

Master thesis

The effects of digital media on memory recall: Comparing different stimuli from digital texts and videos among young adult media multitaskers and with or without ADHD



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Abstract

This study investigates how low or high media multitasking influences executive functions, such as maintaining attention and memory recall, in young adults with or without ADHD. It compares how digital text and videos may affect those executive functions. The experimental research involved 108 Dutch voluntary participants aged between 18 and 29. Participants were asked about an official Attention Hyperactivity Deficit Disorder (ADHD) diagnosis, completed a self-report media multitasking questionnaire about their habits, and were evaluated on their memory recall after being exposed to both text and video content. The findings of the research indicate that ADHD leads to a lower memory recall for digital textual information. On the contrary, ADHD leads to higher memory recall. This suggests that young adults with ADHD respond better to more stimuli from videos. This outcome aligns with the Optimal Level of Arousal theory, which suggests that more stimuli lead to better cognitive performance. Interestingly, media multitasking did not have an influence on memory recall for both text and video information. There was also no difference found between ADHD and media multitasking.

Introduction

The internet has become an indispensable part of the modern world. It provides certain advantages such as being able to immediately look up information and easily contact people (Clark et al., 2017; Sivakumar et al., 2023). However, the growing popularity of technology has also created several problems. For example, internet users are exposed to overwhelming information and are more prone to addiction (Poplawska et al., 2021). The internet also causes more media multitasking, where individuals switch between different social media platforms. Multitasking could potentially affect cognitive skills, attentional control, impulsivity, sensation-seeking traits, and focus (Ophir et al., 2009; Sanbonmatsu et al., 2013; Kirschner & Karpinski, 2010). This negative effect could be comparable to attention deficit symptoms such as attention deficit hyperactivity disorder (ADHD). In this study we compare the consequences of high media multitasking with ADHD symptoms in recall of text.

1.1 Media multitasking between social media networking sites

Multitasking is the activity of switching between different tasks (Ophir et al., 2009; Pool et al., 2000; Pool et al., 2003). Despite common belief that multitasking is performing two tasks at the same time, individuals are not able to perform multiple tasks simultaneously. Instead, their

brains rapidly switch between tasks (Madore & Wagner, 2020). Nowadays, smartphone users regularly engage in switching between different apps. Most of those apps are connected to social networking sites, such as Facebook and Instagram. For example, social networking sites are platforms that allow users to post content, connect with other people, and interact with other people's content.

It is often argued that these platforms are becoming addictive: young American adults report using social networking sites for 7.5 hours a day (Poplwaska., 2021). There are several reasons why these platforms are so popular and becoming addictive. The first reason is the algorithms on which they are based. Social media sites are driven by algorithms that monitor consumers' usage habits and tailor the information to the users (Jaakonmäki et al., 2017). This user-based design makes it easier to stay on social networking sites. The second reason is related to notifications. During the day, these apps supply different pop-up notifications, which are messages that remind you of the content of the app (Seibold, 2017).

1.2. How does media multitasking affect cognitive skills

The addictive nature of social media leads people to media multitasking (Ophir et al., 2009; Pool et al., 2000; Pool et al., 2003). A review study by Drody et al. (2023) found that 9% to 85% of the participants are media multitasking, with an average rate of 38% across 16 different studies, based on 2.972 participants among these studies. Media multitasking has different types of consequences to how we behave and our cognitive skills. Research has shown that media multitasking affects social skills. In the study of Hatchel et al. (2018), they questioned 263 adolescents in a longitudinal study, about their well-being and intensity of media use and engagement in media multitasking. In this study, media multitasking was associated with poor interaction skills and experiencing negative emotions, such as social anxiety. Besides social skills, media multitasking can also affect cognitive skills such as sustaining attention, inhibitory control, and memory recall.

Sustaining attention, inhibitory control, and memory recall

Due to the instant availability of technology, there has been an observable decrease in cognitive skills, such as attention span, among young adults in recent years (Twenge, 2017). Ophir et al. (2009) attributes this cognitive decline to media multitasking. They found that switching between different media types is mentally draining for those who multitask frequently. This cognitive draining results in poor performances on tasks, which require sustained attention, e.g., listening and participating in meetings or lectures. Ophir et al. (2009)

also suggest that individuals who frequently engage in media multitasking show reduced inhibitory control. Inhibitory control is a cognitive ability that suppresses or inhibits irrelevant stimuli to stay focused on task-relevant information (Uncapher & Wagner, 2018). Moreover, the negative impact of media multitasking on sustained attention and inhibitory control is also closely related to memory recall.

The decreasing effect of memory recall can be explained by the Cognitive Load Theory (Paas & Ayres, 2014). This theory claims that disruptions to working memory, like frequent task-switching, negatively impact the brain's learning process (Sweller, 1988; Zhao, 2023). The learning process heavily depends on memory recall. For example, when learning for a test, the ability to recall memorized key concepts is crucial to demonstrate understanding of the subject. Memory recall is the ability to use prior knowledge and experiences to guide behavior and decision-making (Towse et al., 2008). Memory recall relies on working memory, which is a temporary memory storage system. Working memory is responsible for retaining and using information for cognitive tasks (Diamond, 2013b).

Each person has a limited cognitive capacity. Disruptions that take place when multitasking, simultaneously switching between tasks, can strain working memory, increasing the cognitive load. Consequently, outcomes of the learning process, like memory recall, may be impaired as a result. Thus, it could be expected that users who frequently engage in media multitasking will have worse memory recall than individuals who do not engage in media multitasking. Kirschner and Karpinski (2010) found that heavy multitasking with Facebook while studying, may strain cognitive abilities related to task-switching and information processing. Therefore, using Facebook while studying, leads to limited cognitive functioning and results in lower academic performance.

1.3. Impulsivity and sensation-seeking characteristics

Parry and le Roux (2021) did a meta-analysis on the association between media multitasking and cognitive control. In the conclusions of this meta-analysis, they stress the importance of identifying individual differences in users to better understand the effects of media multitasking habits on cognitive skills. A study by Sanbonmatsu et al. (2013) found that these individual traits mostly consist of impulsiveness and sensation-seeking.

Impulsiveness is driven by immediate rewards, which can be present in media multitasking contexts. Research has demonstrated that extended use of social media can raise dopamine levels. For example, when users receive a notification or swipe to refresh for new content, their dopamine level rises (White et al., 2024). Dopamine is a neurotransmitter that

makes the brain feel rewarded for accomplishing an activity (Wise & Rompré, 1989). Similarly, sensation-seeking also depends on dopamine. Sensation-seeking requires mental stimulation from the users for them to remain engaged in a task (Franken et al., 1992; Sanbonmatsu et al., 2013).

These traits, impulsivity and sensation-seeking can make individuals more vulnerable to the effects of media multitasking between social media apps. These individuals could become more easily addicted to the frequent supply of instant gratification in social media apps in the form of likes, comments, and shares (Dhir et al., 2018). Both traits are relevant in individuals with deficiencies such as ADHD. It is highly relevant to know how social media can affect this population. Previous research by Matthews (2022) and Wang et al. (2017) has shown that extensive social media usage and high levels of media multitasking show comparable outcomes among young adults, which is important within this study.

Attention Hyperactivity Deficit Disorder

Attention Hyperactivity Deficit Disorder (ADHD) is a condition which affects three behavioral components: attention, hyperactivity, and impulsivity (Boer et al., 2019). Individuals with attention deficits might be easily sidetracked and they may, therefore, struggle to complete tasks which require sustained attention. Hyperactivity often results in exhibiting physical restlessness, such as constant fidgeting. Impulsivity, as mentioned before, leads to choosing instant gratification over long-term rewards. Individuals with high impulsivity may also act without thinking about consequences. ADHD individuals are diagnosed with either one of these components or all three of these components based on the symptoms they experience (American Psychiatric Association, 2013).

