spinner even though they suffer from a learning impairment. Such a perceived benefit could even drive the fidget spinner-related impairment. If participants are overconfident in their learning while using a fidget spinner, it could cause them to allocate fewer attentional or memory resources toward remembering the to-be-learned information. To test this hypothesis, we collected judgments of learning (JOLs) to assess whether using fidget spinners influenced participants' confidence in their learning.

4.1 | Method

4.1.1 | Participants

Forty-eight UCSC undergraduates ($M_{age} = 19.6$) participated for partial course credit. The sample size was determined based on a power analysis using data from Experiment 1. Specifically, the analysis suggested that a sample size of 45 would be sufficient to provide 90% power to replicate the learning impairment observed in Experiment 1, which we rounded to 48 to have equal numbers of participants in each of the counterbalancing conditions. Before recruitment, participants rated their agreement with the following statement using a 5-point Likert Scale ranging from *Strongly Agree* to *Strongly Disagree*: "Using a fidget device (like a fidget spinner or fidget cube) might help me focus in class." Participants who responded with *Disagree* or *Strongly Disagree* were excluded, leaving an eligible 52.8% of the participant-pool student population. It is noteworthy that over half of the students sampled at UCSC did not disagree with the statement, suggesting that the negative impact of using fidget spinners may not be particularly obvious or well-known.

4.1.2 | Design

Two within-subject conditions were compared (Spinner vs. No Spinner). Participants used a fidget spinner while watching one video lecture (Spinner condition) and did not while watching another video lecture (No Spinner condition). The order of the two conditions was counterbalanced across participants. Unlike in Experiment 1, all participants were run individually, thus providing a more controlled environment. The Spinner Present condition was not included. Three dependent variables were measured: memory performance, self-reported lapses of attention, and JOLs. Two video lectures were used as learning events with the particular video assigned to each condition counterbalanced across participants.

4.1.3 | Materials

Participants watched two educational videos (9:11 and 8:38). The videos were animated biographies of Hawaiian ruler Kamehameha the Great and Australian bushranger Ned Kelly. The videos were chosen because they were of an appropriate length and because they were designed to educate students about lesser known historical figures. As in Experiment 1, these videos also contained no activities or pauses for questions which could prevent attentional lapses. A 15-item fill-in-the-blank memory test was constructed for each video (e.g., ____________, *or spiritual life force, was the bedrock of Hawaiian culture during Kamehameha's time;* Answer: *Mana*). Participants also completed a short questionnaire about fidget spinners (see Appendix B).

4.1.4 | Procedure

Participants were run individually. They were instructed to watch a short educational video and to treat it as if they were watching a lecture because they would be tested on the material later in the study. During the Spinner condition, participants were provided a fidget spinner. During the No Spinner condition, participants were not given anything thus leaving their hands empty. The order of the two conditions was counterbalanced across participants such that half of the participants used a fidget spinner while watching the first video but not the second video, and the other half of the participants did not use a fidget spinner while watching the first video, but did while watching the second video. After watching the first video, participants filled out the attentional-lapses survey and then reported a JOL. Specifically, they were asked to estimate the proportion of questions they would answer correctly on a fill-in-the-blank test for the information covered in the video. After an unrelated 5-min task (Corsi Blocks), participants were given the fill-in-the-blank test. After completing the test for the first video, participants watched the second video, took another attentional-lapses survey, reported a new JOL, completed the distraction task, and were then administered a new fill-in-the-blank test for the information covered in the second video. After taking both tests, participants filled out a short demographic survey along with the questions about fidget spinners before being debriefed and dismissed.

4.2 | Results and discussion

4.2.1 | Memory performance

Descriptive statistics for all three measures are reported in Table 2. Test performance was scored in the same way as in Experiment 1 and analyzed using a paired-samples *t* test, which revealed significantly lower performance in the Spinner condition than in the No Spinner condition, $t(47) = 4.19$, $p < .001$, $d = 0.53$, 95% CI of d = [0.26, 0.79] thus replicating the memory impairment observed in Experiment 1. Interestingly, 31 participants exhibited lower performance in the Spinner condition than in the No Spinner condition, whereas only 11 participants exhibited better performance in the Spinner condition than in the No Spinner condition, 7 of whom answered only 1 additional question correctly in the Spinner condition than in the No Spinner condition.

We analyzed the data in numerous ways but could not find any evidence that having a positive view toward fidget spinners protected participants from suffering impairment as a result of using a fidget spinner. To illustrate, the 21 participants with the most positive views toward fidget spinners (as determined by their average response to the final three questions on the fidget spinner survey shown in Appendix B) still exhibited significant impairment (No Spinner: M = 70%, SE = 4%; Spinner: M = 59%, SE = 5%), $t(21) = 2.553$, $p = .019$, $d = .72$, 95% CI of d = [0.10, 1.01], as did the 28 participants who reported either currently owning a fidget spinner or having considered buying one, (No Spinner: M = 66%, SE = 3%; Spinner: M = 55%, SE = 4%), $t(27) = 3.144$, $p = .004$, $d = .59$, 95% CI of d = [0.18, 0.98]. The impairment was detected even when the analysis was limited only to the 14 participants who reported currently owning a fidget spinner (No Spinner: M = 64%, SE = 6%; Spinner: M = 50%, SE = 5%), $t(13) = .406$, $p = .032$, $d = .64$, 95% CI of d = [0.10, 1.16], indicating that using a fidget spinner can impair learning even in participants for whom a fidget spinner is not novel.

