

Mind Over Munchies: How Sweet and Spicy Snacks Shape Fantasy Film Recall

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ABSTRACT

This study investigates how sweet and spicy snack consumption influences short-term recall during fantasy film viewing through a controlled angle-subject experiment among 16-18-year-old high school students in North Texas. This research is pivotal to the existing scholarly background as sweet and spicy snacks represent two of the most commonly consumed concession items in cinema settings, yet their immediate cognitive effects on narrative comprehension and scene recall are largely inconclusive. Fantasy films were selected as the stimulus because they require sustained attention to complex narratives, making them ideal for assessing real-time cognitive performance during dietary intervention. In an era of increasing screen-based media consumption, understanding how everyday dietary choices shape transient, real-time fluctuations in cognitive performance.

A significant gap exists in the literature regarding the immediate effects of these foods on general cognition, specifically recall. This research used film-specific surveys with 5 questions on a 5-point Likert scale, in which participants rated their recall of specific scenes. Survey data were then analyzed using comparative mean analysis; control group scores ($n=3$ per group) were averaged separately for each film and systematically compared with the experimental subject's scores.

Findings indicate that sweet snacks initially enhance attention but are followed by reduced recall during later viewing, consistent with the “sugar crash” phenomenon. On the latter, spicy snacks temporarily disrupted recall during consumption but were associated with improved recall after the burning sensation subsided. This research examines how everyday dietary choices may subtly shape engagement with real-time information. While the methodological limitations are preliminary and constrained, the findings offer a foundational framework for future controlled, large-scale experimental studies addressing more diverse demographics.

INTRODUCTION

Food preferences exist on a complex spectrum influenced by cultural background, genetic predisposition, and individual psychology (Cooper 2023). Their preferences are not simply reflections of taste but are deeply embedded in a profound bond between the body's physiological and neurological systems. The

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consumption of spicy foods and sweet foods elicits distinct responses from pain receptors and reward pathways, raising questions about their broader implications (Metalonis, 2022).

This underscores the unknown scholarly study of how the consumption of spicy and sweet foods can affect humans' recall in its immediate effects. The existing line of research on spicy and sweet foods elucidates their physiological and neurological ramifications; however, through more comprehensive analysis, it enables us to argue that a strong focus on only long-term outcomes has created a consequential gap in understanding the acute impacts of recall. The methodology was influenced by existing scholarly studies that utilized quantitative measures such as the 5-point Likert scale as well as surveys. The data analysis procedure consists of using the extracted data in a comparative mean analysis and is then supported by the physiological and neurological frameworks from existing scholarly studies to establish a foundation for the results collected.

LITERATURE REVIEW

Physiological Foundation of Taste Perception

The human body's response to food comes from its fundamental anatomy. Spicy foods are distinguished by the sensation of heat they provide at consumption, which is derived from the compound capsaicin. This active compound binds to the Transient Receptor Potential Vanilloid 1 (TRPV1) receptor, which is located throughout the mouth and digestive tract (Metalonis, 2022). As TRPV1 receptors are in place to respond to injurious heat, when consuming capsaicin, it creates a strong sensation of burning or excessive heat that creates pain despite no actual bodily temperature change, therefore effectively tricking the nervous system to release a pain response (McVean, 2017).

Stimulating these neural pathways has a range of complex physiological implications. A cross-sectional study that utilized the Depression Anxiety Stress Scale (DASS) found that there was a positive association between frequent spicy food consumption and an increase in symptoms of depression and anxiety among Chinese college students; however, this study found no link between spicy food consumption and stress (Zhang et al., 2022). This result conflicts with the previous studies, bringing in the notion that capsaicin promotes long-term potentiation and likely impedes depression in the hippocampus as an outcome of the TRPV1 receptor, in turn producing an anti-stress response (Ho et al., 2012). This anomaly highlights an essential idea that food and psychological connections are not just affected by biochemical pathways but also by sensory and emotional associations. (Lee & Hong, 2024).

This is further looked at through the phenomenon of “self-medicating” with food during times of stress. When individuals seek comfort, they often look towards mediating themselves through specific sensory experiences. Moreover, a study done by Macht and Dettmer, which was later reviewed by Brian P. Meier, a researcher from Texas A&M University, one of the few conducted studies examining chocolate consumption and mood, revealed that mindful chocolate consumption causes a significant increase in positive mood in comparison to the control food item (Meier et al., 2017). The findings highlighted the

connection between short-term responses to chocolate consumption and feelings of pleasure. Likewise, recent research confirms this by looking at how even a brief exposure to sugary snacks can actively rewire the brain's dopaminergic circuits, which leads to lasting preferences at times, adjusting neural response to future rewards (Bendix, 2023). Therefore, while capsaicin may instigate a specific neurological response, the overall emotional response is an outcome of taste, personal preferences, and cultural context, underscoring how spicy foods and sweet foods can trigger varying emotional responses despite their similar capacity to impact mood. (Lee & Hong, 2024; Meier et al., 2017; Bendix, 2023).

The Bridge between Physiological Effects and Neurological Consequences

When looking beyond physiological responses, the chronic consumption of spicy and sweet foods can also be linked to consequential lasting effects on cognitive health and neurological functioning. This is underscored through longitudinal research providing compelling evidence to support these long-term implications. A seminal 15-year study utilizing a sample of 4582 Chinese adults discovered that high chili consumption was associated with a nearly doubled risk of self-reported dementia decline and poor cognition. This association between chili intake and memory impairment was stronger in individuals with a Low Body Mass Index (BMI) (Shi et al., 2019). This elucidates that even though there are Potential benefits of capsicum-rich food consumption, such as the physiological anti-stress response from the TRPV1 receptor, may be offset by excessive chronic consumption, which may unknowingly accelerate cognitive aging (Ho et al., 2012).

The long-term neurological impacts of sweet foods, particularly sugar-rich snacks, are similarly concerning to those of high levels of capsaicin-rich spicy foods. However, in terms of compounds, chocolate may offer some benefits. However, its high sugar and fat content can also pose significant neuro risks as well (Whitaker's Chocolate, 2025). Furthermore, looking at the study by Vera Novak, MD, an associate professor of medicine at Beth Israel Deaconess Medical Center, and her colleagues discovered that high sugar intake is positively correlated with impaired memory function and reduced activity in the hippocampus (Novak et al., 2017; Edwards, 2016). This result is similar to that of the study on the association between chili intake and memory impairment. This highlights that both sweet and spicy foods, in excessive amounts, contribute towards poor memory performance (Edwards, 2016; Novak et al., 2017; Shi et al., 2019). In addition, this pathway is inclined towards causing an increased long-term risk for neurodegenerative diseases such as Alzheimer's (Whitaker's Chocolate, 2025).

Research on capsaicin uncovers the astonishing duality of its long-term neurological effects. Some studies position capsaicin as a therapeutic agent tailored towards alleviating central nervous system disorders, including its ability to mediate stroke-related dysphagia and its ability to treat migraines (Pasierski & Szulczyk, 2022). Moreover, it demonstrated an analgesic effect, making it multifaceted, as it shows that capsaicin can decrease pain perception through acute neural processes, suggesting that capsaicin's impact is dose-dependent and determined by individual neurological structures. (He et al., 2025). Looking at all this, we can see that it presents conflicting results, highlighting the nuanced nature of capsaicin's effects and the lack of research into the physiological and neurological implications of these outcomes.

The existing literature on the physiological and neurological implications provides a foundational understanding of how chronic consumption of sweet and spicy foods can affect long-term anatomical health. A compelling paradox drives the existing scholarly landscape: capsaicin is linked simultaneously to anti-stress and analgesic effects, yet also linked to an increase in depressive symptoms and potential cognitive decline (He et al., 2025; Pasierski & Szulczyk, 2022; Shi et al., 2019; Zhang et al., 2022). On the contrary, sugar offers an instantaneous hedonic reward and fundamentally rewires brain circuits in accordance with individual preference; nevertheless, at the cost of fostering long-term addictive appetites and cognitive risk (Bendix, 2023; Meier et al., 2017; Edwards, 2016; Whitaker's Chocolate, 2025).

The Hidden Implications of Cinema Snacking

We can apply these notions of food consumption to film viewing. The study published by the Journal of the American Medical Association Internal Medicine revealed that “people tend to eat more and consume more calories when distracted by programs such as action movies” (McGill, 2014). This principle is often exploited in movie theaters, as snack sales are the main source of income. Hence, concession stands are often strategically positioned in the lobby, front and center, right near the entrance. But astute layout design is not the only reason snack cravings kick in at the theater. Nearly all of our senses are activated at the movie theater, which naturally leads us to overeat (Marie, 2023). In addition, “atmospherics [of the movie theater], such as the ambiance, sounds, temperature, and lighting, impact customer experience [and concession cravings]” (Bitner, 1992; Lefebvre, 2022). Researcher Sara Lefebvre of Murray State University notes in her research that dim lighting “tends to enhance our perception of single-flavored food items.” The study utilized over 80 college students who were given a chocolate square to eat while wearing either a pair of clear-lens sunglasses or a pair of dark-lens sunglasses, which were designed to simulate ambient dark lighting. The results showed that when wearing tinted sunglasses, students reported a higher liking of the chocolate square (Marie, 2023; Lefebvre, 2022). This presents the proposition that, in low light, our sense of sight diminishes, prompting our sense of taste to be more stimulated by ambient lighting.

With this, we can apply the existing scholarly study of the physiological and neurological effects of capsaicin and sugar to film viewing in theaters by looking at the strategic positioning of the concession stand in the lobby, driving consumer snacking and leading to excessive consumption of high dosages of sugar, which is further bolstered by the dim lighting of the theater, which further drives consumption. Through this excessive consumption, we can see its psychological and neurological health implications, such as increased alertness, decrease in stress or inhibiting their memory, and look further into how it perturbs individuals' focus during their film experience (Marie, 2023; Lefebvre, 2022; He et al., 2025; Pasierski & Szulczyk, 2022; Shi et al., 2019; Zhang et al., 2022; Novak et al., 2017; Edwards, 2016).

Gap

While extensive research has examined the long-term physiological and cognitive effects of chronic consumption of sweet and spicy foods, a significant gap in the literature persists in understanding their immediate impact on general cognition, specifically recall. The methodological pillars of large-scale surveys and epidemiological studies are inherently flawed in their ability to capture transient, real-time

fluctuations in cognitive performance following food intake. However, these immediate physiological and neurological effects, which likely constitute pivotal mechanisms that drive long-term habits, addictive consumption patterns, and ultimately explain the conflicting results that were prevalent in chronic research. This prominent oversight in the existing scholarly literature underscores a compelling need for controlled, experimental studies of the acute effects of these everyday dietary stimuli, as they are evident during snacking during film experiences. As a result, this study addresses a gap in the existing literature by using a controlled single-subject experiment to examine how the consumption of sweet and spicy foods influences the recall of fantasy films among 16-18-year-old high school students in North Texas.

METHODS

Ethics Statement

The research conducted below has met the requirements of standard ethical inquiry and was reviewed and approved by an Institutional Review Board.

Participants

The participants in this study will be two groups of teenagers aged 16-18 enrolled in an affluent North Texas school district during the 2025-2026 school year, with 3 participants per group (N=6 total). Group 1 will be selected from my AP Research Class, and Group 2 will be assembled from a personal coding group. The researcher will also participate as the sole experimental subject consuming the food stimuli; no other participants will be exposed to the dietary intervention. The participants served as the “normal condition” (control group) for comparison with the experimental subject. The sample was selected because it was the group of students most easily accessible, given the constraints imposed by the rules and regulations governing research in the AP Research class.

This methodological approach is mirrored in previous scientific studies; for example, the work of Lee and Hong in their study of exploring the roles of food in different sensory attributes of stress relief has significantly influenced this study's design. Their research discovered that controlled digestion of food stimuli produced measurable differences in physiological and psychological states. Nevertheless, while their study measured stress, this research aims to expand that framework to further assess cognition utilizing sweet and spicy foods as the key variable to measure changes in recall of fantasy films. Likewise, the research on analgesic effects of spicy foods by Bojun He and his colleagues further influenced this study. Their findings highlighted that capsaicin consumption led to immediate changes in both subjective and objective experience. Understanding how dietary stimuli are able to rapidly change neurological processing. This study will build upon these principles, proposing that if spicy food can dampen physical pain perception, it may similarly affect cognitive “pain points” like distraction or anxiety. Conversely, sweet foods may enhance cognitive “reward pathways” related to engagement. With this, the best-suited data analysis plan was a Quantitative approach.

Stimuli

The two fantasy films chosen for this study were the first season of Attack on Titan and the film Avatar (2009). The Attack on Titan compilation of each episode was selected rather than the full television season to match Avatar's runtime of approximately 120 minutes ensuring consistent stimulus duration across conditions. These films were chosen as they provide contrasting narratives and visual elements to test the effectiveness of food consumption under different conditions, with Attack on Titan providing a dark fantasy narrative with intense action and psychological trauma, and conversely, Avatar, a science fiction fantasy set in a natural, serene environment with themes of colonialism. The contrasting emotional tones and visual styles of the films allow for an examination of whether dietary effects on recall are consistent across different narrative contexts or interact with the films' emotional content. To preserve the impartiality of the researcher's own response, which are a key component of this study, pre-watching of the films was intentionally limited, as a result of this the selection of the scenes was assisted from the use of Generative AI, ChatGPT under the prompt: "Can you generate 10 scenes from the films: Attack On Titan: Season 1 and Avatar (2009), providing detailed explanation of the scene and its importance to the main idea of the films." Afterward, 5 key scenes from each film were selected for detailed analysis and later selected as the foundation for the survey questions; the justification for these selections is provided in Appendix A.

The food stimuli during each film were selected for their high-intensity attributes to ensure a measurable effect occurs in order to investigate the distinct effects of sweet and spicy flavors, which the researcher will consume during each film viewing. The specific stimuli selected and the justification for each food are documented in Appendix B

The procedure for the experiment will first involve the arrival of the participants, who have already signed the informed consent (see Appendix C), then the viewing of the film during the experiment, and, for the experimental unit, the consumption of the food stimuli. The experiment will be done in a controlled environment with no electronic devices other than the film projector. There will also be limited conversation in order to ensure there are as few interruptions as possible. After the film concludes, there will be a 5-minute break, and then the survey will be conducted. All participants will have 10 minutes to take the survey.

The surveys utilized in this study contain five questions using a 5-point Likert Scale, and will ask participants to rate how much of the scene described in the question they can recall. There will be one survey for each film with questions specifically tailored to the film using the selected extracted scenes (see Appendix D). The 5 Point Likert Scale (see Appendix E) is used in order to measure the focus (recall of events in the scenes) during the film viewing. Participants will rate their recall of specific film scenes, with ratings from 1 ("Strongly Disagree this exact description occurred") to 5 ("Strongly Agree" this exact description occurred). This tool quantified participants' focus on the key plot details, providing measurable data on factual recall.

The data extracted from the survey (see Appendix F) will then be used in a comparative mean analysis. The scores from the control groups will be averaged separately for each film and then systematically

compared with the experimental units' scores for each film using the data tables below. This organization converts the data into a simple format for straightforward comparison of means (see Appendix G and H).

Table of Comparative Mean Analysis of Effects on Recall

Film & Condition	Overall Focus Mean of Control Group	Overall Focus Mean of Experimental Unit
AOT (Sweet)		
Avatar (Spicy)		

This table will summarize the overall findings by presenting the composite means of the recall survey responses for each film of the control groups and for each condition (flavor) for the experimental unit. Look at Appendix I for detailed calculations and justification for each response of the control groups and experimental unit. This structured analytical approach allows the quantized data to be examined simply through mean comparisons to answer the research question.

DATA ANALYSIS

The data analysis process for this study was designed in order to address the critical research gap in the literature. Existing research, such as the longitudinal work of Zumin Shi and his colleagues on the effects of chili intake on cognitive decline, highlights the long-term effects of capsaicin consumption. Moreover, other researchers, such as Zhang et al., underscore the broader associations between diet and mood in both methodologies, as noted in the gap: large-scale longitudinal studies often overlook the transient real-time fluctuations in focus and mood. As a result, this study's analysis aims to measure the direct relationship between a controlled cognitive task rather than identifying its long-term associations.

This reflection led to the development of a two-part analysis: first, a comparative baseline, and second, a quantitative analysis of the numerical data. This analysis will build upon existing neurocognitive framework scholarly studies, incorporate raw survey data, and shift toward evidence that directly addresses the immediate impacts of sweet and spicy foods on recall.

The first part of the analysis was to establish the normative baseline, defined as the "neutral" cognitive state, against which the experimental unit's results will be compared. This step is crucial for addressing the gap left by large-scale surveys, which often lack a controlled normative baseline for individual cognitive tasks. The normal conditions, which are the two control groups for both films, and the non-processed data they yielded, defined what normal recall looks like for the clear narratives within the target demographic. Then we move forward with the actual analysis, which begins by calculating the

overall mean recall from the 5-point Likert-scale data to establish the baseline for factual recall. This means it now serves as the essential foundation for the control condition in this experiment. This establishes a clear quantitative benchmark against which the experimental unit's results can be compared.

The second part of the analysis involves a systematic comparison between the numerical data of the different flavor variables and groups. The scores from the control groups (n=3 per group) were averaged separately for each film and then compared with the experimental subject's scores for each film using the data table below. This approach ensures quantification of differences in recall performance attributable to the dietary intervention, providing a straightforward comparison of means.

Table of Comparative Mean Analysis of Effects on Recall

Film & Condition	Overall Recall Mean of Control Group	Overall Recall Mean of Experimental Unit
Avatar (Spicy)	3.4	4
AOT (Sweet)	3.7	3.2

RESULTS

The consumption of sweet and spicy snacks was found to have significant, time sensitive effects on the overall recall of fantasy films. The findings reveal distinct temporal patterns on each food type, with both sweet and spicy stimuli demonstrating measurable cognitive effects that varied based on the timing of consumption relative to scene presentation.

Overall, as shown in Figure 1, the comparative mean analysis revealed that the experimental subject's overall recall scores differed from the control group's averages for both film conditions. For the Avatar viewing with the spicy condition, the control group (n=3) achieved a mean recall score of 3.4, while the experimental subject scored a 4.0, a difference of 0.6 points on the 5 Point Likert scale, representing a 17.6% increase in overall recall. For the Attack on Titan viewing with the sweet condition, the control group achieved a mean recall score of 3.7, while the experimental subject scored a 3.2, a decrease of 0.5 points, representing a 13.5% reduction in overall recall.

Figure 1. Comparative Mean Recall Scores by Condition

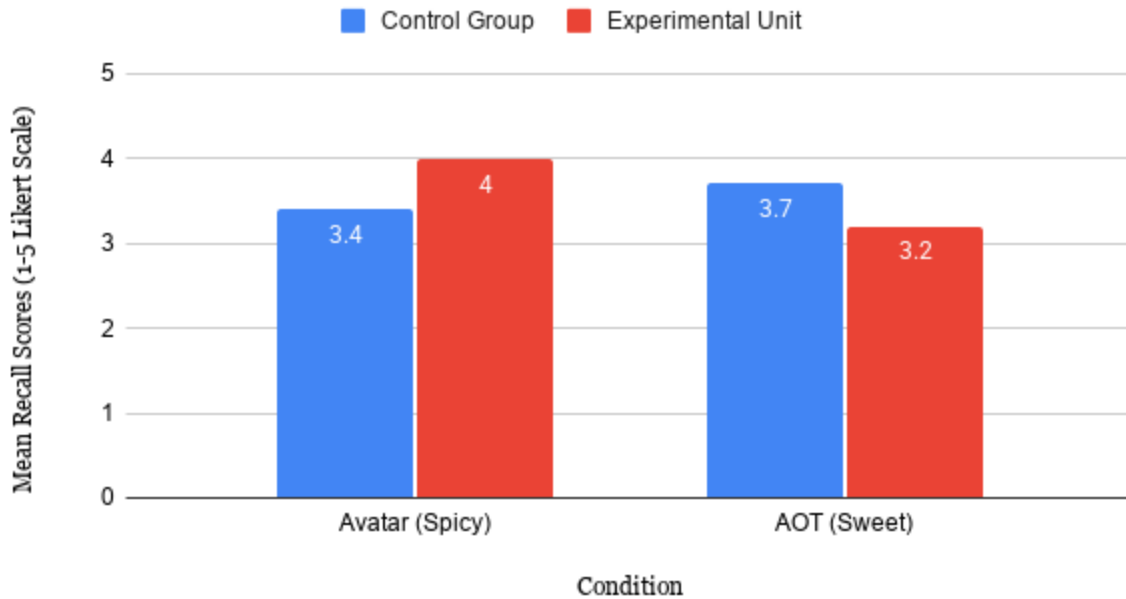


Figure 1. Comparative Mean Recall Scores by Condition. Error bars represent the range of control group responses (n=3). The experimental unit's scores are shown as single data points. The results demonstrate a 17.6% increase in recall under the spicy condition (Avatar) and a 13.5% decrease under the sweet condition (Attack on Titan).

Temporal Analysis of Recall Patterns

Examining the data of the individual questions it reveals the temporal dynamics of dietary effects on recall. Figure 2 presents the question-by-question score comparisons between the conditions.

Figure 2. Temporal Patterns of Recall by Question Number

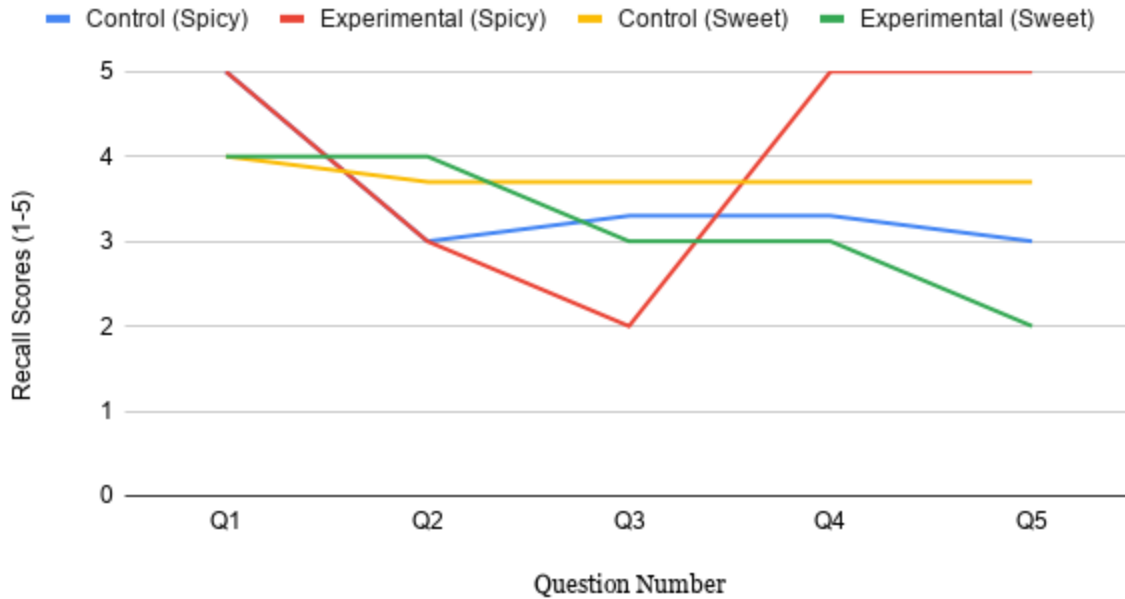


Figure 2. Temporal Patterns of recall by question. Spicy condition (Avatar): note the sharp decline in questions 2-3 during active consumption, followed by recovery and enhanced responses in questions 4-5. Sweet condition (Attack on Titan): note the linear decline from Questions 1-5, with an initial enhancement in film perception followed by a progressive decline.

Sweet - Attack on Titan Condition

For the sweet food condition, the experimental unit's recall scores showcased a linear decline across the 5 survey questions as the film progressed. Question 1 showed identical scores between the experimental unit and control group (both 4.0). However, by question 5, the experimental subject scored a 2.0, while the control group maintained a score of 3.7. This represents a 46% decline from the experimental unit's initial performance in question 1 to final performance in question 5, in comparison to only a 7.5% decline for the control group over the same period.

Figure 3. Temporal Decline in Recall Under Sweet Food Condition

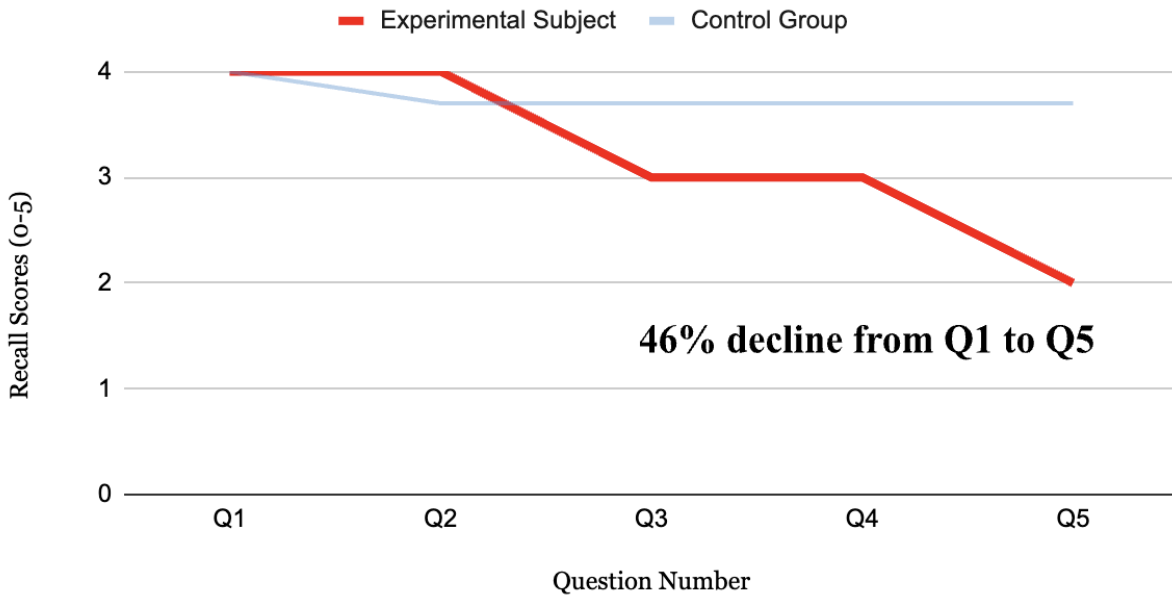


Figure 3. Temporal Decline in Recall Under Sweet Food Condition. The experimental unit's recall declined by 46% from Question 1 to Question 5, consistent with the phenomenon of a "sugar crash" following initial consumption. The control group scores remained relatively stable across the viewing period.

Spicy Snacks - Avatar Condition

For the spicy food condition, the experimental subject demonstrated a U-shaped temporal pattern. At question 1, an early scene before consumption, both the experimental subject and control group scored perfectly (5.0). During questions 2-3, corresponding to the consumption of the spicy food, the experimental subject's recall dropped sharply to 3.0 for question 2 and 2.0 for question 3, representing a 60% reduction from baseline performance. The control group maintained relatively stable scores during these questions (3.0 and 3.3, respectively).

However, after the burning sensation subsided (questions 4- 5), the experimental unit demonstrated a remarkable recovery and subsequent enhancement. For question 4, the experimental subject scored 5.0 compared to the control group's 3.0. This represents a 52% increase in recall performance compared to control group scores during the post-consumption period.

Figure 4. U-Shaped Recovery Pattern Under Spicy Food Condition

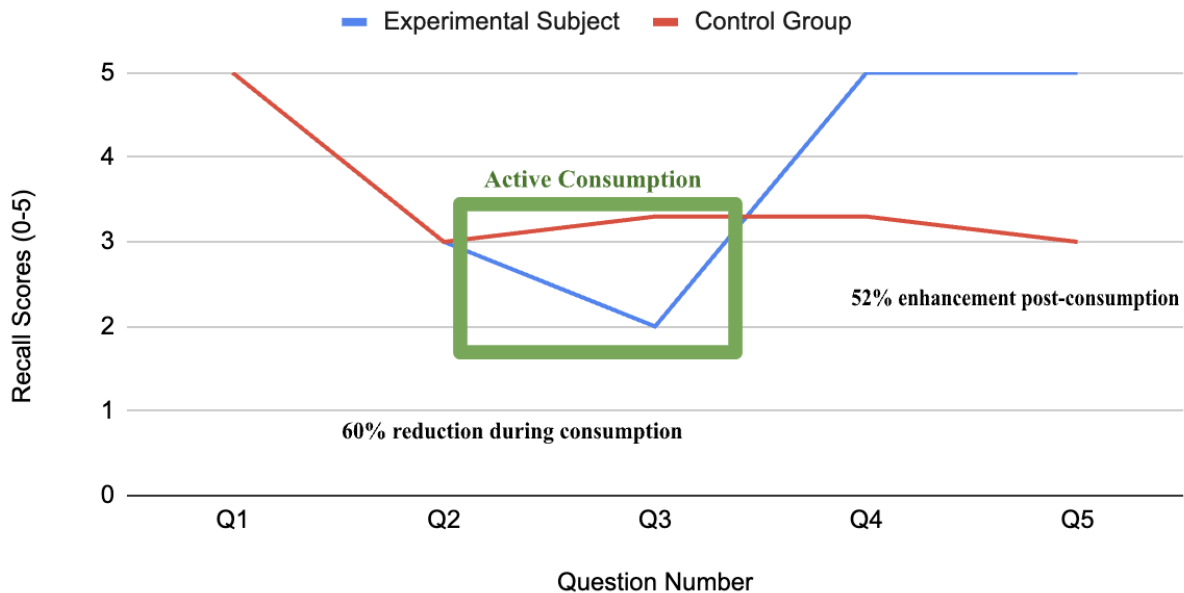


Figure 4. U-shaped Recovery Pattern Under Spicy-Food Conditions. The experimental unit's recall declined by 60% during active consumption but recovered, exceeding the control group's performance by 52% during the post-consumption period. This pattern is consistent with the TRPV1 receptor activation followed by enhanced cognitive alertness after the burning sensation subsides.

Interpretation of Temporal Patterns

The sweet food condition revealed a pattern consistent with the established literature on glucose metabolism and cognitive function. This is evident from the existing scholarly literature: high sugar intake is associated with impaired memory function. Reflecting upon that in this study, it is evident that when the stimuli were first consumed, the experimental unit had what is often referred to as a “sugar rush”, where there is an “energy and excitement that comes after consuming sugary treats,” which can stimulate short-term focus (Academy, 2024). This can be reflected in how “brain functions such as...memory...are closely linked to glucose levels and how the brain uses this [as a] fuel source.”

Moreover, it reveals that the brain is dependent on sugar as its main fuel source, further emphasizing that the acute effects of sugar consumption are correlated with increased memory function and greater recall. However, following a sugar rush, there follows the “sugar crash,” which can cause difficulty in concentrating and underscores the existing idea from the literature that when there is excess glucose consumption, it can lead to memory and cognitive deficiencies (Edwards, 2016; Novak et al., 2017; Gillespie et al., 2023). This finding has pivotal implications for understanding why individuals who snack on sugary foods during prolonged cognitive tasks may experience a decline in performance over

time. The mismatch between initial perceived alertness and actual cognitive decline suggests that sweet snacks may create a fabricated sense of enhanced focus that ultimately undermines sustained attention and recall.

The spicy food condition revealed a more complex bidirectional effect. As we looked more closely at the differences in scores for each question, as shown in Appendix G, we can see that both groups recalled the first question perfectly. However, during the time of consumption of the spicy food stimuli (for the experimental unit), which was at the scene described in the second and third questions, there was a drastic decrease in recall for those two questions. As the heat sensation, which was activated from the TRPV1 receptor, began to diminish, the experimental unit's scores became substantially higher than those of the control groups.

This supports the notion from the literature review that while capsaicin consumption may contribute to memory impairment in the long term, when discussing the acute implications of its consumption, it may bolster short-term memory and focus (McVean, 2017; Shi et al., 2019; Ho et al., 2012). The 52% increase in recall during the post-consumption period compared to controls suggests that spicy snacks may confer delayed cognitive benefits that offset their initial disruptive effects. This finding aligns with the paradoxical nature of capsaicin's effects, as noted in the literature, in that it is simultaneously linked to both impairment and enhancement depending on timing and dosage (He et al., 2025; Shi et al., 2019).

LIMITATIONS

This study is limited by several key factors that constrain the scope and generalizability. The most notable limitation is the extremely small sample size, which was further impacted by the unforeseen departure of one of the participants during the Attack on Titan viewing. This led the participants to watch the rest of the film and complete the survey on their own time under uncontrolled conditions, which may introduce additional biases and confounders. Consequently, the results may be highly idiosyncratic and cannot be statistically generalized to a broader adolescent population, as individual differences in physiology, attention span, and taste preferences disproportionately influence outcomes (Cooper, 2023; McVean, 2017). The dual role of the researcher as both the experimental subject and the primary investigator introduces significant observer bias. Additionally, the use of self-reported Likert scale data for focus is susceptible to response biases, such as acquiescence bias and recall inaccuracy, which may have distorted the recall metric. The study's broad scope, which investigated two food types and two cognitive components, also likely diluted its ability to establish clear, isolated causal relationships. Finally, the absence of a true placebo food condition due to AP Research restrictions also casts doubt on the specific sensory attributes of sweet or spicy foods rather than on the non-specific act of eating. These constraints underscore that the results are preliminary and illustrative, highlighting the need for more controlled, blinded, and narrowly focused experimental designs in future research on the dietary impacts on cognition.

CONCLUSION

This study contributes to the existing body of research on diet and cognition by addressing a critical gap: the lack of experimental research on the acute, short-term cognitive effects of food consumption. While prior studies have mainly used longitudinal or correlational methods to link sweet and spicy foods to long-term neurological and psychological outcomes (Shi et al., 2019; Edwards, 2016; Zhang et al., 2022), these approaches are inherently flawed at capturing real-time cognitive fluctuations. By using a controlled, single-subject experimental design, this study focused on immediate recall, providing novel insight into how everyday dietary stimuli can dynamically influence cognitive engagement during taste perception, thereby affecting effects such as narrative comprehension. As a result, the findings of this study can help bridge the gap between neuropsychological theory and observable short-term cognitive behavior.

The implications of these findings go beyond academic processes and play an essential role in education, media, and behavioral contexts. Adolescents, the target demographic in this study, frequently consume sweet and spicy spirit snacks while engaging in cognitively demanding activities such as studying, watching media, or viewing narrative films. This study suggests that these foods do not merely function as background habits but may actively shape attention, recall, and thematic interpretative depth in time-sensitive ways during film viewing, influencing how viewers comprehend plot details and bring out thematic meaning. Grasping how sweet foods may initially enhance engagement but later impair deeper thematic processing. In contrast, spicy foods may temporarily disrupt focus before ultimately sharpening perception, providing a more nuanced framework for examining how diet can act as a controller of both learning and media comprehension rather than a neural factor. Likewise, the results of this study can be used to bolster the promotion of snacks at movie theater concession stands, highlighting its implications for the business environment. These insights may inform future education- and media-based strategies, particularly in environments where sustained attention and interpretive analysis are essential, such as film studies or visual learning.

Several contextual factors may influence the observed patterns. The contrasting narrative tones of the two films (dark fantasy vs. serene sci-fi) may have moderated the effects of dietary interventions. The intense, psychologically distressing content of *Attack on Titan* may have interacted with the sweet food condition differently than the more tranquil, visually immersive content of *Avatar* interacted with the spicy food condition. This highlights the importance of considering emotional and narrative context in future studies of dietary-cognitive interactions. Moreover, individual differences in taste sensitivity, metabolism, and baseline cognitive function likely influence the magnitude and direction of these effects (Cooper, 2023). The single-subject design of this study prevents generalizing these findings to all individuals, but the clear temporal patterns observed provide a foundation for future research with larger, more diverse demographic sampling.

In conclusion, this study investigated how the consumption of sweet and spicy snacks influences recall during fantasy film viewing, addressing a notable gap in the literature on the short-term cognitive effects

of food. Through a structured experimental design rooted in established neurocognitive research, it was determined that dietary stimuli can exert immediate, measured effects on recall. Rather than producing a singular or linear outcome, sweet and spicy foods demonstrated distinct time-sensitive cognitive patterns, which were bolstered by the complexity and contextual nature of food cognition interactions.

This research examined, in a controlled experimental setting, how everyday dietary choices may subtly but meaningfully shape how individuals engage with information in real time. While the findings are preliminary and constrained by methodological limitations, they offer a foundational framework for future controlled and larger-scale experimental studies to address a more diverse demographic. By shifting attention from long-term dietary outcomes to continuous cognitive processes, this study contributes to a more comprehensive understanding of how sensory experiences merge with cognition, underscoring the importance of examining not just what we consume, but also when and how it interacts with the tasks we perform. Next time you go to a movie and are in line for concessions, don't be afraid to get a side of candy and Hot Cheetos to sustain your recall.

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APPENDIX A

Attack On Titan Season 1

Why I Chose It: This film was chosen for its blend of intense action and dark fantasy. The psychological and trauma story events can also be tied to the horror and drama genres, forming a complex set of genres that will be perfect for use in this study when comparing normal conditions to how they can be altered through the consumption of sweet food.

Scene 1: Titan Assault on Shiganshina (Episode 1)

- **Why chosen:** this opening scene sets the tone for the series's intensity and introduces the titans as a threat to the human [o]ilation. It shows a precise, shocking moment to gauge the audience's focus and initial perception of danger, as well as the characters' responses.

I. Scene 2: Mikasa's Childhood Flashback (Episode 7)

- **Why chosen:** This scene gives a critical backstory, revealing Mikasa's motivations and values. It allows me to examine whether participants perceive the character's evolution through Mikasa's traumatic experiences.

II. Scene 3: Eren's Titan Emergence (Episode 9)

- **Why chosen:** Eren's first transformation is a significant plot twist, making it ideal for assessing recall of complex actions and perception of character power, regardless of whether the participants see this transformation as positive or negative.

III. Scene 4: Eren's Memory of the Injection (Episode 9)

- **Why chosen:** this flashback introduces new plot secrets and foregrounding, allowing us to study how participants interpret the hidden narrative plot elements and connect them to the larger story, and comparing it to the experimental subject

IV. Scene 5: Eren's Escape Plan & the Trost Solution (Episode 10)

- **Why chosen:** this scene shows decision making under high stakes, demonstrates a sense of leadership and responsibility, and offers a good way to examine both the real and expected outcomes of the problem solving strategies and character development.

The Avatar

Why I Chose It: The sci-fi set in the future contrasts with the "past" dark fantasy and horror genres of the previous film, providing a contrast between the two while still falling under the fantasy genre. The movie's moral themes about nature and colonization allow for comparison with the previous film. Scenes were selected for their strong visual storytelling, character development, and thematic features that reinforce the movie's overall theme. They showcase moments in which the viewer's perception of the new world, culture, and character transformations can be studied through focus and perception, and how they can be altered through the consumption of spicy food.

I. Scene 1: Jake's First Avatar Awakening on Pandora

- **Why chosen:** this scene gives insight into Pandora's world and allows the audience to recall the setting and perception of a new environment, and allows the audience to compare it to experimental responses

II. Scene 2: Courtship at the Tree of Voices (Neytiri and Jake's Rite of Passage)

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- **Why chosen:** This scene highlights cultural integration and character relationships, making it ideal for studying how the participants interpret rituals and social dynamics in a non-human society and for comparing them with the experimental subject.
- III. Scene 3: Destruction of the Hometree (Raid on the Na'vi Village)
- **Why chosen:** the home tree destruction is a significant turning point, showing conflict and loss. It is helpful to examine how participants focus on complex actions and perceive the moral, cultural, and environmental stakes.
- IV. Scene 4: Battle at the Tree of Souls (Grace's Sacrifice, Eywa Revealed)
- **Why chosen:** this climactic scene blends action, emotion, and spirituality, making it ideal for examining how the audience interprets the thematic and symbolic content, testing recall of the dramatic events, and comparing it to the experimental subject.
- V. Scene 5: Epilogue – "I See You" and Jake's Transformation
- **Why chosen:** Jake's final transformation provides narrative resolution and emotional closure, helping to see how the participants perceive character development and thematic resolution in comparison to earlier story events.

APPENDIX B

3 foods will be consumed during each film.

- Each food will have a varying degree of spiciness and sweetness
- Only the researcher will be consuming the food
- The researcher will only eat one flavor profile for each film
 - Spicy during The Avatar
 - Sweet during Attack on Titan

List of All The Foods And Why

Attack on Titan Foods:

- I. Cheesecake Factory: 1 slice of the Oreo Cheesecake from Tom Thumb
Sugar content: Approximately 68g of sugar
 - Why Chosen: I chose this because of its high sugar content, which makes it a lovely food and affects the human body when consumed. I chose it for AOT because the sweet 'happy joyful feeling' is opposite to the tense, dark fantasy feelings which the series provides
- II. ½ Talenti Mint fudge ice cream pint
Sugar content: 99g for a whole pint; 33g for ½
 - Why Chosen: I chose this because of its high sugar content, which makes it very sweet and can affect the body when consumed. I decided on AOT because the sweet 'happy joyful feeling' is opposite to the tense dark fantasy feelings which the series provides.

The Avatar Foods:

- I. Dave's Hot Chicken #3 Level 'Hot' spice level.
 - Why Chosen: I chose this because of its high level of spice, which will guarantee to have an effect on the human body when consumed. I decided on Avatar because the spice 'burning stressful feeling' is the opposite of the calm mystery the Avatar film provides.
- II. Hot Cheetos 8.5oz
(Serrano pepper on the Scoville pepper scale)
 - Why Chosen: for the researcher's safety, who is the participant in the experiment group, I have chosen something lower on the spice scale, as Dave's hot chicken tender is much higher. I picked it for the Avatar because the spice 'burning stressful feeling' is the opposite of the calm mystery the Avatar film provides.

APPENDIX C

OVERVIEW

Below is an informed consent agreement that outlines the agreement for consent to voluntarily participate in an AP Research student driven research project.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONFIDENTIALITY

Your responses to this study will be anonymous. Every effort will be made by the researcher to preserve your confidentiality including the following:

- Assigning code names/numbers for participants that will be used on all research notes and documents
- Keeping notes, interview transcriptions, and any other identifying participant information in a locked file cabinet in the personal possession of the researcher.]

Participant data will be kept confidential except in cases where the researcher is legally obligated to report specific incidents. These incidents include, but may not be limited to, incidents of abuse and suicide risk.

CONTACT INFORMATION

If you have questions at any time about this study or the method in which it was conducted, please reach out to the AP Research Teacher

TITLE OF STUDY

Mind Over Munchies: How Sweet and Spicy Snacks Shape Fantasy Film Recall

PURPOSE OF STUDY

The purpose of the study is to learn more about the flavor profiles of sweet and spicy foods and how they impact focus and perception during films.

STUDY PROCEDURES

Participants will arrive at the researcher's home, watch a film in the theater room, and then complete a survey measuring their focus levels of the film. The two films which the participants may be watching will either be Attack On Titan: Season 1 or The Avatar: 2009 Film. In the study, participants are in a normal condition; therefore, they will not be asked to do anything beyond their daily routines. Participants will not be asked to change their diets or engage in any dangerous activities.

RISKS

There are no risks attached to this study. The study will be conducted in a controlled environment where participants' safety will be ensured in the event of any emergency.

BENEFITS

Participants will be part of the researcher's awesome and fun study to support her AP Research grade and AP Portfolio performance. Participants will enjoy watching an entertaining film, which will help them relieve some stress from their rigorous school activities. Participants will receive a goody bag containing a makeshift certificate and medal, along with other small gifts, for their participation in the study. This study opens the door to future studies on taste perception and the impact of food consumption on the human cognitive mind. The results of this study provide society with answers to which flavor profile is best suited for improved focus and perception.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____

Parent's signature _____ Date _____

APPENDIX D

There will be 5 questions for each film.

- Five questions, using a 5 point Likert Scale, will ask participants to rate how much of the scene described in the question they can recall.
 - Example Question: On the 5 Point Likert Scale, how well do you recall Eren and Mikasa screaming and standing still while watching Eren's mom getting eaten by the titan? 1, being you **strongly disagree** that this exact description of the scene did not happen; 5, being you **strongly agree** that this exact description of the scene did occur.

List of All The Questions And Why

Attack on Titan Questions:

1.

Description: Eren, Mikasa, and the townspeople witness the sudden appearance of the Colossal Titan, which breaches Wall Maria. In the chaos, Eren's mother, Carla, is crushed and eaten by a Titan.

Question: On a 5 point Likert scale, how well do you recall Eren and Mikasa standing still and screaming as they watch Carla, Eren's mother, being eaten by a Titan after the Colossal Titan breaches Wall Maria?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: This question measures the participants' attention to key plot events, testing recall of significant moments that drive the story forward, comparing how the experimental subject responds

2.

Description: Young Mikasa and Eren are ambushed by human traffickers. After the traffickers kill Mikasa's parents, Eren encourages Mikasa to fight back, and she kills the attackers to save him.

Question: On a 5 point Likert scale, how well do you recall Mikasa stabbing one of the traffickers and later killing the others after Eren tells her to "fight" during the flashback sequence?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: this question looks at the participants' recollection of a critical character action and background story, comparing it to how the experimental subject responds

3.

Description: After being swallowed by a Titan, Eren bursts out from its stomach in Titan form and fights off nearby Titans, saving Mikasa and Armin.

Question: On a 5 point Likert scale, how well do you recall Eren emerging from a Titan's stomach and transforming into a Titan himself to protect Mikasa and Armin?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: this question looks at attention to substantial action sequences, determining the recall of the climactic reveal of Eren's titan power, and comparing it to how the experimental subject responds

4.

Description: While in Titan form, Eren flashes back to his father injecting him with a mysterious serum and giving him a key, telling him to find out the truth in their basement.

Reaches Wall Maria. In the chaos, Eren's mother, Carla, is crushed and eaten by a Titan.

Question: On a 5 point Likert scale, how well do you recall the flashback showing Eren's father injecting him with a serum and handing him a key to their basement?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: this question checks focus for key exposition and plot foreshadowing, which was critical for understanding long term story development, and compares how the experimental subject responds

5.

Description: After the Trost District battle, Eren exits his Titan form and works with Armin and Commander Pyxis to devise a plan to use his Titan abilities to seal the breach in Wall Rose.

Question: On a 5 point Likert scale, how well do you recall Eren proposing to use his Titan power to carry a boulder and seal the breached gate during the Trost battle?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: this question measures focus on character problem solving ability, allowing us to see how participants remember the strategy and decision making of the character, and compare it to how the experimental subject responds

Avatar Questions:

II. Focus Based

1.

Description: Jake Sully's consciousness is linked to his Na'vi avatar body for the first time, and he explores Pandora's bioluminescent jungle, seeing glowing plants and alien creatures.

Question: On a 5 point Likert scale, how well do you recall Jake first waking up in his Na'vi avatar body and exploring Pandora's glowing jungle filled with bioluminescent plants and alien creatures?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: this question looks at the focus towards the first essential scene of the movie and its narrative details to see if the participants remember the

foundation story events and settings, and compares it to how the experimental subject responds

2.

Description: At the Tree of Voices, Neytiri leads Jake through a Na'vi courtship ritual, connecting with him through the tree's glowing tendrils, marking his integration into Na'vi culture.

Question: On a 5 point Likert scale, how well do you recall Jake and Neytiri performing a courtship ritual at the Tree of Voices, connecting through the glowing tendrils?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: this looks at how participants can recall the culturally significant and plot relevant interactions, which are key to evaluating comprehension of character relationships, and then comparing how the experimental subject responds

3.

Description: RDA forces attack the Omatikaya village, using overwhelming weaponry to destroy the massive Hometree, leaving the Na'vi allies in chaos and exile.

Question: On a 5 point Likert scale, how well do you recall the RDA forces destroying the Hometree and causing chaos among the Na'vi village?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: this question assesses retention of key conflict and action sequences, allowing comparison of attention to plot and environmental stakes, and comparing how the experimental subject responds

4.

Description: During the Na'vi's final stand at the Tree of Souls, Dr. Grace Augustine is mortally wounded. Her consciousness merges with the Tree as she exclaims, "Eywa is real!", validating the Na'vi spiritual beliefs.

Question: On a 5 point Likert scale, how well do you recall Dr. Grace Augustine being mortally wounded during the battle and declaring "Eywa is real" as her consciousness merges with the Tree of Souls?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: this question tests memory for climactic symbolic moments, indicating whether participants accurately recall pivotal thematic moments, and compares how the experimental subject responds

5.

Description: After the battle, Jake says "I see you" to Neytiri and permanently transfers his consciousness into his Na'vi avatar, symbolizing his full integration into their world.

Question: On a 5 point Likert scale, how well do you recall Jake saying “I see you” to Neytiri before permanently transferring his consciousness into his Na’vi avatar?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Why this question: this ensures participants notice narrative resolution and character arcs critical for measuring comprehension of the story's ending and transformation, and comparing it to how the experimental subject responds

APPENDIX E

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Very unsatisfactory	Unsatisfactory	Neutral	Satisfactory	Very satisfactory
Never	Rarely	Often	Usually	Always
Not at all true of me	Not true of me	Somewhat true of me	True of me	Very true of me
Not at all like me	Not like me	Somewhat like me	Like me	Totally like me
Very poor	Poor	Adequate	Good	Very good
Not at all important	Not important	Neither important nor unimportant	Important	Very important

Citation for creator: Likert, R. (1932). *A technique for the measurement of attitudes*. Archives of Psychology. <https://psycnet.apa.org/record/1933-01885-001>

Why: I chose the Likert scale because it's easy to use, flexible, and simple for participants. It also provides quantitative data, which makes it quick to calculate averages, comparing the control group to the experimental subjects. I chose to utilize this for the focus questions, as it allows us to see at what scale the participants can recall events from the scenes.

APPENDIX F

AP Research Group Participant 1

I. Likert

Description: Eren, Mikasa, and the townspeople witness the sudden appearance of the Colossal Titan, which breaches Wall Maria. In the chaos, Eren's mother, Carla, is crushed and eaten by a Titan.

Question: On a 5-point Likert scale, how well do you recall Eren and Mikasa standing still and screaming as they watch Carla, Eren's mother, being eaten by a Titan after the Colossal Titan breaches Wall Maria?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

5

Answer:

Description: Young Mikasa and Eren are ambushed by human traffickers. After the traffickers kill Mikasa's parents, Eren encourages Mikasa to fight back, and she kills the attackers to save him.

Question: On a 5-point Likert scale, how well do you recall Mikasa stabbing one of the traffickers and later killing the others after Eren tells her to "fight" during the flashback sequence?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

4

Answer:

Description: After being swallowed by a Titan, Eren bursts out from its stomach in Titan form and fights off nearby Titans, saving Mikasa and Armin.

Question: On a 5-point Likert scale, how well do you recall Eren emerging from a Titan's stomach and transforming into a Titan himself to protect Mikasa and Armin?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

4

Answer:

Description: While in Titan form, Eren flashes back to his father injecting him with a mysterious serum and giving him a key, telling him to find out the truth in their basement.

Reaches Wall Maria. In the chaos, Eren's mother, Carla, is crushed and eaten by a Titan.

Question: On a 5-point Likert scale, how well do you recall the flashback showing Eren's father injecting him with a serum and handing him a key to their basement?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

3

Answer:

Description: After the Trost District battle, Eren exits his Titan form and works with Armin and Commander Pyxis to devise a plan to use his Titan abilities to seal the breach in Wall Rose.

Question: On a 5-point Likert scale, how well do you recall Eren proposing to use his Titan power to carry a boulder and seal the breached gate during the Trost battle?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

3

Answer:

AP Research Group Participant 2

I. Likert

Description: Eren, Mikasa, and the townspeople witness the sudden appearance of the Colossal Titan, which breaches Wall Maria. In the chaos, Eren's mother, Carla, is crushed and eaten by a Titan.

Question: On a 5-point Likert scale, how well do you recall Eren and Mikasa standing still and screaming as they watch Carla, Eren's mother, being eaten by a Titan after the Colossal Titan breaches Wall Maria?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: **5**

Description: Young Mikasa and Eren are ambushed by human traffickers. After the traffickers kill Mikasa's parents, Eren encourages Mikasa to fight back, and she kills the attackers to save him.

Question: On a 5-point Likert scale, how well do you recall Mikasa stabbing one of the traffickers and later killing the others after Eren tells her to "fight" during the flashback sequence?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: **4**

Description: After being swallowed by a Titan, Eren bursts out from its stomach in Titan form and fights off nearby Titans, saving Mikasa and Armin.

Question: On a 5-point Likert scale, how well do you recall Eren emerging from a Titan's stomach and transforming into a Titan himself to protect Mikasa and Armin?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: 4

Description: While in Titan form, Eren flashes back to his father injecting him with a mysterious serum and giving him a key, telling him to find out the truth in their basement.

Reaches Wall Maria. In the chaos, Eren's mother, Carla, is crushed and eaten by a Titan.

Question: On a 5-point Likert scale, how well do you recall the flashback showing Eren's father injecting him with a serum and handing him a key to their basement?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: 3

Description: After the Trost District battle, Eren exits his Titan form and works with Armin and Commander Pyxis to devise a plan to use his Titan abilities to seal the breach in Wall Rose.

Question: On a 5-point Likert scale, how well do you recall Eren proposing to use his Titan power to carry a boulder and seal the breached gate during the Trost battle?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: 2

Experimental Unit/Researcher Avatar survey

II. Likert

1.

Description: Jake Sully's consciousness is linked to his Na'vi avatar body for the first time, and he explores Pandora's bioluminescent jungle, seeing glowing plants and alien creatures.

Question: On a 5-point Likert scale, how well do you recall Jake first waking up in his Na'vi avatar body and exploring Pandora's glowing jungle filled with bioluminescent plants and alien creatures?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 4

2.

Description: At the Tree of Voices, Neytiri leads Jake through a Na'vi courtship ritual, connecting with him through the tree's glowing tendrils, marking his integration into Na'vi culture.

Question: On a 5-point Likert scale, how well do you recall Jake and Neytiri performing a courtship ritual at the Tree of Voices, connecting through the glowing tendrils?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer:4

3.

Description: RDA forces attack the Omatikaya village, using overwhelming weaponry to destroy the massive Hometree, leaving the Na'vi allies in chaos and exile.

Question: On a 5-point Likert scale, how well do you recall the RDA forces destroying the Hometree and causing chaos among the Na'vi village?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer:2

4.

Description: During the Na'vi's final stand at the Tree of Souls, Dr. Grace Augustine is mortally wounded. Her consciousness merges with the Tree as she exclaims, "Eywa is real!", validating the Na'vi spiritual beliefs.

Question: On a 5-point Likert scale, how well do you recall Dr. Grace Augustine being mortally wounded during the battle and declaring "Eywa is real" as her consciousness merges with the Tree of Souls?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer:5

5.

Description: After the battle, Jake says "I see you" to Neytiri and permanently transfers his consciousness into his Na'vi avatar, symbolizing his full integration into their world.

Question: On a 5-point Likert scale, how well do you recall Jake saying "I see you" to Neytiri before permanently transferring his consciousness into his Na'vi avatar?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer:4

Coding Group Participant 1

II. Likert

1.

Description: Jake Sully's consciousness is linked to his Na'vi avatar body for the first time, and he explores Pandora's bioluminescent jungle, seeing glowing plants and alien creatures.

Question: On a 5-point Likert scale, how well do you recall Jake first waking up in his Na'vi avatar body and exploring Pandora's glowing jungle filled with bioluminescent plants and alien creatures?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 5

2.

Description: At the Tree of Voices, Neytiri leads Jake through a Na'vi courtship ritual, connecting with him through the tree's glowing tendrils, marking his integration into Na'vi culture.

Question: On a 5-point Likert scale, how well do you recall Jake and Neytiri performing a courtship ritual at the Tree of Voices, connecting through the glowing tendrils?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 3

3.

Description: RDA forces attack the Omatikaya village, using overwhelming weaponry to destroy the massive Hometree, leaving the Na'vi allies in chaos and exile.

Question: On a 5-point Likert scale, how well do you recall the RDA forces destroying the Hometree and causing chaos among the Na'vi village?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 4

4.

Description: During the Na'vi's final stand at the Tree of Souls, Dr. Grace Augustine is mortally wounded. Her consciousness merges with the Tree as she exclaims, "Eywa is real!", validating the Na'vi spiritual beliefs.

Question: On a 5-point Likert scale, how well do you recall Dr. Grace Augustine being mortally wounded during the battle and declaring "Eywa is real" as her consciousness merges with the Tree of Souls?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 2

5.

Description: After the battle, Jake says "I see you" to Neytiri and permanently transfers his consciousness into his Na'vi avatar, symbolizing his full integration into their world.

Question: On a 5-point Likert scale, how well do you recall Jake saying "I see you" to Neytiri before permanently transferring his consciousness into his Na'vi avatar?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 3

Coding Group Participant 1

II. Likert

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1.

Description: Jake Sully's consciousness is linked to his Na'vi avatar body for the first time, and he explores Pandora's bioluminescent jungle, seeing glowing plants and alien creatures.

Question: On a 5-point Likert scale, how well do you recall Jake first waking up in his Na'vi avatar body and exploring Pandora's glowing jungle filled with bioluminescent plants and alien creatures?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 5

2.

Description: At the Tree of Voices, Neytiri leads Jake through a Na'vi courtship ritual, connecting with him through the tree's glowing tendrils, marking his integration into Na'vi culture.

Question: On a 5-point Likert scale, how well do you recall Jake and Neytiri performing a courtship ritual at the Tree of Voices, connecting through the glowing tendrils?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 2

3.

Description: RDA forces attack the Omatikaya village, using overwhelming weaponry to destroy the massive Hometree, leaving the Na'vi allies in chaos and exile.

Question: On a 5-point Likert scale, how well do you recall the RDA forces destroying the Hometree and causing chaos among the Na'vi village?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 2

4.

Description: During the Na'vi's final stand at the Tree of Souls, Dr. Grace Augustine is mortally wounded. Her consciousness merges with the Tree as she exclaims, "Eywa is real!", validating the Na'vi spiritual beliefs.

Question: On a 5-point Likert scale, how well do you recall Dr. Grace Augustine being mortally wounded during the battle and declaring "Eywa is real" as her consciousness merges with the Tree of Souls?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 3

5.

Description: After the battle, Jake says "I see you" to Neytiri and permanently transfers his consciousness into his Na'vi avatar, symbolizing his full integration into their world.

Question: On a 5-point Likert scale, how well do you recall Jake saying “I see you” to Neytiri before permanently transferring his consciousness into his Na’vi avatar?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

- Answer: 5

Experimental Unit/Researcher AOT survey

I. Likert

1. **Description:** Eren, Mikasa, and the townspeople witness the sudden appearance of the Colossal Titan, which breaches Wall Maria. In the chaos, Eren’s mother, Carla, is crushed and eaten by a Titan.

Question: On a 5-point Likert scale, how well do you recall Eren and Mikasa standing still and screaming as they watch Carla, Eren’s mother, being eaten by a Titan after the Colossal Titan breaches Wall Maria?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: 5

2. **Description:** Young Mikasa and Eren are ambushed by human traffickers. After the traffickers kill Mikasa’s parents, Eren encourages Mikasa to fight back, and she kills the attackers to save him.

Question: On a 5-point Likert scale, how well do you recall Mikasa stabbing one of the traffickers and later killing the others after Eren tells her to “fight” during the flashback sequence?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: 4

3. **Description:** After being swallowed by a Titan, Eren bursts out from its stomach in Titan form and fights off nearby Titans, saving Mikasa and Armin.

Question: On a 5-point Likert scale, how well do you recall Eren emerging from a Titan’s stomach and transforming into a Titan himself to protect Mikasa and Armin?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: 3

4. **Description:** While in Titan form, Eren flashes back to his father injecting him with a mysterious serum and giving him a key, telling him to find out the truth in their basement. Reaches Wall Maria. In the chaos, Eren’s mother, Carla, is crushed and eaten by a Titan.

Question: On a 5-point Likert scale, how well do you recall the flashback showing Eren's father injecting him with a serum and handing him a key to their basement?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: 3

5. **Description:** After the Trost District battle, Eren exits his Titan form and works with Armin and Commander Pyxis to devise a plan to use his Titan abilities to seal the breach in Wall Rose.

Question: On a 5-point Likert scale, how well do you recall Eren proposing to use his Titan power to carry a boulder and seal the breached gate during the Trost battle?

(1 = strongly disagree this exact description of the scene occurred; 5 = strongly agree this exact description of the scene occurred)

Answer: 2

APPENDIX G

Quantitative Likert Scale Responses Collection

Mean = Sum of All Score Values/Number of Score Values

Coding Group Responses on Focus (Likert Scale) Questions - Avatar (2009)

Questions	Participant 1	Participant 2	The Mean of Each Response
Question 1	5	5	5
Question 2	3	2	2.5
Question 3	4	2	3
Question 4	2	3	2.5
Question 5	3	5	4

Question 1 Calculations of the Mean: $(5+5)/2=5$

Question 2 Calculations of the Mean: $(3+2)/2=2.5$

Question 3 Calculations of the Mean: $(4+2)/2=3$

Question 4 Calculations of the Mean: $(2+3)/2=2.5$

Question 5 Calculations of the Mean: $(3+5)/2=4$

Total mean: $(5+2.5+3+2.5+4)/5=3.4$

Experimental Unit/Researcher Responses on Focus (Likert Scale) Questions

Question	Experimental Unit/Researcher Response
1	4
2	4
3	2
4	5
5	4

Total mean: $(5+4+2+5+4)/5=4$

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AP Research Class Group Responses on Focus (Likert Scale) Questions - Attack on Titan (Season 1)

Questions	Participant 1	Participant 2	The Mean of Each Response
Question 1	5	5	5
Question 2	4	4	4
Question 3	4	4	4
Question 4	3	3	3
Question 5	3	2	2.5

Question 1 Calculations of the Mean: $(5+5)/2$

Question 2 Calculations of the Mean: $(4+4)/2$

Question 3 Calculations of the Mean: $(4+4)/2$

Question 4 Calculations of the Mean: $(3+3)/2$

Question 5 Calculations of the Mean: $(3+2)/2$

Total mean: $(5+4+4+3+2.5)/5=3.7$

Experimental Unit/Researcher Responses on Focus (Likert Scale) Questions

Question	Experimental Unit/Researcher Response
1	5
2	4
3	3
4	3
5	2

Total mean: $(5+4+3+2+2)/5=3.2$

APPENDIX H

Table 1: Mean Focus Score for *Attack on Titan*

Question	Control Group Mean	Experimental Subject Score
1	5	5
2	4	4
3	4	3
4	3	3
5	2.5	2

Table 2: Mean Focus Scores of *Avatar*

Question	Control Group Mean	Experimental Subject Score
1	5	4
2	2.5	4
3	3	2
4	2.5	5
5	4	4