Worldwide, 5 to 8% of all children and 2.58% adults are diagnosed with ADHD (Song et al., 2021; World Health Organization, 2019). In the Netherlands, 3.6% of all children and an estimated 3.2% of adults are affected by ADHD, resulting in approximately 404,600 individuals (Have et al., 2023). Between 2011 to 2021, people with ADHD diagnoses and people who show ADHD symptoms also increased, which may be attributed to more research and greater awareness of the condition. Research by Sibley et al. (2022) also demonstrates that ADHD symptoms persist into adulthood for approximately 90% of diagnosed individuals. This challenges the concept of symptom reduction with age; instead, symptoms evolve and can be influenced by different factors (Faraone et al., 2004; Kessler et al., 2006; Abdelnour et al., 2022). Therefore, it is of great importance to study ADHD in the context of their media multitasking habits.

Individuals diagnosed with ADHD experience difficulties in their developmental neuropsychological functioning. ADHD disrupts brain chemicals, like dopamine, affecting how to control impulses and focus on tasks (Blum et al., 2008; Kühn et al., 2017). As described by Petrović and Castellanos (2016), this disruption in brain chemicals often leads to having troubles with top-down processes, which are important for paying attention, controlling impulses, and making decisions. In contrast, bottom-up processes involve reacting to stimuli directly, without cognitive influence. Unlike top-down processes, which are influenced by cognitive skills, top-down processing involves optimal cognitive skills to perform tasks, such as interpreting visual and auditory stimuli. Problems with top-down processing can affect daily life, including work, school, and socializing (Halse et al., 2022; Wallace et al., 2023).

ADHD and the effect of the optimal arousal theory

ADHD may affect an individual's cognitive skills, but these individuals can follow different strategies to minimize the effects of ADHD on their daily life. Individuals with ADHD may reach an optimal performance with the appropriate level of stimuli. For example, an individual with ADHD may use a toy to stim while trying to focus on a task. According to the Optimal Level of Arousal theory (Berlyne, 1960), an individual's performance in a given task is affected by their arousal level. The arousal level follows an inverted U-shaped curve, which is optimal when it reaches the right amount of arousal. This theory is based on the Yerkes-Dodson Law. This law describes that performance improves with physical or mental arousal until it reaches an optimal level. Hence, further arousal might lead to performance decline (Yerkes & Dodson, 1908). This law points out the complicated connection between task performance and arousal levels. It also emphasizes how crucial it is to maintain an optimal level of arousal for the most effective cognitive performance (Anderson, 1994). For example, individuals with ADHD might seek external stimuli for optimal arousal to function effectively in society (Blum et al., 2008). On the contrary, this could also lead to performance decline if the social media use frequency is too high.

ADHD and the use of social media

ADHD symptoms could be worsened by using social media and multitasking. In fact, Boer et al. (2019) investigated the relationship between Social Media Use (SMU) and the effects on ADHD. This study involved 543 Dutch, 11- to 15-year-old adolescents, who completed self-report questionnaires about their SMU intensity, frequency, and duration from 2015 till 2017. The outcomes were that social media problems were correlated to more ADHD

symptoms in adolescents. They also suggest that social media addiction might worsen those symptoms, such as impulsiveness and attention deficits, over time. The duration of social media use did not have an impact on ADHD symptoms, just as the intensity of social media use. These results suggest that addictive behaviors related to social media could be harmful in the long term. The researchers also emphasized the need to study different social media behaviors and how they affect ADHD symptoms. Moreover, individuals with ADHD are more susceptible to addictive behaviors due to deficits in their executive functioning, which social media platforms often exploit.

1.4 How processing information works in texts and videos

Social media offers content in different types of media. This ranges from very basic one-channel content, like text, to more complicated processing content, e.g., TikTok videos with background music, subtitles, a voiceover, visual stimuli, and everything in between. Due to research, it is known that processing information from text and videos could be different. Johnson and Kim (2020) even suggest that cyberlearning could enhance executive functions when tailored with a useful interface.

Other studies have found significant cognitive processing differences in both text and video formats. Salmerón et al. (2020) examined how primary school student's perceptions of tap versus bottled water were shaped by different web page formats, e.g., reading or watching. The study revealed that videos had a greater impact on the student's beliefs. This impact was suggested due to the persuasive impact of human voices. In contrast, some studies have found that people can better understand information from a text than from video. For example, List and Ballenger (2019) discovered that textual information facilitated a deeper understanding of factual content among pre-service teachers. Due to the results, this also emphasizes better research on the role of presentation format in educational settings.

In contrast, other studies have found no difference in text and video. A study by Pezdek et al. (1984) compared reading, watching television, and listening to the radio. They found that comprehension and memory were better in both reading and television conditions compared to radio. Yet, they found no significant difference in performance between reading and watching television. More recent research by Delgado et al. (2021) studied how secondary school students read text blogs or watch video blogs to examine their relation to comprehension and learning outcomes. This study also found that video blogs are as effective as text blogs for learning.

The appeal of multimedia for people with ADHD and media multitaskers

Although there are contradicting results in research, the use of different channels has a substantial impact on an individual's arousal levels. The appeal of multimedia content leads to more media multitasking. For example, this could be explained due to increased arousal levels, which can enhance or exhaust cognitive processing. Enhanced arousal might contribute to better memory retention and comprehension. Furthermore, cognitive exhaustion can also slow that process down due to draining all sorts of cognitive capabilities (Dekker & van Hoorn, 2022). Thus, social media's nature is to captivate attention and stimulate engagement. This could also drive individuals with ADHD to spend more time on different channels (Boer et al., 2019). Therefore, young adults with ADHD and high media multitaskers might benefit from high arousal for improved alertness, while others function better in lower arousal environments (Diamond, 2013a; Yerkes & Dodson, 1908).

This sets the prediction for young adults with ADHD as follows: If multimedia content increases the arousal of the user, then it can be expected that young adults with ADHD will better process information that comes in a multimedia context (like a video) than in one medium (like a text). Similarly, high media multitaskers whose cognitive skills are worsened due to media multitasking will also better understand information in multimedia contexts than in one-medium context because of the level of arousal.

How digital text can be processed

Building on the understanding of cognitive arousal levels, the processing of digital text, offers further insights into the cognitive strategies employed by individuals. The processing of digital text involves cognitive strategies that help with better remembering and recalling information (Craik & Lockhart, 1972; Craik & Tulving, 1975; Salomon, 1979). These strategies allow readers to interpret the text, understand its meaning, and organize information mentally. When reading digital texts, it is also easier to revisit the text, implying that readers have control over its duration (Latini et al., 2019).

Moreover, reading books on paper and digitally differ as well. According to Mangen et al. (2013), reading materials aloud on paper improves memory recall compared to reading on digital screens. This also relates to personal taste. Ackerman and Lauterman (2012) found that when reading lengthy texts, individuals benefit from the ability to take notes on their own, facilitating memory retention and comprehension. This process involves creating simpler mental imagery and connecting it with previous knowledge (List & Ballenger, 2017).

People are more likely to choose digital texts now that they can access the internet and acquire information more easily (Liu, 2005). Thus, it's critical to pay attention to digital reading. Furthermore, reading online texts can divert attention and promote multitasking due to the nature of digital platforms and the potential for distractions (Liu, 2021). Therefore, understanding the cognitive differences between reading on paper and digitally is essential in evaluating their respective impact on memory recall.

How videos can be processed

Videos are processed through their multiple options, such as audio and visualization, to a good and fast understanding of complex concepts (Mayer, 2001). Comprehension of videos is cognitively processed by recognizing the objects in the video. Due to situation recognition, it links those objects to previously stored information in the brain (Henderson & Hollingworth, 1999; List & Ballenger, 2019). Videos can have the ability to amplify certain stimuli. This may be due to peripheral information processing in which surrounding details have the power to process memories better (Chung & Sparks, 2015). This plays a crucial role in understanding and recalling videos.