TABLE 2 Descriptive statistics for Experiment 2

Condition	Memory	Attentional lapses	JOL
No spinner	63.1% (18.8%)	2.44 (0.74)	71.6 % (14.4%)
Spinner	52.4% (22.1%)	2.85 (0.90)	66.9% (16.6%)

Note. Means based on condition and dependent measure; standard deviations appear in parenthesis.

Abbreviation: JOL, judgment of learning.

4.2.2 | Attentional lapses

Data from the attentional-lapses survey were analyzed using a paired-samples *t* test, which revealed higher levels of attentional lapses when participants used fidget spinners than when they did not $t(47) = 2.75$, $p = .008$, $d = 0.49$, 95% CI of d = [0.13, 0.85]. This pattern of results was observed when each attention question was analyzed separately (task-unrelated thoughts: $t(47) = 2.61$, $p = .012$, $d = 0.47$, 95% CI of d = [0.11, 0.83], difficulty staying on task: $t(47) = 2.26$, $p = .029$, $d = 0.39$, 95% CI of d = [0.04, 0.75], zoning out: $t(47) = 2.45$, $p = .019$, $d = 0.42$, 95% CI of d = [0.08, 0.77]). These findings indicate that rather than benefitting attention while watching educational videos, fidget spinners impair attention. Attentional lapses appeared to have a similar negative relationship with memory performance as in Experiment 1, but this relationship failed to reach the conventional standard for statistical significance, $r(46) = -.254$, $p = .081$, 95% CI of r = [−0.55, 0.03].

4.2.3 | Judgements of learning

Due to experimenter error, two participants did not make JOLs. A paired-samples *t* test was conducted on the remaining data, revealing significantly lower JOLs in the Spinner condition than in the No Spinner condition, $t(45) = 2.34$, $p = .024$, $d = 0.39$, 95% CI of d = [0.06, 0.73]. As such, participants did not seem to experience a metacognitive illusion that using a spinner-aided learning. Rather, their JOLs seemed to accurately reflect the memory costs associated with using fidget spinners. This observation is particularly noteworthy given that we limited the sample to participants who had relatively positive views about fidget spinners.

5 | GENERAL DISCUSSION

The present data suggest that using a fidget spinner can negatively affect memory performance. In both experiments, participants who watched an educational video while using a fidget spinner answered significantly fewer questions correctly about the material covered in the video than participants who watched the video while not using a fidget spinner. This memory impairment was observed even when the samples and analyses were restricted to individuals with relatively positive views about fidget spinners. It is possible, however, that such individuals may have been particularly susceptible to fidget spinner-related impairments because of their positivity toward fidget spinners and enthusiasm toward using them. Still, it seems unlikely that the impairment was caused by participants expecting fidget spinners to be disruptive or by participants being irritated by the fact that they were asked to use fidget spinners.

These results add to a growing literature on the potentially adverse consequences of using fidget spinners in learning contexts. Graziano et al. (2018), for example, found that children with ADHD demonstrated poorer attention as a result of using fidget spinners. It is informative that fidget spinners cause impairment in young adults and not only children with ADHD. One might have predicted that college students would be less prone to distraction or lapses in attention caused by using fidget spinners. Dual-task costs are not always observed when the primary and secondary tasks occur in different modalities (McLeod, 1977) or when the secondary task is particularly easy (Strayer & Johnston, 2001). The fact that reliable impairment was observed for young adults—with presumably intact or even relatively high levels of working memory capacity and more extensive experience with multitasking—suggests that it may not only be children with attention deficits that are susceptible to the negative effects of using fidget spinners.

One could argue that, if fidget spinners aid learning by preventing boredom, they might not be effective in an engaging learning environment where participants are unlikely to become bored. Thus, the videos used in the current study were chosen because they were not particularly engaging and because video lectures have been shown to induce high rates of boredom and mind-wandering (Risko, Anderson, Sarwal, Engelhardt, & Kingstone, 2012). Although we did not measure boredom directly, participants did not report high levels of interest in the videos on a postvideo questionnaire. It remains possible, however, that fidget spinners would have been more effective (or at least less harmful) in contexts where learners were even more bored than they were in the current study.

Interestingly, participants appeared to be at least somewhat aware of the learning costs associated with using a fidget spinner. In Experiment 2, for example, participants reported higher levels of attentional lapses and lower JOLs in the Spinner condition than in the No Spinner condition. That participants were not overconfident in their attention or performance in the Spinner condition helps limit the potential mechanisms underlying the impairment. Specifically, it suggests that participants did not fail to engage in active or deep learning processes because they suffered from a sort of metacognitive illusion as a result of using fidget spinners. Instead, it suggests that the participants were likely aware of the negative effect of using fidget spinners while they were using them and that they were either unwilling or unable to overcome that effect.

