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Visual Distraction or Aid? EEG and Behavioral Effects of Background Dynamic Visual Stimuli on Attention and Comprehension in ADHD

Bachelor's Project Thesis

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Abstract: Attention-Deficit/Hyperactivity Disorder (ADHD) is marked by difficulties sustaining focus and distractability to external stimuli. A recent trend on platforms like TikTok pairs informational content with unrelated "oddly satisfying" videos , raising questions about whether such background visual stimuli help or hinder attention. This study examined the impact of an unrelated background video on listening comprehension and brain activity in young adults with high and low ADHD symptoms. The EEG activity indicated higher cognitive arousal after descriptive statistical analysis, albeit the presence of a background video had almost no change in quiz performance for both groups (differences $\leq$1 point). These findings suggest that while additional distractions are typically assumed to worsen task performance for individuals with ADHD, not all would have a direct impairing effect on performance itself, and could even satisfy the need for "variation" in obtaining new information. Further research with larger samples is needed to confirm these trends and determine when such stimuli can act as a distraction versus an aid.

1 Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by repeating pattern of one or more of the following symptoms: inattention, hyperactivity, impulsivity of Mental Health (2024). As Stokes et al. (2022) stated "Distractibility by extraneous stimuli is so readily associated with ADHD, that it is one of the 18 items listed in the Diagnostic and Statistical Manual of Mental Disorders – 5". In other words, people with ADHD often struggle to maintain focus when irrelevant sights or sounds are present, and external task-irrelevant distractors tend to disrupt performance more in those with ADHD than in those without. Such distractibility can negatively impact academic and cognitive performance, making it challenging for individuals with ADHD to sustain attention in the presence of competing stimuli (Osborne et al., 2023; Henning et al., 2022). Traditionally, the primary treatments for ADHD are stimulant medications, which have a high success rate (improving symptoms in roughly 80% of cases) but can cause side effects (e.g. insomnia, weight loss, anxiety) (Cleveland Clinic, 2022). Behavioral interventions (e.g. parent training, cognitive-behavioral therapy, attentional training) are also commonly recommended as non-pharmacological approaches, underscoring that effective management need not rely solely on medication (Centers for Disease Control and Prevention, 2024b). Nevertheless, even with treatment, day-to-day attentional challenges persist, and organizations devise coping strategies or seek environmental modifications (Centers for Disease Control and Prevention, 2024a).

One emerging real-world trend intended to capture and hold attention is the use of simultaneous multi-frame videos on social media. For example, on TikTok and YouTube, some creators pair a primary informational video (such as a story narration or educational commentary) with a secondary, unrelated video playing alongside it, often satisfying or fast-paced visuals like gameplay or craft demonstrations. This format, informally dubbed "sludge content", features unrelated but attentiongrabbing side clips meant to increase viewer retention and engagement. Commonly, the secondary content may include looping game footage (e.g. A mobile game Subway Surfers), ASMR, or "oddly satisfying" (Vanhersecke, 2021) scenes, shown in a split-screen or background while the main narrative's audio plays (Wikipedia contributors, 2025). The rationale is that by bombarding the viewer with multiple streams of stimuli, especially visual stimuli, content producers can hold fickle attention for longer. Indeed, such split-screen videos have spread widely across TikTok and other platforms, reflecting an extreme response to the audience's growing appetite for stimulation and the perceived decline in attention spans. A recent study however, found that engaging with multiple digital media simultaneously (e.g. texting, browsing and watching videos at once) worsened attention and memory recall in young adults. Albeit, it is conceivable that some viewers, especially those who are neurodivergent, might benefit from the added stimulation. There are anecdotal reports of people with ADHD finding such dual-content videos more engaging or easier to focus on, perhaps because the extra stimuli provide a more diversely engaging feeling to a task. Scientific perspectives are mixed: some experts warn that more stimuli could overwhelm an already attention-challenged brain (for instance, viewers with ADHD or autism might feel burned out by the overload), whereas others note that ADHD participants can show increased responsiveness to peripheral or extraneous cues under certain conditions. In sum, whether these dynamic background visuals act as a distraction or a useful stimulation aid – and for whom – is an open question with practical importance in today's media environment.

Given the presence of "dual content" videos online, it is crucial to investigate their effects on attention and comprehension, particularly in individuals prone to distractibility. The current study aims to address this question empirically by testing how the presence of a continuous irrelevant background video influences task performance and brain activity in people with and without ADHD. Focusing on a scenario reflecting the common TikTok split screen format, participants listen to an educational audio narrative (primary content) with or without a secondary video playing silently in the background. We measure behavioral outcomes (listening comprehension quiz scores) as well as markers from EEG recordings. In doing so, we seek to determine whether a dynamic visual stimulus will impair performance, as classic distraction theory would predict, or potentially enhance engagement for those with attentional difficulties, as suggested by the optimal stimulation theory of ADHD.

2 Background and Literature Review

2.1 ADHD, Attention, and External Stimuli

The classical view of ADHD states that external stimuli compete with attention and engagement in tasks. Specifically, it could be said that a person with ADHD is more prone to simple distractions leading to worse performance in the main objectives. This is a supported claim within studies or even diagnostics (an ASRS-v1.1 Symptom Checklist is an example of this by stating a question "How often are you distracted by activity or noise around you?" (World Health Organization et al., 2015)), implying that there exists a "distraction hypothesis". In short, more sensory input would increase problems with attention in individuals with ADHD.

However, it can be debated that there is an opposing hypothesis that could be phrased as "stimulation hypothesis". This, by name, would suggest that there exists a way of implementing additional stimuli as a stimulation towards attention and task performance rather than simple distraction. This idea would origin from the low arousal theory in people on the ADHD spectrum. The low arousal theory in this case means that individuals on the ADHD spectrum suffering from low alertness, tend to find themselves additional stimulation to increase it. This is supported by scientific findings showing that temporary performance may increase, reduce omissioning errors, or improve cognitive task performance (Nigg et al., 2024; van Mourik et al., 2007). Further down the line it would mean that individuals are not using their capabilities to the fullest, and an additional stimulus would help them achieve this. The main support behind this hypothesis is that scientifically, a low stimulation environment might disinterest such ADHD individual, leading to lower attention or mind wandering. As an example of such additional stimuli, playing white noise in the background has potential to be effective in improving memory and attention in children with ADHD when tailored correctly (Pickens et al., 2019). Similarly, fidgeting or restlessness (as mentioned in World Health Organization et al. (2015)) has been considered as a sign of generating own additional stimulus to increase activity (Son et al., 2024). Richter et al. (2023) tested a device that provided continuous peripheral visual stimulation. After 2 months of the experiment, the experiment participants had shown improved attention and execution ratings as well as improved responses. This study suggested that task irrelevant additional stimuli can indeed help attention and other cognitive functions.

Considering these two opposing hypotheses, it can be determined that there has to be a line between stimulus being beneficial and becoming distracting.

2.2 "Sludge Content" and Dual Task Attention

The rise of "sludge content" provides a real-world test case of the above theories. In these videos, viewers are exposed to multiple simultaneous streams of information. From a cognitive load perspective, this scenario resembles a multitasking or divided attention paradigm, which would predict reduced comprehension of the primary content due to interference. Research on dual task performance shows that when people attempt to attend to two inputs, performance on one or both typically suffers (Caldani et al., 2019). Catrysse et al. (2023) examined high-school students watching a science video with either a neutral background, a contextually relevant background, or an off-topic video playing behind the instructor. In their work they stated that the eye tracking data had shown the least distraction with neutral background, with higher focus on relevant video content. Furthermore, students subjectively highlighted that the off-topic background was the most distracting, however there was no statistically significant effect between the two scenarios. At last, the authentic background did not bring any positive effect, which is contrary to the hypothesized result by the author. While this is not exactly studying the effects of sludge content nor ADHD specific effects, this study can be considered a proof of potential effect of such stimulus.

This suggests that by adolescence, learners may ignore or tune out irrelevant visuals to some extent, preserving comprehension, better than younger individuals (Robinson et al., 2018). In the realm of social media, "sludge content" is an extreme case of irrelevant secondary stimuli. Notably, many sludge videos involve fairly low-information secondary clips (e.g. repetitive game footage or simple satisfying motions) (Wikipedia contributors, 2025), which may be easier to filter out compared to two narrations at once. These findings push towards the question whether "sludge content" could serve towards the "stimulation hypothesis".

A research by (Rozati, 2025) provides relevant insight towards the effect of sludge videos themselves. In the study, two groups of high school students attended a lecture under different conditions. One was allowed to use popular short content media platform "TikTok", while the other group had no access to it. A quiz after the lecture had shown that students with access to the platform had retained considerably less information which was seen by their quiz scores. This had shown that the "TikTok" content itself had to disturb or divert their attention away from the lecture. This paper can be strongly related to the current research. The core task was similar, follow educational content (lecture) and perform a quiz, while in the meantime being possibly subject to the external stimuli. While this study did not focus on individuals on the ADHD spectrum, it provides relevant insight on the effect of "sludge media" on attention. Additionally, increasing the credibility of the "distraction" hypothesis.

2.3 EEG of Attention

EEG is a widely used method for recording brain activity with high temporal resolution, and certain frequency band signals in EEG correlate with attention and cognitive arousal. In particular, the ratio of theta (4–7 Hz) to beta (13–30 Hz) power in the frontal cortex – often called the Theta/Beta Ratio (TBR) – has been widely studied. TBR appears to have functional significance, as high TBR correlates with poorer attention and cognitive processing capacity. For example, Picken et al. (2020) reported that in adults (both with and without ADHD), higher frontal TBR was associated with longer P300 latencies (slower information processing) on an EEG task. Such findings suggest that lowering the theta/beta ratio (i.e. increasing beta or reducing theta) corresponds to a more task active brain state. In the context of this study, it is anticipated that when participants engagement and comprehension increases, their frontal TBR should decrease and the other way around.

Beta oscillations (13–30 Hz) are generally associated with active thinking and sustained attention, often increasing when the brain is engaged in cognitive or sensory processing. Prior research indicates that lower beta power in task relevant posterior areas may be correlated to ADHD. In a review of EEG studies, Loo & Makeig (2012) noted that, on average, ADHD groups showed about 5–10% lower beta-band power in posterior regions compared to control groups.

Together, monitoring frontal TBR and posterior beta allows us to gauge both attentional state and sensory engagement under the two conditions.

Reflecting these literature findings, specific hypotheses can be formed to answer the question of how background visual stimuli can affect attention and comprehension in individuals on the ADHD spectrum.

- *H1* Participants with high ADHD symptoms will perform worse on the comprehension test with no background visual stimuli than participants with low symptoms
- *H2* Background visual stimulation will improve test scores in individuals scoring high on the ADHD spectrum
- *H3* Participants with high ADHD symptoms will have higher beta band activity in posterior brain regions with background stimulus present
- *H4* The theta/beta activity ratio will decrease in participants with high ADHD symptoms with a stimulus present compared to no stimulus
- *H5* All participants will have higher beta band activity in posterior brain regions with background stimulus present

The hypotheses together should help to classify both the behavioral and EEG effects of the stimulus inclusion.

3 Methodology

3.1 Participants

Eight volunteer participants were initially recruited from the University of Groningen, Faculty of Science and Engineering. All were young adults (age 20–22) with no known neurological disorders. Each participant completed the Adult ADHD Self-Report Scale (ASRS v1.1) symptom checklist (World Health Organization et al., 2015), a standardized questionnaire for ADHD-related behaviors. Based on their ASRS scores and any prior ADHD diagnosis (self reported), participants were categorized into either a High ADHD group (high probability of ADHD) or a Low ADHD group (low probability). No clinical diagnosis was presented by the participants, however 1 participant subjectively thought of himself as High ADHD. Three participants were in the High ADHD category and remaining 5 were assigned to the Low ADHD group. After data collection, two participants (both from the Low ADHD group) were excluded due to problems with the recording and data legibility. The final sample included 6 participants (High ADHD = 3, Low ADHD = 3). All participants provided informed consent for the experiment. There was no physical or monetary compensation for participation in the experiment.

3.2 Materials and Stimuli

To conduct the experiment several components were prepared. Firstly, two different stories were prepared for each trial per participant. The stories were generated using ChatGPT GPT-4o (OpenAI, 2025) with a prompt asking to generate two as similar as possible stories on as unknown as possible topic. The detailed prompt used to generate the stories is listed in the Appendix A. After generating the stories, ChatGPT (OpenAI, 2025) was asked to generate two quizzes consisting of 10 questions each based on the stories. These questions were generated automatically as part of the question in the generated answer “Would you like the quiz questions for these stories generated next?”. The stories covered the topics of Pneumatic Tube Systems and The Atmospheric Railway. They can be found in the Appendix A after the prompts. The voice over was then generated using ElevenLabs model

AI text-to-speech engine (ElevenLabs Inc., 2025).

From the two generated stories, four videos were prepared. two with black background and white bordered subtitles in the middle of the screen parallel to the audio, and two with a video from platform TikTok reflecting the mentioned earlier "oddly satisfying" format (Vanhersecke, 2021). The video was chosen by assessing the length (sufficient for an entire story), views count (at least 5 million views), high "Like" number (at least 500 thousand, as view count was set relatively high as well), and ability to download and cite the video (TikTok Profile, 2025).

The experiment was further developed within the OpenSesame software.

3.3 Experimental Design and Procedure

The experiment had a within subjects design concerning the presence of visual stimulus, and a between subjects comparison for High and Low ADHD. The order of "no stimulus trial" and "stimulus trial" was not altered. This was to ensure a similar experience among the participants. Hence, there is a possibility that participants could be prepared better for the second quiz as they completed the first phase. Albeit, at the beginning of an experimental session the choice of videos with and without additional stimulus was randomized. This means that some participants could have story 2 as the one with no additional stimulus, and some story 1. Respectively, the remaining story was with the background stimulus. The experiment started with watching and listening to the entire story, followed by a quiz of 10 questions. The questions were all multiple choice and can be found in the Appendix A. The questions were displayed one by one on the screen with immediate saving of an answer and proceeding to a next question. The time limit for an answer was set to 10 seconds to avoid overthinking the answer. Participants were additionally verbally instructed to avoid guessing as much as possible. After the first video and quiz, second pair of video and quiz began once the participant was ready and indicated that by a key press. The task was the same however it involved another story, now with the background stimulus. Between the sections, participants were displayed an informational screen informing about what will happen next, how they should act, and whether to rest before continuing.

Each session had the following procedure.

1. Introduction to the experiment
2. Signing of written consent
3. ASRS-v1.1 administered to the participants
4. EEG hardware is prepared and applied to the participant
5. Experimental software is initialised
6. First story without a video in the background is played
7. Participant is quizzed on the contents of the story to measure their accuracy
8. A short break is held between the tasks
9. Second story with additional stimulus in the background is played
10. Participant is quizzed on the contents of the story to measure their accuracy
11. Participant is asked to fill a subjective form on any possible differences found in their performance

In total, the experiment lasted around 60 minutes per participant. One participant could be examined at a time. All the experiments were conducted within the same laboratory and hardware.

3.4 EEG Setup

The collection of EEG data was done using the BioSemi ActiveTwo system. It involved Ag-AgCI electrodes at 32 channels. The placement of the electrodes followed the 10-20 system and the reference for stabilization of the recordings was done using Common Mode Sense (CMS) and Driven Right Leg (DRL). The electrooculарograms used were placed on the left and right eye temples at the level of pupils, and above and below the left eye (above the eyebrow and below the eye respectively). The signal was recorded using a 512Hz sampling rate, and the impedance was below $20k\Omega$ for all electrodes.

3.5 EEG Data Processing

EEG data was analyzed using a custom Python script and the Python MNE library for signal processing. Band-pass filtering from 1–35 Hz was performed to remove slow drifts and high- frequency noise. The continuous EEG was then visually inspected for artifacts and areas with evidence of such were marked as “bad”. An Independent Component Analysis (ICA) was performed on each recording to identify components corresponding to blinking, muscle movement, heartbeat and similar artifacts. After artifact correction, the data was divided into epochs based on the stage of the recording (first story, first quiz, second story, second quiz). Each epoch was analyzed for Power Spectral Density (PSD) using Welch’s method (averaging periodograms over 2-second Hanning-windowed segments with 50% overlap). The PSD was used to obtain the beta and theta band powers in both frontal and posterior regions (as mentioned in the previous sections). The posterior channels used for obtaining posterior beta power were P3, P4, Pz, PO3, PO4, and the frontal channels were F3, Fz, F4. All electrodes were averaged within the area to obtain the overall powers. The frequency range for theta power was $4Hz \leq F \leq 7Hz$ and the range for beta was $13Hz \leq F \leq 30Hz$ For the TBR the theta power was divided by the beta power to obtain the ratio.

Further analysis of the results involved statistics. Mainly descriptive as the population was small and statistical tests would mostly show insignificance. The data was then compared with respective components for the presented hypotheses.

4 Results

4.1 Behavioral Results: Comprehension Performance

All participants completed the listening and quiz tasks in both conditions. For the comprehension quiz scores, there were clear differences between the ADHD and control groups. Table 4.1 (see below) summarizes the quiz performance for each group in each condition. The behavioral hypotheses will be revisited in this section.

Calculating from the Table 4.1, the average High ADHD score for both control and with stimulus trials was 7.67. The average Low ADHD score was however 9.67 for control and 9.33 for stimulus present. Furthermore, it is important to note that 2 out of 3 High ADHD participants did not manage to answer 1-2 questions during the quiz. This phenomenon occured only in the High ADHD group and involved 66% of the group. It is important to scale this measurement to a larger format as to check if this high percentage persists or not.

Table 4.1: Quiz scores among the Low and High ADHD groups - (“Both” in section No Ans (no answer) means that the participants did not answer 1 question in both quizzes, “nSTIM” stands for no stimulus scenario, meaning that the participant did not answer the question in the respective quiz)

#	ADHD	Control	Stimulus	No Ans
1	High	8	7	2 (BOTH)
2	Low	10	9	0
3	Low	9	10	0
4	High	8	9	0
5	Low	10	9	0
6	High	7	7	1 (nSTIM)

Revisiting *H1*, using descriptive statistics due to small sample size, it can be stated that the High ADHD group has scored worse than the Low ADHD group, by about 2 points on average. This supports the first hypothesis stated earlier.

On the other hand, introducing the stimulus had shown no valuable change in pattern between the participants. *H2* was not supported as there was completely no change on average in the 2 conditions for the High ADHD individuals. It is important to note that there is also no pattern among the 3 High ADHD participants, the change was positive (+1), negative (−1), or even absent (0).

Interestingly, the change in scores between the trials have not exceeded 1.

The post experiment questionnaire involved subjective review of the experiment by terms of interest, difficulty, and attention. With a question regarding difficulty of recalling informations from the videos, on average participants rated the no stimulus variant as around 4.5/5 (1 - Hard to recall, 5 - Easy to recall), while the stimulus variant was rated 4/5 (on the same scale). In terms of focus (1 - Hard to focus, 5 - Easy to follow) the scenario with no additional stimulus was rated slightly above 4/5 on the subjective scale, and the scenario with stimulus present was rated slightly below 3/5 on the subjective scale. No participants indicated that the dual task version was easier for them to focus on, and two participants (both High and Low ADHD) indicated in the middle of the scale (3/5) stating no difference between the two.

This subjective insight follows the "distraction hypothesis" introduced earlier, meaning that participants consciously preferred no additional stimulus during the task.

4.2 EEG Results

After analyzing the EEG data using the aforementioned Python scripts, two main objects were highlighted in line with the hypotheses. They were divided across the different stages of each trial, no stimulus story, respective quiz, stimulus story, and another respective quiz.

The posterior beta power results were divided between the High ADHD (Figure 4.1) and Low ADHD (Figure 4.2) groups. As it can be seen, 2 out of 3 High ADHD subjects showed slightly higher beta power. One subject had a large drop in beta activity that might either indicate an anomaly or vast decrease in engagement between the trials. While slight increase occurred in 2 out of 3 subjects, the results were statistically insignificant ($t(3) = -0.3433$, p-value: 0.7641). The insignificance of results indicated by the test should be considered with lower importance as there are two possible reasons for that, low sample size and/or anomalous power values for subject 1.

Furthermore, similar scenario appeared among the Low ADHD group (Figure 4.2). Two out of three subjects indicated an increase in posterior beta power. In total four out of six participants had shown an increase in beta power, however it is statistically insignificant ($t(6) = 0.0998$, p-value: 0.9244).

With this data, it can be concluded that both *H3* & *H5* are only partially supported by descriptive statistics, as test results do not indicate significant difference.

The Theta/Beta Ratio (TBR) was obtained from the frontal regions. As mentioned previously, it is meant to indicate cognitive arousal. The data for High ADHD individuals was plotted in Figure 4.3.

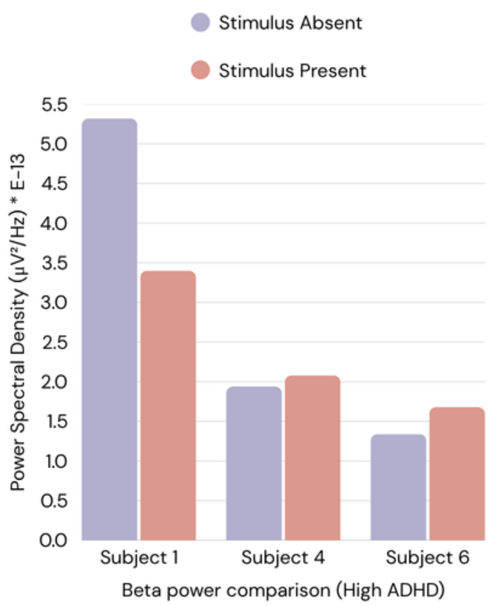

Figure 4.1: Bar plot displaying the beta power comparison between High ADHD participants

No pattern was determined by descriptive statistics, as for each of the subject there was respectively no change, slight increase, and slight decrease in the TBR. As the *H4* stated, it was hypothesized that the TBR should decrease among the High ADHD group. As descriptive statistics did not support it, and the statistical test difference was not significant ($t(3) = -0.9433$, p-value: 0.4451) it can be concluded that the hypothesis *H4* should be rejected.

Additionally, it is important to note that the TBR analysis fell in line with expected behavior. As the participants engaged in more attentive parts (in this case the quiz) the TBR had decreased increased higher cognitive arousal (in this case most likely for recall and reasoning). This can be seen within the Figure 4.4.

5 Discussion

The paper focused on a common phenomenon, "sludge media" (Wikipedia contributors, 2025). While the name for the phenomenon itself is informal, it had taken over the modern media streams (Ampere Analysis, 2025), bringing dual tasks closer

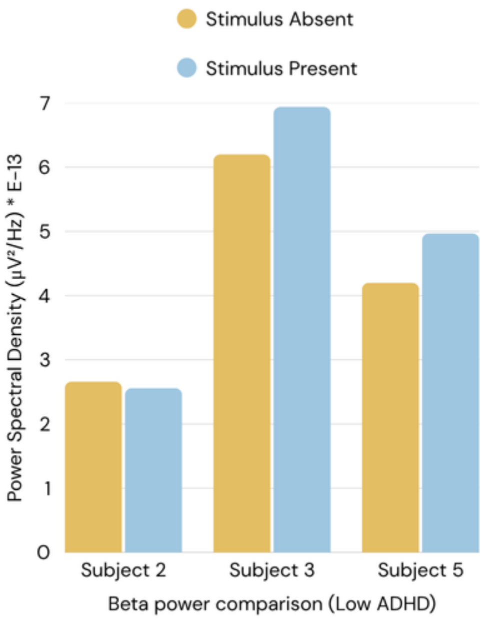

Figure 4.2: Plot displaying the beta power comparison between Low ADHD participants

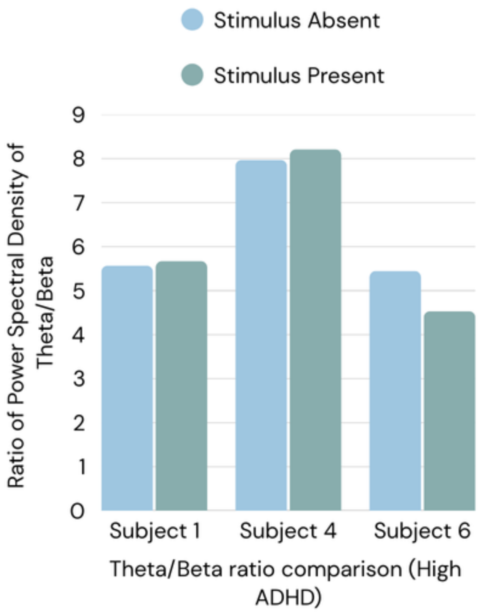

Figure 4.3: Plot displaying the Theta/Beta ratio comparison between High ADHD participants

in common settings.

As the results section showed, while the posterior beta power had grown, and the frontal TBR decreased (considering descriptive statistics due to the sample size), the quiz score remained mainly unchanged for the High ADHD participants, and slightly decreased for the Low ADHD participants. This increase in power is as expected from the findings in the literature review section, additional stimulus would require higher activity in the posterior region in order to process more incoming information. Despite deemed by the EEG analysis increased attention and engagement, there was no behavioral improvement among the subjects. Interestingly, even through the subjective review of the experiment by the participants, the additional stimulus involvement had induced harder conditions for focusing and comprehension.

The insignificance of the results is most likely caused by the low sample size.

From these findings, it can be derived that additional stimulus in the format of "sludge media" does indeed require more attention from the human side, however it does not improve the comprehension. Neither in High ADHD nor Low ADHD individuals. The attention itself could be considered as increased, however there is not much evidence for a better behavioral performance. Finally, it is important what type of media is presented as stimuli, as Richter et al. (2023) talked about a simple flashing of light as beneficial stimulus.

The key to the improvement might compromise between complexity and intensity, as simple intensive stimulation, might become much more valuable than the complex stable but calm constant stimulus.

5.1 Limitations

The conducted research is mainly limited by the sample size (n=6) and by the use of only a single specific video as the additional stimulus. Extending it further, with larger sample size the order of no stimulus/stimulus could be altered to achieve more balance between the trials.

Even though there was no comprehension improvement among the population, it could be that the "sludge content" would be beneficial to some

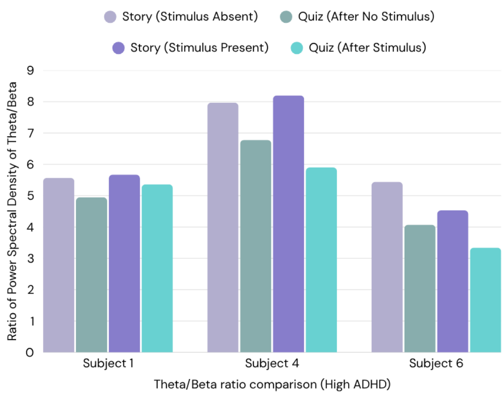

Figure 4.4: Plot displaying the Theta/Beta ratio comparison between High ADHD participants

people. This is mainly due to the complicated nature of human brain. Each human, processes the information slightly differently, with different traits and strengths. That is why, such conditions as ADHD should be considered as a spectrum. Thus, there is still a chance that the "sludge content" used as a stimulus contrary to the uninterrupted trial with no additional video, could be beneficial to some group of people. It does not however, based on the current population, bring any benefits in behavioral performance.

Furthermore, the research involved a narrow choice of participants. All participants were of similar age and occupation. Hence, no comparison was possible between ADHD subtypes, younger or older population and other. What is also important is that the participants appeared to vary in emotions when arriving to the experiment. Some of them were more tired than others, some were more energetic, and some were rather quiet. While this is a subjective opinion, it is important to account for these differences as some participants could have had a worse day than others, causing them to lose focus on extracurricular activities such as participation in an experiment.

Moreover, the used stimulus video was the same across all attempts. As the paper discussed the border between beneficial and distracting form of stimuli it is important to verify which exact parameters and their combinations influence the result. This study employed a video with vivid colours, consistent tempo of progress, and no audio from the video itself. There is a possibility that these factors, if changed, may influence how the stimulus affects the performance.

Lastly, it is important to verify the cognitive impact more thoroughly. As an example, a delayed quiz might bring more information about the effects of the stimulus on long-term retention of information from the story.

5.2 Implications

While the implications are rendered primarily unclear, the main idea to be followed from the study does not exclude that there could be some participant wide differences that would change the effect of such intervention. Mainly, by the existence of the "tipping point". It is important to determine before further actions what specifically would still count as aid, and what would become distracting.

Together with the background literature findings, it is important to further examine the deemed "border" between being distracting and stimulating. As this, may be the key to enhancing performance both in the individuals on the ADHD spectrum, and the general population.

As discussed throughout the paper, there could be a tipping point between the "distraction hypothesis" and the "stimulation hypothesis". The results both from the behavioral side and the EEG side, have a perspective of being analysed together. The task in common, enabled a possibility of connecting both behavioral and EEG findings together. This is specifically important considering an emerging pattern between them.

To answer the question of "Visual Distraction or Aid?", with the obtained data it would be most rational to find a middle ground, and consider it as an addition itself, with currently no strong effects both enhancing or impairing performance.

6 Conclusions

As the discussion had shown, there is a chance of a group existing where people would indeed benefit from additional stimulus while being focused.

This exploratory thesis had considered the nature of dual tasking, involving two opposing perspectives, main wanted content and irrelevant "filling content".

By both the behavioral and EEG analysis it was determined that there is no clear direct benefit from the "sludge video" format. While it does indeed increase the posterior beta power and frontal TBR, it did not bring any meaningful behavioral benefits. Meaning as well that increased potential cognitive arousal and attention does not directly mean improved behavioral performance. With the current state of results, it can be claimed that multitasking is counterproductive.

What emerged from the experiment, was more close to an information overload. As the participants watched the videos, they did not improve on the quizzes; however they used more energy. This is where the "border" hypothesis would help understand the performance change between scenarios. There is a possibility that even more vivid, more dynamic, and more engaging background videos would in fact directly decrease performance of participants. Albeit, it was not disproved that certain choice, or even tailoring of stimulus, may help on attention and comprehension in the end.

Further research should directly focus on determining the type of stimulus or its parameters and effects in context of aid, to reach and find the border between distraction and stimulation, both for the ADHD and the general population. As mentioned in the discussion section, it should further analyse effects of specific stimulus components, verify the results on a larger and more diverse sample, and explore the effects with additional cognitive metrics. And as the performed study serves a role of a pilot study, it should maximize the statistical analysis and transform trends to actual leads and factual differences. This could provide better future support towards individuals on the ADHD spectrum.

7 Use of AI Assistance

While writing this paper, ChatGPT (OpenAI, 2025) was used to enhance writing and to guide potential improvements to the overall flow of the paper. All empirical data and research related statements were prepared outside of such automated assistants.

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A Appendix

Prompt used for generating the 2 stories for the experiment:

"Create 2 stories in a lecture like format. They will be implemented in an experiment that will verify participants focus and comprehension of a topic. Thus, they have to be on topics that no one would rather know about to eliminate bias. Moreover, the format/language/level of complexity has to be as uniform between the stories as possible to avoid more bias. The stories have to be about 500 words long, and they need to contain facts that the participants can be easily quizzed on in a multiple choice question fashion. Please ask me any questions that will be required for you to complete this task appropriately"

Further answer included following details:

"The participants will be college students. The comprehension level should be non native English undergraduate-level. The subject domain should be real, and preferably same in case of both stories. The lecture should be between normal/lecture style so that there are no discomforts in comprehension. It should support 10 quiz questions per story, and the questions should focus on mix. Written text is fine. Do not use diagrams, equations, or bullet points, it should be raw story format."

The generated stories were as follows:

Story 1: The Rise and Fall of the Pneumatic Tube Transport System In the late 19th and early 20th centuries, cities across Europe and North America explored an unusual method of transporting small packages and letters: pneumatic tube systems. These systems used pressurized air to propel cylindrical containers through narrow tubes, some of which extended for several kilometers beneath city streets. Though most commonly associated with sending paperwork between floors of large office buildings, early implementations were far more ambitious in scale and purpose.

The first commercial urban pneumatic post system was introduced in 1853 in London. It consisted of a small network that connected key post offices, and it was seen as a modern marvel. The technology was quickly adopted in cities like Paris, Berlin, and later New York City. At its peak in the 1890s, Paris had over 450 kilometers of pneumatic tubes, moving hundreds of thousands of messages each day.

These systems worked by creating a pressure differential using steam-powered compressors. A capsule would be inserted into the tube, and air pressure would either push or pull it to its destination. Although the capsules could not carry large packages, they were ideal for telegrams, banking documents, and legal correspondence. Their speed was remarkable for the era, often exceeding 30 kilometers per hour.

However, the complexity and cost of maintaining these networks proved unsustainable over time. Compressors broke down frequently, and the tubes were prone to leaks, misalignments, and moisture buildup. Moreover, the systems were labor-intensive, often requiring a staff of technicians to oversee daily operations and repairs. As newer communication technologies emerged—most notably the telephone and eventually the fax machine—the need for physical message transport declined sharply.

By the mid-20th century, most municipal pneumatic networks had been decommissioned. New York City's system officially shut down in 1953, and Paris followed in 1984, though some internal networks within buildings continued to operate. Today, the legacy of pneumatic tubes lives on primarily in hospitals and banks, where smaller systems are still used to transport specimens and documents quickly between departments.

While largely forgotten in modern urban planning, the pneumatic tube system was an early example of distributed, semi-automated infrastructure. It reflected the 19th-century optimism in mechanical engineering and the belief that human labor could be increasingly assisted—or replaced—by pressurized technology. Though ultimately replaced by more efficient and digital alternatives, the pneumatic tube network remains a fascinating footnote in the history of logistics and communication.

Story 2: The Atmospheric Railway: A Failed Innovation in 19th-Century Transit During the mid-1800s, several European engineers attempted to revolutionize railway transportation using an unconventional method: atmospheric propulsion. The idea was to eliminate the need for heavy locomotives by using air pressure to move train cars along a track. The concept was both daring and mechanically intricate, but its short life proved the difficulty of applying novel engineering solutions at large scales.

The most notable experiment in atmospheric railways took place in England between 1844 and 1848. The South Devon Railway Company, under the guidance of engineer Isambard Kingdom Brunel, constructed a line between Exeter and Newton Abbot that used this air-powered method. A long pipe was installed between the rails, and stationary pumping stations were placed at intervals of roughly three miles. The pump created a vacuum inside the pipe, pulling a piston attached to the train. A continuous leather flap ran along the top of the pipe and opened only briefly to let the piston arm pass through before resealing.

The system initially worked, and trains achieved respectable speeds of up to 70 kilometers per hour. However, many unforeseen problems arose. The leather flap, essential for maintaining the vacuum seal, deteriorated quickly due to exposure to weather and animal damage. Tallow was used to keep it supple, but this attracted rats, which chewed through the material. Maintaining airtight seals over long distances proved nearly impossible. The technology also required precise timing between the pumping stations, which often failed to synchronize correctly.

Brunel and his team persisted, but costs escalated rapidly. Within four years, the system was abandoned. Other trials had occurred earlier in Ireland and later in France, but none succeeded beyond short-term demonstrations. In Dublin, an atmospheric railway operated briefly between Kingstown and Dalkey in 1843 but was also discontinued by the 1850s. In France, the Paris–Saint-Germain line tested the technology with limited success.

Despite its failure, the atmospheric railway was a bold attempt to rethink how mass transit could be powered. It was emblematic of a time when industrial innovation embraced mechanical experimentation without fully understanding the limitations of available materials. Ironically, while the concept was ultimately discarded, it laid groundwork for future technologies. Some engineers drew inspiration from atmospheric systems when designing pneumatic dispatch networks and even modern maglev trains.

In the end, the atmospheric railway's problems were largely practical rather than conceptual. The idea of propulsion without on-board engines was sound, but 19th-century materials and weatherproofing techniques were not up to the task. Still, the project left behind pumping station buildings, some of which still stand today as curious reminders of a forgotten phase in railway history.