Many different stimuli can lead to better or worse remembering and recalling certain information shown in a video (Sweller, 2011). For example, short videos are better in attracting focus and retention of content compared to longer videos (Slemmons et al., 2018). Nevertheless, text appears to be processed more deeply and effectively than videos by readers who analyze it step by step (Sweller, 1994). Videos can also cause cognitive load, as it can be experienced as too much (Mayer & Moreno, 2003). This may be contributed to high media multitasking in which many stimuli might overload a person (Rosen et al., 2013). Even though these people are used to it, it can lead to worse cognitive processing (Foerde & Shohamy, 2011).

1.5 This study's focus and theoretical and practical relevance

The study seeks to identify which type of stimuli (video or text) might help memory recall in individuals with ADHD and heavy multitaskers. Furthermore, this study also investigates whether ADHD among young adults could be associated with media multitasking.

- **RQ1:** Does ADHD affect young adults' memory recall? Is this effect influenced by the type of medium (video or text) in which the information is presented?

- **RQ2:** Does media multitasking affect young adults' memory recall? Is this effect influenced by the type of medium in which the information is presented?
- **RQ3:** Is ADHD among young adults associated with media multitasking?

Hypotheses

Research shows that adults with ADHD exhibit worse attention and memory recall. However, the optimal arousal theory predicts that adults with ADHD perform a task better if their arousal is high. In addition, previous research has also found associations between ADHD symptoms and social media use. Therefore, we expect:

- **H1a:** Young adults with ADHD will exhibit lower memory recall than adults without ADHD when reading texts (low arousal).
- **H1b:** Young adults with ADHD will perform similar memory recall to young adults without ADHD when watching videos (high arousal).
- **H2a:** High media multitaskers will exhibit lower memory recall than low media multitaskers when reading texts (low arousal).
- **H2b:** High media multitaskers will perform similar on memory recall to low media multitaskers when watching videos (high arousal).
- **H3:** A significant difference is expected between ADHD and multitasking behavior.

Theoretical and practical implications

This study will tackle individual differences in the effect of social media on cognitive skills. This study acknowledges the recommendation made by Parry and le Roux (2021) to differentiate certain personality behaviors and traits outside laboratory contexts to explain specific outcomes of cognitive deficits such as ADHD e.g., inattentiveness and impulsivity. They emphasize the importance of gaining further insights into the factors that may drive media multitasking. Matthews et al. (2022) also stress the need for further research to understand the impact of specific content and presentations on young adults' behavior.

This study aims to fill the knowledge gap regarding the long-term impact of social media exposure and media multitasking on our cognitive skills. Young adults have grown up surrounded by the internet and are accustomed to its use. This is unlikely to change soon. Studying the effects of social media use and media multitasking on cognitive skills is even more crucial with vulnerable populations, like individuals with ADHD.

This study will also provide information on how to ease the learning process in high media multitaskers and young adults with ADHD. Therefore, different tactics could be employed to alter behavior, raise awareness of consequences, and implement various strategies. The findings from this study could be used in the development of materials for e-learning and educational settings. Understanding the difference between texts and videos might optimize the optimal level of arousal needed to enhance learning strategies.

Methodology

Materials

There were two texts and two videos created for this experiment. Participants saw one text and one video. Each text and video were designed to provide comprehensive information about sign language and animal testing.

The digital texts consisted of one paragraph: an introduction and a subtopic related to sign language or animal testing. The text about sign language discussed the linguistic structure of sign language and the difficulty of learning sign language. The text about animal testing discussed the evolution and the effects it had on animals. Each paragraph contained 150-200 words. The texts were supplemented with four pictures related to the topics. The pictures provided support for the information in the text, but they did not provide extra information.

The videos were based on the text to ensure that the difficulty only lay in the number of channels used. They included the same pictures as the texts in a slideshow fashion. They included a voice-over reading the information from the text and subtitles in the style of TikTok videos. The duration of each video and text was approximately three minutes, ensuring that participants had sufficient time to engage with the material thoroughly.

Participants

This study included 108 voluntary Dutch participants aged between 18 and 29 ($M = 24.39$, $SD = 3.14$), categorized as 'young adults' for the purposes of this research. This age range is supported by Matthews (2022), who found that individuals aged 7 to 29 demonstrated superior performance in media multitasking tasks compared to those over 30. Participants falling outside this age range were therefore excluded. Furthermore, female participants (50%) were slightly more represented within the study than male participants (48,1%). Two individuals were non-binary (0.09%) or didn't want to tell their gender (0.09%). The majority of participants stated they had a finished university degree (WO) (36.1%), which was followed

by a degree from a university of applied science (HBO) (35.2%), and the last two degrees were secondary vocational education (MBO) (28.7%) and high school (5,6%).

The participants were also divided into high or low media multitaskers based on a median split ($Mdn = .23$) of the media multitasking short questionnaire; more details about this questionnaire will be given in the instruments section. Of the 108 participants there were 51 people (47.2%) in the low media multitasking group and 57 people (52.8%) in the high media multitasking group. Within the two (low/high) media multitasking groups, there was no significant difference in the age distribution ($\chi^2 (11) = 6.04, p = .871$). The age ($\chi^2 (3) = 6.55, p = .088$) and education ($\chi^2 (3) = 1.39, p = .707$) groups were equally distributed among the two media multitasking groups. In contrast, gender was not equally distributed, there were more female participants ($N = 34$) in the high media multitasking group than men ($N = 20$).

Design

The conducted study was a mixed method design. In this mixed methods study, there were both within- and in-between measurements. In the experiment, all participants were exposed to two different information media (text and video). Therefore, the media were implemented in a within-subject design. Because each person has unique traits, the section measuring participants' media multitasking ability and degree of ADHD used an in-between-subjects design.

Instruments

Memory Recall. To assess memory recall, there has been a task implemented which is commonly used to measure comprehension. The participants were asked per medium to answer three multiple-choice questions about the sign language or animal testing text and video. This was done via a cloze test (Taylor, 1953). In a text-closing test, participants saw a sentence that was included in the text (or video), and the sentence included a blank where a word was omitted. Participants selected the most suitable word. Cloze tests for videos worked similarly. Participants saw a sentence read out loud in the video by the voice-over, and they had to fill in blanks based on what they heard (Luo et al., 2020). This approach was sufficient for assessing learning objectives because it evaluated participants' comprehension, memory recall, and grasp of the content presented in both textual and visual formats. Each correctly filled-in blank received one point. The total score from the video and text was calculated based on the number of correct responses out of the total number of blanks, ranging from 0 (no memory recall) to 6 (complete memory recall).

Media multitasking (MMM-S). To measure participants' media multitasking, a short questionnaire created for adolescents by Baumgartner et al. (2017) was used. The measuring scale had nine items on a 4-point Likert scale, ranging from 1 (= never) to 4 (= very often), asking how often they engaged in two media activities at the same time. For example, participants were asked how often they engaged in listening to music, sending messages via phone or computer while watching television. The reliability of the MMM-S scale in relation to high or low media multitasking, consisting of nine items, was acceptable: Cronbach's $\alpha = .79$. The sum of those nine items was used to measure low or high levels of media multitasking, which was used in further analyses. To calculate the MMM-S score, the average response was used, ranging from 1 (low media multitasking) to 4 (high media multitasking).

ADHD symptoms. The participants were asked if they had an ADHD diagnosis (1) or not (0). All participants were also asked to fill out the hyperactivity, emotional symptoms, conduct problems, peer problems, and prosocial subscales of the Strengths and Difficulties Questionnaire. This questionnaire was used to determine if most participants were young adults with ADHD and exhibited most of the symptoms (Bryant et al., 2020; Goodman, 1997). The questionnaire made use of a three-point Likert scale with five items starting with "is it true that..." such as:

Table 1. *The Strengths and Difficulties Questionnaire*

Hyperactivity scale:	Emotional symptoms scale:	Conduct problems scale:	Peer problems scale (In the past):	Prosocial Scale (In the past):
'Restless, overactive, can't stay still for long'	'Often complains of headaches, stomach-ache, or sickness'	'Often has temper tantrums or hot tempers'	'Rather solitary, tends to play alone'	' <i>Considerate of other people's feelings</i> '
'Constantly fidgeting or squirming'	'Many worries, often seems worried'	' <i>Generally obedient, usually does what has been requested</i> '	' <i>Has at least one good friend</i> '	'Shares readily with other children (treats, toys, pencils, etc.)'
'Easily distracted, concentration wanders'	'Often unhappy, downhearted or tearful'	'Often fights with other people or bullies them'	' <i>Generally liked by others</i> '	' <i>Helpful if someone is hurt, upset or feeling ill</i> '
' <i>Thinks things out before acting</i> '	'Nervous or clingy in new situations, easily loses confidence'	'Often lies or cheats'	'Picked on or bullied by other children'	' <i>Kind to younger children</i> '
' <i>Sees tasks through to the end, good attention span</i> '	'Many fears, easily scared'	'Steals from home, work or elsewhere'	'Gets on better with adults than with other children'	' <i>Often volunteers to help others (parents, teachers, other children)</i> '

The scale was evaluated as 0 (= not true), 1 (= somewhat true), and 2 (= certainly true). Specific items, which are italicized, were reversed: 2 (= not true), 1 (= somewhat true), and 0 (= certainly true). The reliability of the hyperactivity scale in relation to ADHD symptoms, consisting of five items, was acceptable: Cronbach's $\alpha = .74$. The reliability of the emotional

symptoms scale in relation to ADHD symptoms, consisting of five items, was good: Cronbach's $\alpha = .80$. The reliability of the peer problems scale in relation to ADHD symptoms, consisting of five items, was also good: Cronbach's $\alpha = .80$. In contrast, the conduct problems scale's reliability for ADHD symptoms, with five items, was low: Cronbach's $\alpha = .56$. The scale of conduct problems only asked about childhood instead of adulthood. The analysis for the other scales might have worked better due to the fact they were based on adulthood, which is the primary focus of this study. Therefore, the conduct problems scale has been excluded from the overall SDQ score.

Each of the four scales was calculated by summing up the scores within the items. The range consisted of 0 to 10. The scales for hyperactivity, emotional symptoms, and peer problems were combined as a total difficulty score, ranging from 0 to 30, except for the prosocial scale. The cutoff score used to assess ADHD symptoms for participants was adopted from the official SDQ scale (Bryant et al., 2020; Goodman, 1997). The means of the overall scales are shown in Table 2.

Table 2. *The Strengths and Difficulties Questionnaire Means per Scale*

SDQ Scale	No ADHD (Mean)	ADHD (Mean)
Hyperactivity	3.29	6.24
Emotional symptoms	1.61	5.43
Peer problems	1.92	5.65

Procedure

To recruit participants, the experiment was distributed within the researcher's circle, via social media channels or in person, where people were randomly asked to participate on the street while handing out a flyer with a QR-code, see Appendix B. This has also been conducted on the Radboud University campus. For social media, the invitation was supplemented with accompanying visuals and text that indicated in short sentences what the experiment was about and approximately how long it would take. Participants were invited to participate in the experiment via Qualtrics (2024). At the start of the experiment, the participants were asked for consent to use their anonymized data. This was followed up with questions about demographics including age, gender, education level, and linguistic background.

Following the demographic questions, two different media were randomly assigned to participants. These included one text and one video, which presented information about sign

language or animal testing. After each medium was presented, a set of questions were asked to assess 'memory recall', see Appendix C and D. There was no time pressure for participants to finish the experiment to guarantee their participation. To ensure accurate results during the experiments, participants were only allowed to continue reading texts after three minutes had passed. In the video condition, participants were also allowed to continue after three minutes.

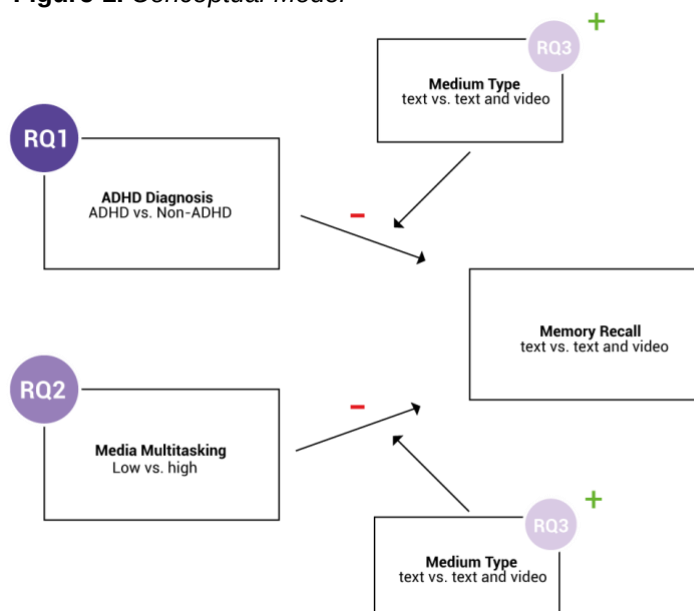
After exposure to these two items, the experiment was followed up with questions about participants' media multitasking behavior using the MMM-S. In addition, they were asked to complete the SDQ regarding experiencing ADHD symptoms and diagnosis. After completing the experiment, they were thanked for their participation.

Statistical analysis

In this study, to test the first two research questions and four hypotheses, a Multivariate Linear Regression has been conducted. The dependent variable in this statistical analysis is Memory Recall. Additionally, there are three categorical independent variables: ADHD (Yes/No), Media Multitasking (High/Low use), which also uses a binary variable instead of an average score to match the ADHD variable to make the comparisons easier, and the Medium (Text and visuals vs. Text, Video, and Visuals). In addition, to test an interaction-effect, there have been two Simple Linear Regressions conducted while splitting the file into two separate subsets.

To test the third and last research question and hypothesis, a Simple Linear Regression was conducted. Within this statistical analysis, the dependent variable was Media Multitasking, and the independent variable was ADHD Diagnosis (Yes/No).

Figure 1. Conceptual Model



Results

The focus of this study was to examine the effects of low and high media multitasking and the possible influence of ADHD presence or absence on young adults' memory recall in digital texts with visuals and videos. The results of the study will be reported with a look into the descriptive of the SDQ scores between young adults with an ADHD diagnosis and followed with a detailed explanation of the differences between the SDQ scales. This will be followed with the descriptive of the MMM-S overall score and the low and high media multitasking groups. As last, the results of the three hypotheses will be reported with additional interpretation analyses.

The impact of ADHD diagnosis on SDQ scores

An independent *t*-test was conducted to examine the difference in SDQ scores between participants with an ADHD diagnosis and those without a diagnosis. The dependent variable was the SDQ score, and the independent variable was the diagnosis group (ADHD versus no ADHD).

The independent *t*-test revealed a difference in SDQ scores between participants with and without an ADHD diagnosis. This difference, -0.42 , 95% CI $[-0.54, -0.29]$, was significant, $t(170.908) = -6.66$, $p < .001$. There was a large effect, $d = -0.95$. Participants with an ADHD diagnosis ($M = 0.61$, $SD = 0.49$) had higher SDQ scores than participants without a diagnosis ($M = 0.19$, $SD = 0.40$). This supports the validity of the reported ADHD diagnoses.

The impact of ADHD symptoms on the SDQ scale scores

Participants were also asked if they had received an ADHD diagnosis. From the 108 participants, 7 people (6.5%) had the hyperactivity type (ADHD-H), 14 the inattentive type (13%) (ADHD-I) and 19 the combination type (17.6%) (ADHD-C), which makes a total of 40 participants with ADHD. To ensure that most of young adults with ADHD would be the ones presenting ADHD symptoms, participants were asked to fill out a questionnaire about ADHD. These were assessed through three of the five scales of the Strengths and Difficulties Questionnaire (SDQ) of Goodman (1997). After collecting the data, there was a cutoff score calculated based on the official scores of the DSQ. This resulted in 43 participants (39.8%) scoring as having ADHD symptoms.

In addition, there have been three independent *t*-tests conducted to examine the differences and validity in SDQ scores between the three different scales. The dependent

variable was the overall SDQ score, and the independent variables were the Hyperactivity, Emotional Problems and Peer problems scales.

The independent *t*-test revealed a difference in Hyperactivity scores between participants with and without ADHD symptoms. This difference, -2.95, 95% CI [-3.46, -2.43], was significant, $t(188.259) = -11.27, p < .001$. There was a large effect, $d = -1.57$. Participants with ADHD symptoms ($M = 6.24, SD = 1.96$) had higher hyperactivity scores than participants without symptoms ($M = 3.29, SD = 1.82$). Participants with ADHD symptoms have significantly higher hyperactivity scores than those without ADHD symptoms.

The independent *t*-test revealed a difference in Emotional Problems scores between participants with and without ADHD symptoms. This difference, -3.82, 95% CI [-4.37, -3.27], was significant, $t(156.509) = -13.72, p < .001$. There was a large effect, $d = -1.98$. Participants with ADHD symptoms ($M = 5.43, SD = 2.27$) had higher Emotional Problems scores than participants without symptoms ($M = 1.61, SD = 1.63$). Participants with ADHD symptoms have a much higher Emotional Problems scores than those without ADHD symptoms.

The independent *t*-test revealed a difference in Peer Problems scores between participants with and without ADHD symptoms. This difference, -3.73, 95% CI [-4.28, -3.19], was significant, $t(171.362) = -13.46, p < .001$. There was a large effect, $d = -1.91$. Participants with ADHD symptoms ($M = 5.65, SD = 2.18$) had higher peer problem scores than participants without symptoms ($M = 1.92, SD = 1.77$). Participants with ADHD symptoms have much higher Peer Problems scores than those without ADHD symptoms.

The comparison of MMM-S scores between media multitaskers

To confirm that the groups indeed differ in their media multitasking behavior for the multivariate regression analysis, an independent *t*-test was conducted of Media Multitasking (MMM-S) scores between participants categorized as Low Media Multitaskers and High Media Multitaskers. The dependent variable was the total MMM-S score, and the independent variable was the media multitasking group (low versus high).

The independent *t*-test revealed a significant difference in total MMM-S score between low and high media multitaskers. The difference, -7.71, 95% CI [-8.41, -7.00], was significant, $t(214) = -21.67, p < .001$. There was a very large effect, $d = -2.95$. Participants categorized as low media multitaskers ($M = 18.29, SD = 2.53$) had significantly lower total MMM-S scores than participants categorized as high media multitaskers ($M = 26.00, SD = 2.68$). This indicates that the groups are truly representing low and high media multitaskers.

Memory recall, predicted by ADHD and media multitasking

A multiple regression analysis revealed¹ that Memory Recall was explained by 5.3% by the three predictor variables ADHD Diagnosis (yes/no), Media Multitasking (low/high), and medium type (video/text) and the interaction terms between ADHD Diagnosis and Medium Type, and Media Multitasking and Medium Type ($F(5, 209) = 3.10, p = .010$).

The effect of ADHD Diagnosis was not a significant predictor ($\beta = -.06, p = .350$). Media Multitasking alone as the main effect was also not a significant predictor ($\beta = .02, p = .795$). This was also for the main effect of Medium, which was not significant predictor of Memory Recall ($\beta = .05, p = .460$). This means that Memory Recall was not significantly predicted by any of the predictor variables alone, because none of them showed a significant effect on Memory Recall.

The interaction between ADHD diagnosis and Medium Type was a significant predictor for Memory Recall ($\beta = .19, p = .007$). Thus, Memory Recall increases by .19 standard deviations for every one standard deviation increase in ADHD Diagnosis and Medium Type, keeping the other variables constant. This means that the combination of having ADHD and the type of Medium used together leads to an improvement on Memory Recall.

The effect of Media Multitasking in interaction with Medium Type was not a significant predictor ($\beta = .08, p = .254$). This suggests that the influence of Media Multitasking and Medium Type on Memory Recall does not significantly predict Memory Recall.

Table 4. Means and Standard Deviations of Correct Responses for Memory Recall by Media Multitasking (Low/High), ADHD (Yes/No), and Medium Type (Text/Video) ($N = 216$)

Condition	Media Multitasking	M	SD	n
ADHD (Yes), Text	High	1.75	0.86	54
	Low	1.82	0.81	60
ADHD (Yes), Video	High	1.85	0.88	50
	Low	1.89	0.83	52
ADHD (No), Text	High	1.80	0.87	55
	Low	1.85	0.85	58
ADHD (No), Video	High	1.84	0.77	56
	Low	1.90	0.83	56

¹ A Linear Mixed Model has been conducted, which presented similar results to the Multivariate Regression. The outcome of the LMM analysis can be found in Appendix F.

To interpret the interaction-effect between ADHD Diagnosis and Medium Type, there have been two separate simple linear regression analyses conducted. This has been done by splitting the two groups from ADHD Diagnosis in young adults with ADHD and young adults without ADHD.

A simple linear regression analysis revealed that Memory Recall in young adults with ADHD was explained by 11.9% by Medium Type ($F(1, 78) = 10.49, p = .002$). Medium Type was a significant predictor of Memory Recall in young adults with ADHD, with a positive relation between Medium Type and Memory Recall, digital text was worse, and videos were better ($\beta = .53, p = .002$). From table 4, it can be observed that participants with ADHD in the condition with text show a decrease in Memory Recall ($M = 1.75, SD = 0.86$), while Memory Recall increases compared to the video condition ($M = 1.85, SD = 0.88$). This means that young adults with ADHD and the type of medium they use significantly affects how well they can remember things.

A simple linear regression analysis revealed that Memory Recall in young adults without ADHD was explained by 1.2% by Medium Type ($F(1, 134) = 1.61, p = .207$). Medium Type was not a significant predictor of Memory Recall in young adults without ADHD ($\beta = -.11, p = .207$). This means that for young adults without ADHD the type of medium they use did not significantly affect how well they can remember things.

ADHD diagnosis and media multitasking

A simple linear regression analysis revealed that Media Multitasking was explained by 3.5% by the predictor variable ADHD Diagnosis ($F(1, 106) = 3.87, p = .052$). The effect of ADHD Diagnosis showed a trend towards significance ($\beta = 0.20, p = .052$). This means that Media Multitasking almost was predicted by ADHD Diagnosis, as the analysis showed a positive relation between ADHD Diagnosis and Media Multitasking. However, the evidence was not strong enough to meet the conventional threshold for statistical significance.

Discussion and conclusion

This study examined whether ADHD affects young adults' memory recall (RQ1), including whether the type of medium (text or video) influences this effect. It also investigated whether media multitasking (low/high) affects memory recall and if this is influenced by the medium type (RQ2). Additionally, the study explored if ADHD in young adults is associated with media multitasking due to similar characteristics in ADHD people and people who frequently media

multitask (RQ3). The findings indicate that ADHD affects memory recall, with lower recall for texts among participants with ADHD, while video recall was similar between those with and without ADHD. Media multitasking did not affect memory recall in either medium. Furthermore, no difference was found between ADHD and media multitasking behavior. These findings will be discussed in detail in the following paragraphs.

ADHD as predictor for memory recall

Within this study the first research question asked whether ADHD affects young adults' memory recall and if this effect could be influenced by the type of medium (text or video) in which the information is presented. For young adults with ADHD there was not a direct effect found on memory recall. An explanation for the withholding of a direct effect from ADHD on memory recall could be due to the fact that the scores from young adults with ADHD and without, after answering questions when exposed to either a video or text condition, are summed up to a total score. When comparing the scores between young adults with ADHD and those without, the averages may appear similar. Thus, this might be the reason why ADHD did not show a direct effect on the memory recall of young adults. Moreover, this study explained that each person has individual preferences and characteristics.

Young adults with ADHD generally differ a lot from young adults without ADHD. Studies demonstrate that while some young adults with ADHD may achieve the same outcomes as young adults without ADHD, most of them experience struggles in academic, social, and work environments (Loe & Feldman, 2007; Shaw et al., 2012). Furthermore, Boer et al. (2019) noticed that factors such as digital media usage can influence ADHD symptoms and outcomes. Therefore, in this study other factors were considered to question whether different medium types might have an influence on memory recall, which was split into two hypotheses.

ADHD, memory recall, and the influence of digital media

The first hypothesis (1A) expected young adults with ADHD to exhibit lower memory recall than young adults without ADHD when reading digital text accompanied with visualizations. The present study confirmed this hypothesis by revealing a significant difference in lower memory recall in participants with ADHD when presented with a digital text. Therefore, this medium could be considered to have low arousal as predicted by the Optimal Level of Arousal theory. This could mean that a textual format with visualizations

does not provide enough stimuli to reach an optimal threshold to sustain attention and remember what has been read. This is similar to the second part of this hypothesis (1B).

Young adults with ADHD were also expected to perform similarly on memory recall as young adults without ADHD when the information is presented in a video format with subtitles, a voiceover, and visualizations. This hypothesis (1B) was also confirmed by revealing a significant improvement in memory recall when participants with ADHD were presented with a video. Therefore, this could be considered as an optimal level of arousal where a threshold has been reached that allows young adults with ADHD to gain focus and understanding.

These results are in line with some conclusions and the results of other studies. For example, the meta-analysis of Parry & le Roux (2021) emphasized the importance of focusing on individual differences, whereby young adults with ADHD is seen as significant different than young adults without. In combination with a medium, ADHD does indeed generate an important and different outcome. In addition, Salméron (2020) found that videos have a greater impact on students compared to text. This is because the multiple stimuli in videos can be more persuasive and therefore lead to greater memory recall than textual information. The study of Johnson and Kim (2020) suggested that tailored cyberlearning environments can enhance executive functions. Within their research they found that personalized e-learning can improve cognitive outcomes. This study reinforces Salmerón's conclusions about the effectiveness of video content in educational settings, as well as the findings of Johnson and Kim (2020).

In summary, when answering research question one, this study found that different media types, such as videos and texts, affect young adults differently based on their ADHD diagnosis and level of arousal. This also explains why there has not been a direct effect of ADHD on memory recall found, as the scores were summed up in total. The video condition might be overcompensated for the text condition where young adults with ADHD scored lower on memory recall than young adults without ADHD. This suggests that customizing educational content to young adults with ADHD could boost their learning experience and cognitive performance.

Media multitasking as predictor for memory recall

The second research question asked whether media multitasking affects young adults' memory recall and if this effect could be influenced by the type of medium in which the information is presented. The results of media multitasking show that there has not been a direct effect found on memory recall. This might be because the averages of the groups categorized

as low and high media multitasking seem to be a bit skewed. Although the groups are evenly divided into low and high categories, the average of the low media multitasking group are more concentrated in the middle. The result shows that people in the low category might not truly present low media multitaskers.

For future research, media multitasking groups, such as low and high, might benefit from a third group, due to the average of the low media multitasking group centering around the middle. Previous studies have shown that moderate multitaskers may differ from both low and high media multitaskers in their cognitive outcomes (Matthews et al., 2022). This addition could provide more nuanced insights. This leads to the second part of this research question, hypotheses 2A and 2B, regarding possible differences in media multitasking and memory recall in different media types.

Media multitasking, memory recall and the influence of digital media

The first part of the second hypothesis (2A) expected that people who are high media multitaskers would exhibit lower memory recall than low media multitaskers when reading text, prompted as low arousal. The second part of this hypothesis (2B) expected that high media multitaskers would perform similar on memory recall to low media multitaskers when watching a video, prompted as high arousal. Both expectations are not supported by the results of this study. This suggests that media multitasking does not affect memory recall regardless of the medium type. This could mean that neither medium type (video or text) does stimulate the optimal level of arousal, as proposed by the optimal level of arousal theory.

The findings of the current study align with other research showing no significant effects of media multitasking on cognitive performance. Pezdek et al. (1984) and Delgado et al. (2021) found no performance difference between text and video. Similarly, the current study found that medium type (text vs. video) does not significantly affect memory recall among media multitaskers. Alzahabi and Becker (2013) indicated that media multitasking does not always negatively correlate with cognitive performance and can sometimes improve task-switching abilities. This nuanced view supports the current findings that media multitasking does not significantly impair memory recall.

The current findings also contradict research suggesting frequent media multitaskers have poorer cognitive control and perform worse on tasks requiring sustained attention for memory recall (Ophir et al., 2009). The Cognitive Load Theory states that frequent task-switching and working memory disruptions reduce learning and memory recall (Paas & Ayres, 2014; Sweller, 1988). Kirshner and Karpinsky (2010) found that heavy media multitasking,

e.g., using social networking sites while studying, impaired cognitive abilities and academic performance. The lack of significant differences in this study suggests media multitasking may not be challenging enough to impact memory recall, or that other factors than medium type might moderate this relationship.

This study challenges the assumption that media multitasking inherently lowers cognitive performance and highlights the complexity of this relationship. The current findings call for a more nuanced perspective on media multitasking and encourage further exploration into the factors that might influence cognitive outcomes after exposure to digital media. This also aligns with Parry & le Roux's (2021) statement about studying characteristics differences and calling for more research about distinctions between certain personality traits.

ADHD and media multitasking

The last research question asked whether ADHD among young adults could be associated with media multitasking. This led to hypothesis three which expected that between ADHD and media multitasking would be a significant difference. However, this expectation was also not supported by the results of this study. The absence of a significant difference might suggest that young adults with ADHD do not significantly differ from others in their media multitasking behaviors. However, it is noteworthy that the effect was just outside the threshold for statistical significance. This suggests there might be a possible trend. As mentioned earlier, this might also be a possible outcome due to the average of the low media multitasking group centering around the middle. Moreover, the result of hypothesis three contradicts the findings from previous studies.

Earlier research proposed that ADHD symptoms are often correlated with certain behavioral characteristics which may lead to media multitasking. For example, Sanbonmatsu et al. (2013) found that traits like impulsiveness and sensation-seeking are factors that have an impact on media multitasking behavior. Additionally, Boer et al. (2019) found that social media problems increased the severity of enduring ADHD symptoms among young adults. Their findings suggest a possible connection between ADHD-related traits and high media multitasking behavior, which has not been supported by the current study.

A possible explanation for the lack of significant results could also be due to the difference in methodologies. In the research of Boer et al. (2019) they conducted a longitudinal study whereby they examined the intensity of social media use and ADHD symptoms over a longer period, with significant outcomes. The environment of this study might not have

replicated the real-world of media multitasking tasks, such as they did with social media use. Instead of participating in switching between different social networking sites, participants were asked to respond directly after completing each task. The difference in this method could explain the non-significant results between the current findings and previous research. This could suggest that short-term assessments might not capture the full impact of ADHD on media multitasking behaviors.

Limitations and further research

The current findings on the effects of media multitasking on executive functioning, specifically comparing participants with ADHD with non-ADHD participants, have several limitations. One possible limitation might be the influence of distractions and interruptions during the participation of this study. Those factors could be environmental, such as background noises and interruptions from others, but also internal, such as fatigue, being easily distracted, or not understanding the given information. Moreover, the study did not take participants their cognitive abilities, stress levels or familiarity with the content presented in the text and videos in account. This could have had a significant influence on cognitive performance. Future studies should measure cognitive load by asking participants about their mental state, interruptions, and time of participation.

In addition, studies should test the hypothesis of arousal levels more often, by asking participants if they were engaged in more stimuli than the ones provided within the experiment, such as stimming or listening to music. A more detailed measurement can help determine the effect of media multitasking based on other factors. This could provide more insight into how individual differences impact cognitive outcomes and might help in designing better controlled experiments. It might also lead to more effective interventions tailored to individuals with specific characteristics, such as young adults with ADHD or media multitaskers.

Furthermore, the short-term design of this study might not capture the long-term effects of media multitasking and ADHD on memory recall. For replication of the study, a longitudinal approach is advised. A longitudinal study follows participants over an extended period, which allows researchers to observe changes and developments over time. This approach can provide a deeper understanding of the lasting effects of media multitasking and ADHD on memory recall.

Lastly, the media multitasking scale used in this study was initially designed for adolescents. Although adapted, it may not have fully captured the representation of media multitasking behaviors in young adults. Future research should consider developing or employing scales specifically designed for young adults to assure accuracy.

However, Parry & le Roux (2021) advised choosing a method that fits best to get accurate responses. They also noted that self-report scales might not always be the best option due to the potential for underestimating or overestimating one's own behavior. Therefore, alternative methods such as using a soundproof or distraction-free room could also be considered. In addition, the environment should replicate a typical media multitasking scenario, such as tasks requiring switching between different social networking sites, to ensure accuracy in the data.

Conclusion

This study provides important insights into the relationship between ADHD, media multitasking, and memory recall in young adults. The findings show that ADHD makes it harder to remember information from text and visualizations alone. However, videos provided with more stimuli led to better memory recall. This supports the notion that young adults with ADHD can focus better when the optimal level of arousal is reached through exposure to different stimuli. The optimal level of arousal also declines when presented with a textual format. Surprisingly, ADHD did not have a significant impact on memory recall, which also applied to media multitasking on memory recall. There was also not enough evidence of a difference between ADHD and media multitasking, although the difference nearly reached the significance threshold. This might suggest a potential trend.

Future research should consider more factors such as cognitive load, stress levels, and familiarity with content to provide deeper insights. Additionally, longitudinal research could lead to significant outcomes that might enrich research on the understanding of ADHD and its possible connection to media multitasking. Therefore, media multitasking groups, such as high and low groups, would benefit from an additional moderate category to assess accurate differences within groups. These findings highlight the importance of the study and the need for more detailed research into ADHD, media multitasking and cognitive capabilities.

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Appendix A

Declaration on plagiarism and fraud

The undersigned,

First name, surname

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Bachelor's or Master's student

Masterstudent

Student at the Radboud University Faculty of Arts,

declares that the assessed thesis is entirely original and was written exclusively by themselves. The undersigned indicated explicitly and in detail where all the information and ideas derived from other sources can be found. The research data presented in this thesis was collected by the undersigned himself/herself using the methods described in this thesis.

Place and date:

June 16, 2024

Signature:



Radboud University



Appendix B: Flyer and social media post



Appendix C: Sign language text and video with the answers

Inleiding

Gebarentalen zijn visueel-manuele vormen van communicatie die worden gebruikt door doven- en slechthorende gemeenschappen en personen over de hele wereld. Deze talen zijn ingewikkeld, maar vormen volwaardige systemen en hebben een uitgebreide linguïstische structuur, inclusief een volledige en kenmerkende grammatica, syntaxis en woordenschat. Ze reiken verder dan louter gebaren of pantomimes. Hoewel gebarentalen al eeuwen bestaan, varieert de officiële erkenning ervan per land. Zo is de Nederlandse gebarentaal sinds 2020 een officiële taal, maar is er in Argentinië nog geen gebarentaal officieel erkend. Pas in de 20e eeuw kregen ze ook academische aandacht. Tegenwoordig worden gebarentalen door miljoenen mensen wereldwijd geleerd en gebruikt, worden ze erkend als officiële talen in tal van landen en worden ze gebruikt in diverse omgevingen, waaronder academische instellingen, werkplekken en sociale bijeenkomsten. Gebarentalen ondergaan een organische evolutie, waarbij ze zich voortdurend aanpassen aan veranderende culturele en sociale contexten en nieuwe gebaren in hun lexicon worden opgenomen.



Er is geen universele gebarentaal

In tegenstelling tot wat vaak wordt gedacht, is de opvatting dat gebarentalen universeel begrepen worden een veelvoorkomend misverstand. Er worden wereldwijd meer dan 300 verschillende gebarentalen geleerd en gebruikt. Bovendien vertonen gebarentalen natuurlijk grote verschillen tussen landen en ook tussen regio's binnen hetzelfde land. Net zoals gesproken talen zoals Nederlands of Frans een unieke woordenschat, grammatica en culturele invloeden hebben, hebben verschillende gebarentalen ook hun eigen lexicons, grammaticale structuren en culturele invloeden. Gebruikers van verschillende gebarentalen kunnen verschillende tekens gebruiken voor dezelfde concepten en dit kan in specifieke contexten tot mogelijke misverstanden leiden.



Een voorbeeld van miscommunicatie is het gebruik van het essentiële concept "ja". Het gebaar voor "ja" in de Amerikaanse gebarentaal bestaat uit het maken van een y-vorm met de hand, waarbij zowel de pink als de duim worden uitgestrekt en de hand op en neer wordt bewogen, terwijl dit concept voor Japanse gebarentaalgebruikers een heel ander teken inhoudt. Japanse gebarentaalgebruikers maken een cirkel met de wijsvinger en duim, die ze vervolgens op en neer bewegen. Zelfs een concept als "ziekenhuis" kan zeer verschillend worden uitgedrukt in gebarentalen. In de Nederlandse gebarentaal bestaat "ziekenhuis" uit een kruis dat gevormd wordt door beide wijsvingers, met een beweging van het lichaam af. Het gebaar voor "ziekenhuis" in Amerikaanse gebarentaal bestaat uit het gebruik van de wijs- en middelvinger van één hand en het tekenen van een kruis op de schouder. Hoewel deze verschillen misverstanden kunnen creëren, verloopt communicatie doorgaans goed genoeg dankzij de context waarin de communicatie plaatsvindt. Verschillen tussen talen benadrukken de complexe aard en het belang van het erkennen en waarderen van de unieke taalkundige en culturele kenmerken van elke (gebaren)taal.

Video: <https://www.youtube.com/watch?v=pt7YzhrWDo4&t=2s>

QST SL text 1

Kunnen twee gebruikers van verschillende gebarentalen elkaar verkeerd begrijpen?

- ☐ Ja, hoewel dezelfde gebaren worden gebruikt voor basisconcepten zoals "ja" of "nee", kunnen sommige gebaren verschillen tussen talen
- ☐ Ja, sommige gebarentalen maken gebruik van gezichtsuitdrukkingen terwijl andere dat niet doen
- ☐ Ja, gebarentalen zijn, net als gesproken talen, verschillend genoeg van elkaar
- ☐ Nee, gebarentalen kunnen verschillende tekens hebben, maar ze zijn transparant genoeg om universeel te worden begrepen

QST SL text 2

Welke van de volgende beweringen is waar volgens de tekst?

- ☐ Alle gebarentalen zijn afgeleid van de internationale gebarentaal
- ☐ Gebarentalen kunnen per provincie verschillen
- ☐ Gebruikers van gebarentaal met verschillende nationaliteiten zullen elkaar waarschijnlijk begrijpen
- ☐ Gebarentalen uit verschillende landen kunnen verschillen in woordenschat, maar de syntactische structuren zijn universeel

QST SL text 3

Welke van de volgende beweringen is waar volgens de tekst?

- ☐ Gebruikers van verschillende gebarentalen, bijvoorbeeld een Amerikaanse gebarentolk en een Japanse gebarentolk zullen moeite hebben met het beantwoorden van eenvoudige ja/nee vragen
- ☐ De verschillen tussen gebarentalen zijn gewoonlijk minimaal en belemmeren het begrip niet
- ☐ Gebarentalen verschillen inderdaad, maar gebaren voor begrippen die nuttig kunnen zijn in gevaarlijke situaties, zoals bij het vragen om medische hulp, zijn hetzelfde
- ☐ In de toekomst moeten alle gebarentalen worden samengevoegd tot een universeel gebarentaalsysteem

Appendix D: Animal testing text and video with the answers

Inleiding

Dierexperimenten, beter bekend als dierproeven, zijn een onmisbaar onderdeel in huidige biomedische onderzoeken. Al eeuwenlang wordt deze manier van experimenteren gebruikt in de wetenschappelijk onderzoek en ook in de industrie. Dierproeven kunnen worden ingezet om kennis te ontwikkelen over hoe mensen en dieren functioneren, en om meer te weten te komen over hoe bepaalde ziektes ontstaan, behandeld of genezen kunnen worden. Dierproeven worden in verschillende contexten veelvuldig gebruikt. In medisch onderzoek worden muizen als modelorganismen gebruikt om de doeltreffendheid van een nieuw geneesmiddel tegen bijvoorbeeld kankercellen te onderzoeken. Ook cosmeticabedrijven vertrouwen sterk op dierproeven om de veiligheid van hun nieuwste producten zoals make-up of huidverzorgingsproducten vast te stellen. Waar enerzijds een dierproef gezien wordt als een onmisbaar instrument ten behoeve van wetenschappelijk- en medisch onderzoek, pleit men anderzijds voor alternatieven. Het zijn dan ook ethische implicaties van deze onderzoekspraktijk waarover in de loop der jaren steeds vaker gedebatteerd wordt.



Hoe testen effect hebben op dieren

De specifieke soorten dieren die worden gebruikt bij experimentele tests zijn afhankelijk van de aard van het onderzoek. Sinds de 19e eeuw is er sprake van een breed scala aan dieren, variërend van muizen tot primaten. De schadelijke gevolgen van dierproeven voor de betrokken dieren zijn voelbaar. Testprocedures kunnen bijvoorbeeld gaan over gedwongen inname, huidirritatietests en chirurgische ingrepen. Niet alleen veroorzaken deze procedures fysieke schade, maar ze veroorzaken ook psychologische stress, angst en soms zelfs depressie. Deze psychologische gevolgen vloeien voort uit het feit dat deze dieren worden onderworpen aan herhaalde tests en worden gehuisvest in een laboratoriumomgeving.



Hun leefomgeving in deze instellingen is meestal beperkt en de krappe kooien voldoen lang niet altijd aan hun gedrags- of sociale behoeften. Dergelijke leefomstandigheden kunnen leiden tot stress, agressie en andere negatieve gevolgen van het algemene welzijn. Dierproefmethoden kunnen ook gevaarlijk zijn. Een voorbeeld hiervan is het injecteren van dieren met giftige stoffen of het dwingen tot het inademen van giftige gassen. In extreme gevallen kunnen dieren zelfs genetisch worden gemanipuleerd om specifieke eigenschappen of aandoeningen te ontwikkelen die vervolgens in experimenten kunnen worden bestudeerd. Genetische modificaties kunnen ook schadelijk zijn, omdat ze kunnen leiden tot ernstige en langdurige gezondheidsproblemen voor de dieren zelf. Daarnaast sterven veel proefdieren uiteindelijk als gevolg van de procedures die zij ondergaan of worden zij aan het eind van de experimenten gedood. Dit is opnieuw een reden waarom veel mensen pleiten voor eerdergenoemde alternatieven.

Video: <https://www.youtube.com/watch?v=8aulEln4pQM&t=2s>

QST AT text 1

Welke van de volgende beweringen is volgens de tekst waar?

- ☐ Muizen worden gebruikt in dierproeven
- ☐ Dieren die lijken op mensen worden gebruikt in dierproeven
- ☐ Eierleggende dieren worden gebruikt in dierproeven
- ☐ Alle opties zijn waar

QST AT text 2

Waarom is volgens de tekst genetische manipulatie nuttig?

- ☐ Onderzoekers kunnen hiermee onderzoeken hoe zij specifieke aandoeningen kunnen genezen
- ☐ Onderzoekers kunnen de voordelen van een nieuw medicijn bestuderen zonder dieren te hoeven besmetten
- ☐ Onderzoekers kunnen nieuwe geneesmiddelen testen met behoud van het welzijn van de dieren
- ☐ Onderzoekers kunnen een dier bestuderen dat toevallig een aandoening heeft en medicijnen testen om de aandoening te genezen

QST AT text 3

Welke van de volgende beweringen is volgens de tekst waar?

- ☐ Als gevolg van het testen kunnen dieren alleen fysieke problemen ondervinden
- ☐ Volgens de Europese regelgeving brengen dierproeven die tegenwoordig worden uitgevoerd geen enkele vorm van lijden met zich mee
- ☐ Dieren die bij het testen worden gebruikt, kunnen beheersbare pijnniveaus ervaren
- ☐ Dieren kunnen psychische problemen ervaren

Appendix E: MMM-S Questionnaire

MMM-S question 1



Tijdens het tv kijken (films/series), hoe vaak doe je de volgende activiteiten

	Nooit	Soms	Vaak	Heel vaak
Naar muziek luisteren	☐	☐	☐	☐
Berichten versturen via telefoon of computer	☐	☐	☐	☐
Sociale media gebruiken	☐	☐	☐	☐

MMM-S question 2



Tijdens het gebruik van sociale netwerksites, hoe vaak doe je de volgende activiteiten.

	Nooit	Soms	Vaak	Heel vaak
Naar muziek luisteren	☐	☐	☐	☐
Berichten versturen via telefoon of computer	☐	☐	☐	☐
Tv kijken (films/series)	☐	☐	☐	☐

MMM-S question 3



Tijdens het versturen van berichten via telefoon of computer, hoe vaak doe je de volgende activiteiten

	Nooit	Soms	Vaak	Heel vaak
Naar muziek luisteren	☐	☐	☐	☐
Sociale media gebruiken	☐	☐	☐	☐
Tv kijken (films/series)	☐	☐	☐	☐

Appendix G: Demographics



Eerst worden een aantal vragen met betrekking tot je achtergrond gesteld

Wat is je leeftijd?

18 19 20 21 22 23 24 25 26 27 28 29

Schuif de slider naar de juiste leeftijd



☐ Vrouw

☐ Man

☐ Niet-binair/derde geslacht

☐ Ik zeg dat liever niet

Wat is je hoogst genoten opleidingsniveau?

☐ Geen opleiding

☐ Middelbare school

☐ Middelbaar beroepsonderwijs

☐ Hoger beroepsonderwijs

☐ Wetenschappelijk onderwijs

☐ Promovendus/PhD

Appendix F: Linear Mixed Model analysis

Table 3. *Linear Mixed Model analysis of Memory Recall with ADHD and Media Multitasking*

Variable	Mean	Standard Deviation	t value	p value
ADHD Diagnosis	-0.23	0.19	-1.28	.204
Media Multitasking	0.13	0.19	0.69	.491
MediumType	0.03	0.19	0.18	.857
ADHD Diagnosis * Medium Type	-0.65	0.23	-2.78	.006
Media Multitasking* Medium Type	-0.26	0.23	-1.16	.247