It is informative that memory costs were only observed for participants who used fidget spinners. Participants in the same room as fidget spinner users, but who did not use fidget spinners themselves, were not significantly affected. It is difficult to make much from a null result in a single experiment, but at best, this finding suggests that the costs of using a fidget spinner are not as robust for others nearby as they are for the user. To some, this finding might seem surprising, as the mere presence of a brightly colored, noisy fidget spinner could be distracting. In hindsight, though, the finding fits well with the more straightforward intuition that fidget spinners have the most significant potential to impair the learning of the people who use them, perhaps due to the dual-task costs incurred by using a fidget spinner.

There are several limitations of the present work that could be addressed in future studies to elucidate the circumstances, if any, in which using a fidget spinner has the potential to enhance learning. It is possible, for example, that using a fidget spinner benefits learning only after the novelty of the object wears off. Stalvey and Brasell (2006), for instance, only found benefits of students using stress balls in the classroom after the novelty of the stress balls had waned. However, as discussed in the results of Experiment 2, even participants who reported owning a fidget spinner still showed impaired memory while using a fidget spinner relative to when their hands were free. Still, this possibility could be better addressed using a longitudinal design. Granting participants the freedom to self-modulate their fidget-spinner use could also reduce or even reverse the observed fidget-spinner impairment. Though anecdotally no participants had trouble keeping the fidget spinner in their hands, it is possible that participants were distracted by the task of reminding themselves not to put down the fidget spinner. Future work should explore the effects of free fidget-spinner use over long periods of time to explore whether fidget-spinner use might cause learning benefits under such conditions.

There are also some methodological limitations that could be addressed in future work. Our posttest measure of attentional lapses could be improved by employing an online probe-caught mind-wandering technique intended to catch attentional lapses without relying on participants' memory of their own mind-wandering (Weinstein, 2018). We chose to use posttask surveys to avoid the possibility that such probes might influence participants' propensity to mind-wander (Seli, Carriere, Levene, & Smilek, 2013) and as such alter the participants' interaction with the fidget spinner. Retrospective judgments, however, allow for the possibility that the measure of attentional lapses relied on many of the same intuitions as participants' JOL ratings. Indeed, in Experiment 2, self-reported attentional lapses were negatively correlated with JOLs, $r(44) = -.471$, $p < .001$, 95% CI of $r = [-0.67, -0.21]$. As such, future work might consider how fidget spinners affect mind-wandering measured online. In addition, the present study used a cued-recall memory test to assess learning, but several other measures could be added to gain a more holistic understanding of how using a fidget spinner affects learning outcomes more broadly.

Students in classroom settings use fidget spinners for many reasons beyond those related to trying to enhance their focus and learning. Cohen, Bravi, and Minciacchi (2018), for example, recently found that using a fidget spinner can benefit fine motor control as measured by accuracy in a spiral-tracing task. The variance in how and why people use fidget devices, not just spinners, grows even further when one considers the multitude of objects with which people choose to fidget (da Câmara, Agrawal, & Isbister, 2018). Future research should evaluate other claims associated with fidget spinners, including uses for individuals with particular disorders, who might benefit from their use in ways that cannot be captured by the present set of experiments. Moreover, although the current study investigated effects across participants, individual differences between students are vitally important in classroom settings. To be sure, we are not arguing that fidget spinners are always detrimental, but rather that fidget spinners are at least not likely to be a panacea for restless hands and minds in the classroom. On the contrary, it seems more likely than not, at least at this point given the overall state of evidence, that their use would backfire and thus disrupt, rather than aid, learning. For now, students who struggle to focus in class or while studying should consider the potential costs and benefits of using fidget spinners carefully and perhaps place more emphasis on evidence-based interventions.

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APPENDIX A

Survey of self-reported attentional lapses

The following 4 questions are about your experience watching the lecture. *Mind-wandering* is when your thoughts stray from the primary task you're engaged in, in this case, watching the lecture.

I noticed myself mind-wandering about things directly RELATED to the video

1. Never
2. Rarely
3. Sometimes
4. Often
5. Very often

I noticed myself mind-wandering about things UNRELATED to the video

1. Never
2. Rarely
3. Sometimes
4. Often
5. Very often

I had difficulty staying on task while watching the video

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

I caught myself “zoning out” while watching the video

1. Never
2. Rarely
3. Sometimes
4. Often
5. Very often

APPENDIX B

Fidget-spinner attitude survey

The following questions are about your opinion of fidget devices like spinners or cubes, as well as your opinions about fidgeting and attention.

I have considered buying a fidget spinner or other fidget toy in the past

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

I own a fidget spinner or other fidget toy

1. Yes
2. No
3. I have owned one in the past, but no longer have/use it

I have a positive view of fidget spinners or other fidget toys

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

I feel like I can focus better when my hands are busy

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

Using a fidget device (like a fidget spinner or fidget cube) might help me focus in class.

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree