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A Memory-Based Approach to Multiple Document Comprehension

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A MEMORY-BASED APPROACH TO MULTIPLE DOCUMENT COMPREHENSION

BY

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ABSTRACT

A MEMORY-BASED APPROACH TO MULTIPLE DOCUMENT COMPREHENSION

By

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University of New Hampshire, May, 2022

Multiple document (MD) comprehension is of growing interest in the Internet age, in which reading material is readily available from multiple sources. However, comprehension research has typically been dominated by studies investigating single documents (Bråten et al., 2019; McNamara & Magliano, 2009). This dissertation applies a memory-based approach traditionally used in research on single document comprehension to a MD context, with the goal of understanding the on-line processing and integration of information from multiple documents. Expository-style passages were created in which the first half contained information that was either consistent or inconsistent with a target sentence in the second half. A series of experiments measured reading times on the target sentences when the passage halves were presented as one single passage (Experiment I & IV) or as two separate passages, which were presented either consecutively (Experiment II & IV) or interleaved with an unrelated passage (Experiment III & IV). Reading time data revealed that, for all passage presentations, reading times were longer in the inconsistent condition compared to the consistent. These results indicate that information from earlier in the text or from previous passages was being reactivated and, when inconsistent, impacting on-line processing. In Experiment IV, a post-reading measure of memory for the inconsistencies revealed that participants' memory was better when the inconsistency occurred across passages compared to when it occurred within a single passage.

INTRODUCTION

Whether they are staying up to date on the news, researching for a review paper, or simply keeping connected through social media, individuals have ready access to the information they need from a wide variety of sources via the Internet. However, while the Internet allows for easier data retrieval, that accessibility also can lead to an overabundance that places additional strain on a readers' cognitive resources (Magliano et al., 2018). Internet users need to sort out the torrent of information they receive after each online inquiry: consulting different opinions, filtering misinformation, and researching conflicting facts. Despite a growing interest in how learners deal with this influx of information, models of multiple document (MD) comprehension have generally not focused on the cognitive mechanisms underlying the comprehension and integration of information from multiple documents. Thus, it is critical that research examine the basic cognitive processes involved in the comprehension of information from multiple documents, especially when they conflict.

MD processing, as compared to single document processing, involves taking in information from multiple sources with potentially different styles, perspectives, and motivations. In addition to the basic processing needed to comprehend each individual document, the reader must also be able to integrate information across sources to form a coherent representation of the document set as a whole or of the situation being described across various documents. It is important to understand how these additional demands in MD processing influence comprehension and to investigate the differences between processing information within a single document versus processing information across documents.

Research on MD processing to date has focused on the ways in which varying source information (e.g., the reliability of the author or publisher) influence individuals' integration and comprehension of documents (e.g., Bråten et al., 2009; Britt & Aglinskas, 2002; Rouet & Britt, 2011; Wiley et al., 2009; Wineburg, 1991). While this research has provided valuable insights into more naturalistic reading processes, the majority of this prior work has assessed comprehension outcomes after reading. In particular, studies often rely on an essay-writing paradigm that requires participants to develop an argument based on information from multiple sources (Braasch et al., 2012, 2016; Rouet et al., 2016). These essay tasks occur after individuals have finished reading and involve numerous skills (e.g., writing and argumentation) beyond those involved in text processing (i.e., encoding incoming information and updating the text representation) (Allen et al., 2014; Graham & Perin, 2007; Weston-Sementelli et al., 2018). Thus, while MD research has taken great strides in past years to understand how information is processed from multiple sources, many research gaps remain. In order to get a comprehensive picture of the complex process that is MD comprehension, it is important to investigate how information is activated from memory and integrated across passages in order to form a mental representation of the documents. It is important for any model of comprehension to be able to account for basic cognitive processes (e.g., attention and memory) that contribute to text comprehension.

Across different contexts, successful reading comprehension relies on the reader developing a coherent representation of the text (Kintsch, 1998). There are two sources of information that influence readers' development of a coherent representation: the information provided directly by the text and the readers' general world knowledge (GWK) (Albrecht & O'Brien, 1991, Cook, 2014, Cook & Myers, 2004, Creer et al., 2018). In the memory-based view

of comprehension, information from both sources is made available through passive activation and is then integrated into the evolving representation of the text (Myers & O'Brien, 1998; O'Brien & Myers, 1999). Importantly, research exploring this theoretical perspective has relied heavily on methodologies that tap into on-line processes. For instance, the contradiction paradigm (Albrecht & O'Brien, 1993; O'Brien & Albrecht, 1992) measures reading times on target sentences that are either consistent or inconsistent with information presented early in the same passage or with the readers' GWK. Using reading time measures in this way can give insights into the information that is being reactivated in an individual's memory as they read a text. For example, when reading times are slower on inconsistent target sentences compared to consistent ones, this indicates that information related to the target sentence from earlier in the text and/or the readers' GWK has been reactivated upon reading the target sentence, causing a quantifiable disruption in processing.

To date, this paradigm has typically been used to investigate the types of information that are reactivated and incorporated into the readers' representation of the text in single document contexts. Applying this methodology to investigations of MD comprehension can provide insights into the patterns of memory activation that occur when the information being processed is spread across multiple sources. Understanding how passive, memory-based processes operate while reading multiple documents is a crucial first step in understanding the types of representations that readers build when processing information from multiple sources.

Investigations of on-line passive processes have traditionally used narrative texts because they are easy to control and manipulate. However, MD reading contexts typically involve expository-style texts as opposed to narrative ones. There are many circumstances in which a reader must read multiple documents about the same expository topic, such as gathering

information to produce an essay or to present to others on a given topic. The process of integrating information across documents becomes even more complex when those documents contain information that conflicts with each other. While there have been investigations of how readers combine information from multiple expository documents, especially when they conflict (Braasch et al., 2012; Stadtler & Bromme, 2014), these investigations have not fully explored the on-line processes involved. On-line investigations of expository texts have typically been limited to how information is processed within a single document, (Noordman et al., 1992; Singer et al., 1997; Wiley & Myers, 2003), these experiments have not investigated what happens when readers are required to make connections across multiple expository documents. It remains unclear whether connections across multiple expository documents are made on-line and how those might impact the readers comprehension of text information.

This dissertation investigates the integration of information across multiple expository-style passages using a memory-based approach. Chapter I discusses the current state of MD research, including current models of MD comprehension and recent trends to highlight the areas that could benefit from further investigation. Chapter II provides a brief overview of some early models of single document reading comprehension to make clear the basic assumptions that are common to all models, including current models of MD comprehension. Chapter III introduces the memory-based view along with models consistent with that view to make clear the benefits of taking a memory-based approach to MD comprehension. Chapter IV outlines the areas in the field of MD research left relatively unexplored and introduces how exactly the current studies address those needs.

CHAPTER I

MULTIPLE DOCUMENT COMPREHENSION

As our society evolves, so do the ways we consume information. Today's reading landscape is constantly expanding through a growth in the number of sources readers have access to, a change in the number and types of content creators, an increase in the number of ways that content can be consumed (e.g., physical book, computer, cell phone) and an increase in the number of modalities of content (e.g., text, diagram, film, video game, graphic novel) (Magliano et al., 2018). These changes have placed increased importance on the skills required to comprehend and learn from various sources of information. As a result, researchers have begun to investigate the factors contributing to multiple document (MD) comprehension (Bråten et al., 2019; Goldman, 2004; Goldman et al., 2016). Early work on MD comprehension was primarily conducted in educational contexts because students' success often requires them to be able to gather and use information from multiple documents (Hartman, 1995; Perfetti et al., 1995; Rouet et al., 1996; Stahl et al., 1996; Wineburg, 1991). Since then, many other disciplines have shown interest in MD comprehension, including but not limited to cognitive psychology, education, information literacy, discourse processes, and social psychology (Braasch et al., 2018). With the prevalence of MD reading, investigating the cognitive processes involved in our engagement with multiple documents is a critical step to developing a complete model of MD comprehension and consequently informing practices that can enhance comprehension skills in the Internet age.

The representation that the reader forms of a text (i.e., mental model or situation model; see Magliano & McNamara, 2009 for a review), consists of multiple levels and can include information from the text itself, relevant prior knowledge that was activated during reading, and

any inferences that were generated by the reader. According to a memory-based view of text comprehension, both the information from the text and prior knowledge is made available through passive activation and integrated into the representation during reading (Myers & O'Brien, 1998; O'Brien & Myers, 1999). Many models of MD comprehension presume that the memory-based processes established in single document research remain the same when reading multiple documents; however, these assumptions have not been tested directly. A complete theory of MD comprehension needs to first explain how readers take in information from multiple documents at the most basic level (i.e., passive cognitive processes) and then build to more complex active processing when simpler explanations fail. The memory-based processes described in research using single documents cannot simply be assumed to extend to multiple documents because establishing coherence while reading multiple documents introduces additional complexity.

Multiple document researchers tend to distinguish MD use from single document use based on the degree of integration that is required by the reading task to form coherence (Britt & Rouet, 2011; 2012; 2020; Goldman & Brand-Gruwel, 2018; Rouet et al., 2021; Saux et al., 2020). When reading a single document, readers only need to establish coherence for that particular document—this process is often made easier through cohesive cues in the text that signal the reader to make connections between pieces of information. MD comprehension complicates this process, as it requires the reader to not only develop a coherent representation of the information in each separate document but also for an entire set of documents. Further exacerbating this complexity, the connections *across* documents in a set are rarely ever made explicit and can therefore place greater knowledge demands on the reader to make those connections for themselves. In many traditional studies of single document processing

participants read a series of self-contained narrative passages, but even though there are multiple individual passages, readers are not required to integrate information across them and thus it is considered a single document task. In a MD reading situation, the reader is expected to integrate information across documents in order to form a complete representation of the situation that the various documents are describing. Reading comprehension in any context involves forming a coherent representation of the information presented in the document. It follows then that MD comprehension would be the process of developing a coherent representation by integrating information across multiple documents that are separated by some form of document boundary.

To understand what MD comprehension is and what it involves, it is important to define what counts as a 'document boundary' separating one text from another (e.g., change in source information, change in topic, a break between documents). In experiments on single document comprehension, participants often read a collection of reading passages back-to-back with breaks in between. However, this cannot be considered MD comprehension because the passages are fully independent and there is no need to integrate information across passages to form a coherent representation of the situation described by all passages. Many MD researchers use the presence of source distinctions (e.g., different webpages or authors) to signal a document boundary (e.g., Saux et al., 2020). However, this cannot be the only type of document boundary that distinguishes between separate documents. For example, under a strict source-distinction definition of multiple documents, it is unclear if two webpages written by the same author on different topics or an anthology of short stories written by the same author would count as separate documents or not. Furthermore, basing the perception of a document boundary solely on the presence of source information assumes that the reader has access to such information (e.g., about when, by whom, or for what purpose a text was written), which may not be provided.

In a recent study Rouet et al. (2021) defined a "text" as any piece of cohesive discourse, and this distinction did not need to include any information regarding source. The presence of source information may serve to act as a clear document boundary, but source information is not always necessary to have distinct documents. One way to understand document boundaries may be considering it on a scale of degree of separation or strength of the boundary. The best example of a strong document boundary would be two different documents (e.g., webpages, journal articles, books), created by different sources (e.g., different authors or publications), and containing no related or overlapping information. In contrast, an example of a soft boundary might be two distinct webpages with no source information provided discussing a similar or overlapping topic.

There is some evidence that the processing of text information is different following a passage break compared to when the text information is presented in a single passage without a break, which may indicate a that a passage break serves as a document boundary (Sonia et al., 2021). In a series of experiments, Sonia et al. (2021) investigated a text manipulation where an early inconsistency caused a later text anomaly to be detected earlier than it would have if the prior text had remained consistent. This effect was explained as an attention manipulation; the early inconsistency in the text served to increase readers attention to the text that followed, allowing them to detect the anomaly earlier in processing. Once this effect was established they investigated what might cause this manipulation of attention to be reset to a baseline. The results indicated that attention was not reset following several lines of filler text or a 5000ms pause in reading, however it was reset following a full passage break identical to the passage breaks at the end of each passage (i.e., with a comprehension question and reset to the "READY" cue for the reader to continue to the next passage when they are ready). Although Sonia et al. (2021) was not

directly investigating MD comprehension (because the detection of the semantic anomalies did not require the integration of information across multiple passages), the results suggest that the break in between the passages served a purpose beyond simply forcing readers to pause their reading. This break may have reset participants' attention to the passages, which could serve as a boundary between passages.

A further complication of MD comprehension relates to how readers evaluate any available source information about the documents they are reading, ranging from details about the type or reliability of the publication (e.g., a peer-reviewed journal article vs. an opinion piece) to its publication date (Bråten et al., 2009; Britt & Aglinskas, 2002; Rouet & Britt, 2011; Wiley et al., 2009; Wineburg, 1991). These activities are referred to as *sourcing*. Given their importance for MD comprehension, sourcing strategies have not only received the majority of the attention in MD research, but also formed the basis for many models of MD comprehension. The following sections will provide an overview of the most commonly cited theoretical models and frameworks on MD and then highlight some of the gaps in this research that will be addressed in the proposed project.

Theoretical Models of Multiple Document Comprehension

The Documents Model Framework

Arguably the most influential of frameworks conceptualizing how readers comprehend information from multiple documents to date is the Documents Model Framework (DMF; Britt et al., 1999, 2013; Britt & Rouet, 2012; Perfetti et al., 1999; Rouet, 2006). This framework was developed to understand how readers develop a coherent representation of information from multiple documents, especially when they contain conflicting information. In the DMF, it is assumed that the ability to integrate information from multiple documents is facilitated by the

readers' attention to source information. The framework suggests that there are two mental structures created beyond the mental representation (i.e., situation model) described in theories of single document processing: one is an *integrated mental model* of the global situation described by the documents. The integrated model includes information that is found only in one of the documents or is shared across multiple documents (Bråten et al., 2019). The other additional mental structure proposed in the DMF model is an *intertext model*, which uses source features (e.g., author, publisher) to create links between source information and the arguments presented (e.g., Author A claims...) as well as linking sources based on their argumentation (e.g., "Author A disagrees with Author B"). The concept of a mental representation is based on research of single-text processing. The assumption is that the basic processes involved in the formation of mental models are the same in MD processing as they are in single document processing, though this has not been directly tested.

The DMF provided the first attempt to explain how readers integrate information about multiple sources into a coherent representation. This framework builds off of theories about the nature of engaging with source information and therefore focuses on how readers integrate information about the sources (e.g., author, publication) into their mental representation of the text. Since this initial framework, many other frameworks have been developed expanding on the ideas presented in the DMF to provide a more complete understanding of the processes involved in MD reading tasks.

The MD-TRACE Framework

The Multiple Document Task-based Relevance Assessment and Content Extraction model (MD-TRACE; Rouet & Britt, 2011; 2012) focuses on understanding how a readers' goals interact with the process of information gathering. According to this model, readers' goals

(represented in a *task model*) guide the inquiry process through a series of five main steps. The first step is task construction, in which the reader interprets the goals of a given task based on instructions (i.e., develops the *task model*). For example, a student may be given the task to write an essay on the topic of global warming with the goal of understanding its causes. In the second step, the reader assesses their information needs. In the case of the global warming example, the student may need information on what global warming is as well as the potential causes. Once the information needs are understood the reader moves on to the third step, which involves selecting the documents, reading (i.e., processing), and integrating the information that they read. In the fourth step, the reader evaluates the product of this task (i.e., the information they have gained). For example, the student has written their essay on global warming and now evaluated what they have learned about its causes. In the fifth and final step, the reader assesses the quality of the product. The authors make it clear that a reader may cycle back to any of these stages at any point if they find that they are missing something from a previous stage. For example, if the student is in the fifth stage evaluating the quality of their essay and find it is lacking, they may go back to step three to find more sources.

One focus of the MD-TRACE model is understanding the internal and external resources that contribute to optimal comprehension. Internal resources are things such as general world knowledge (GWK), domain-specific knowledge, and evaluation strategies (i.e., search, sourcing, or processing strategies) that the reader brings to bear. External resources include task instructions, documents, search devices, and notes generated during the task (Rouet & Britt, 2011). The MD-TRACE model attempts to explain how the reader engages with the inquiry task and allows for the inclusion of many factors of the reader, text, and task that could influence comprehension. In this way, the model is quite broad.

However, this model is also quite limited in that it focuses on goal-driven processing that assumes that a reader has a clear task to complete beyond simple comprehension. There are cases where the reader may not have clear goals, such as when scanning through the news or browsing social media. Therefore, the MD-TRACE model is not able to capture the full range of tasks and contexts that require the integration of information from multiple documents. The current proposed experiments could provide findings that guide further research and study towards a more effective MD processing model.

The Integrated Framework of Multiple Texts

The recently proposed Integrated Framework of Multiple Texts (IF-MT; List & Alexander, 2019) builds off the previously described models. The goal of this framework is to account for the wide range of empirical work in how readers use and understand multiple documents. The IF-MT describes the process of MD inquiry in three stages: preparation, execution, and production. In the preparation stage, the reader conceptualizes the task in terms of its goals and requirements as well as how the reader feels towards the task (e.g., their motivation and attitudes). The execution stage is when the reader strategically processes the documents. And finally, in the production stage, the reader constructs the product required of the task (e.g., an essay or response). The IF-MT framework stands out from previous models in that it attempts to account for the influence of individual differences such as interest, attitudes, and MD proficiency. Readers with low interest in the task and/or weak comprehension skills will approach it in a disengaged way and as a result, are less likely to engage in sourcing activities. In contrast, readers who have high interest and/or proficient comprehension skills will be more engaged and more likely to effectively engage with source information.

The IF-MT also allows for the inclusion of prior knowledge as a predictor of comprehension, which is consistent with previous work on individual differences in MD comprehension (Bråten et al., 2009, 2014; Bråten & Strømsø, 2010a, 2010b). The IF-MT, MD-TRACE, and DMF are all models of MD comprehension that focus on the strategic processing of texts to complete an inquiry task. Although these models make important contributions to the field of MD comprehension, they do not account for non-strategic, passive text processing. A complete model of MD comprehension will combine both passive and strategic cognitive processes to develop a more complete understanding of the comprehension process.

The Discrepancy-Induced Source Comprehension Model

The models described up to this point have focused on the process of completing a task requiring the integration of multiple documents. Other models of MD comprehension have focused more specifically on situations in which readers encounter multiple sources presenting conflicting information, such as the Discrepancy-Induced Source Comprehension model (D-ISC; Braasch et al., 2012), which builds upon the DMF. This model focuses on how readers take source information into account and build a coherent representation that integrates information across documents, especially when the sources conflict with each other. Within the D-ISC model, it is assumed that comprehension proceeds passively, similar to how processing is described in memory-based models of single document comprehension (e.g., Cook & O'Brien, 1998; McKoon & Ratcliff, 1998; McKoon et al., 1996; O'Brien et al., 1998), and it is presumed that readers do not naturally attend to source information. This assumption fits with findings indicating that readers do not typically engage with source information under natural reading conditions (Britt & Aglinskas, 2002; Claassen, 2012; Wineburg, 1991). However, when the reader experiences a disruption in comprehension, such as when reading conflicting information

between documents, the reader engages in strategic processes to resolve the conflict. When attempting to resolve a conflict, the reader may turn to information about the sources of the conflicting documents and integrate it into their mental representation of the documents (Braasch et al., 2012; Braasch & Bråten, 2017; Bråten et al., 2018). This is supported by eye-tracking research showing that when a text is incoherent, readers spend more time fixating on source information (Braasch et al., 2012).

The New Literacies Framework

The New Literacies Framework is different from the previous models described in that it focuses entirely on reading from online sources (Kinzer & Leu, 2017; Leu et al., 2013). However, similar to the MD-TRACE (Rouet & Britt, 2011; 2012) model, it is assumed that the reader is approaching the MD task with a specific goal. The first step in this framework is for the reader to identify a specific question or problem that they would like to address (e.g., learning more about the causes of global warming). In the second step, the reader locates and reads information that might help address the question or problem (e.g., developing a set of search terms or scanning information from various websites). In the third step, the reader evaluates which information is reliable using relevant information (e.g., accuracy, reliability of the source, potential bias). Finally, the fourth step involves synthesizing the information found into a coherent understanding (Leu et al., 2013). One potential problem with this framework is that it outlines a very specific reading situation in which the reader has a clear question to answer while reading in online settings, which often occurs without a clear question or goal. In addition, the framework describes a strict sequence of events, whereas during natural processing readers will often violate this sequence.

Measuring On-line Multiple Document Comprehension Processes

All models of MD comprehension described in this chapter either assume that the basic cognitive processes established in single-text comprehension are operating similarly in MD comprehension or else ignore them entirely. Some models state the assumption that readers form a mental representation of each text in the set, such as the DMF (Britt et al., 1999, 2013; Britt & Rouet, 2012; Perfetti et al., 1999; Rouet, 2006) the IF-MT (List & Alexander, 2019) and the D-ISC model (Braasch et al., 2012). In addition, some models include additional representations such as an integrated mental model and intertext model (Britt et al., 1999, 2013; Britt & Rouet, 2012; Perfetti et al., 1999; Rouet, 2006) or the task model (Rouet & Britt, 2011; 2012). However, the necessary research has not been conducted to determine how these representations are formed or used during the on-line comprehension of multiple documents.

To date, the field of MD research has primarily focused on the use of measures that look at the strategic processing of documents. A commonly used measure of MD comprehension requires participants to write essays to demonstrate their understanding of information gathered from multiple sources (Bråten et al., 2009; Britt et al., 2000; Britt & Aglinskas, 2002; Wiley et al., 2009). For example, essay prompts used in multiple-document research include "What was the primary cause of the Salem Witch Trials?" (Britt et al., 2000) and "Write an essay about the causes, consequences, and or best solutions for the problem of climate change?" (Bråten et al., 2009). To answer this question, participants are given access to a selection of documents to read first. The documents are typically either presented by the researcher or selected by the participants via a search engine. Students are required to read and process the information from the documents and then use that information to construct an essay on a given prompt. The essays are then evaluated on many dimensions such as writing quality, use of source information, or arguments presented. These types of essay-writing tasks, although helpful for gauging learning

outcomes, occur off-line and involve many additional levels of knowledge and skills such as writing ability, vocabulary, argumentation, and organization that go beyond simple text processing (Allen et al., 2014; Graham & Perin, 2007).

Due to the difficulty of isolating the effects of different evaluation skills and strategies (i.e., writing skills, sourcing, argumentation) beyond simple text processing, the MD comprehension literature would benefit from using methods that are typically used in research with single documents such as passive on-line measures (e.g., reading times, eye-tracking). On-line measures provide insight into the cognitive processes that occur during reading. These processes cannot be accurately captured by off-line measures due to interference from strategic processes such as reasoning and evaluation, communication skill, and social influence. On-line passive cognitive processes are the foundation for text comprehension because they determine what information is encoded and integrated to form the readers' representation of the text. The representation that the reader builds during the process of reading directly impacts later strategic processing.

Measuring line-by-line reading times as opposed to other on-line and off-line measures allows us to measure disruptions in processing that occur due to previous inconsistent text information being reactivated and integrated with incoming information. Measuring reading times also allows us to capture processes involved in on-line comprehension without interrupting the reader or changing the nature of the reading task, like measures relying on think-alouds or self-monitoring. A limitation to reading times is that although they do a good job of indicating when information has been reactivated that has caused a disruption in processing, reading times cannot give us insight into the impact that the processing difficulty has on the reader's resulting representation of the text in memory. According to the two-stage model of validation proposed

by Richter & Maier (2017), readers monitor the consistency of incoming information against prior knowledge via a passive memory-based process, but once an inconsistency is detected, the reader may engage in strategic processing depending on their goals and motivations. In order to measure the memory representation that results from a reading task (and any strategic processing the reader has engaged in), researchers need to obtain off-line measures.

In an exemplary effort to capture the process of on-line text integration in a MD context using expository passages, Beker et al. (2016) looked at whether connections between documents are created spontaneously while reading and if these connections affect the memory representation of the texts after reading. They used a multiple-text integration paradigm based on the contradiction paradigm (Albrecht & O'Brien, 1993; O'Brien & Albrecht, 1992). Participants read sets of short (i.e., 5-sentence) expository-style passages based on made-up information so that participants' processing would not be impacted by their prior knowledge of the topic. See sample passages in Table 1. There were three conditions: consistent, inconsistent with explanation, and inconsistent without explanation. Reading times were measured on a target sentence (e.g., "It is not easy to spot the rulver in the white snow") that was the same across all three conditions. In the consistent condition, information consistent with the target sentence (e.g., that the rulver has white fur) followed by the target sentence were presented in a single passage. In both of the inconsistent conditions, inconsistent information (e.g., that the rulver has brown fur) followed by the target sentence were presented in the second text following a separate first text that either provided an explanation for the inconsistency (e.g., the rulver has brown fur that changes to white in the winter) or did not provide an explanation. Reading times on the target sentences were longer in the inconsistent without explanation condition compared to the inconsistent with explanation and consistent conditions. No difference in reading times were

Table 1.
Sample Passage from Beker et al. (2016)

Consistent:
The rulver's fur has a beautiful <u>white</u> color and is therefore very popular. Many hunters search for the rulvers. But in the winter they stop hunting the rulver. <u>It is not easy to spot the rulver in the white snow.</u> The hunters have to wait until the snow disappears.

Inconsistent With Explanation
<u>Text 1</u>
The rulver is an animal that lives on heathland. It has a pretty brown fur for which hunters can get a lot of money. But in the winter they stop hunting the rulver. *In the winter, the color of the rulver's fur changes to white.*

<u>Text 2</u>
The rulver's fur has a beautiful <u>brown</u> color and is therefore very popular. Many hunters search for rulvers. But in the winter they stop hunting the rulver. <u>It is not easy to spot the rulver in the white snow.</u> The hunters have to wait until the snow disappears.

Inconsistent Without Explanation
<u>Text 1</u>
The rulver is an animal that lives on heathland. It has a pretty brown fur for which hunters can get a lot of money. But in the winter they stop hunting the rulver. *The hunters have to get their money from another source to be able to get enough income.*

<u>Text 2</u>
The rulver's fur has a beautiful <u>brown</u> color and is therefore very popular. Many hunters search for rulvers. But in the winter they stop hunting the rulver. <u>It is not easy to spot the rulver in the white snow.</u> The hunters have to wait until the snow disappears.

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detected between the inconsistent with explanation and consistent conditions. These results indicate that when participants encountered the inconsistency, information from the previous text was reactivated and they were disrupted only when there was no explanation given to resolve the inconsistency.

In conclusion, research on MD comprehension to date has made great strides in understanding how readers gather and use information from multiple sources. Most of this work focuses on processes that occur outside of reading itself, such as judging the quality of sources or using information to form an opinion or argument. Because of this focus, the basic passive processes that occur during reading have been overlooked in MD research. Many models of MD comprehension assume that the basic processes involved in single-text comprehension operate in the same way in MD comprehension. These models are then expanded to include additional strategic processing of the text (i.e., sourcing and argumentation) based on those assumptions. However, it remains important to test the basic processing assumptions in MD reading contexts because there are critical differences in the level and nature of integration across multiple documents compared to within a single document. The following chapter will discuss early models of single document comprehension that introduced some important processing assumptions maintained in current models within the memory-based view.

CHAPTER II

EARLY MODELS OF SINGLE DOCUMENT COMPREHENSION

Comprehension requires a reader to encode each piece of incoming textual information, and to translate written words into meaningful concepts that are then incorporated into a memory representation of the text. How exactly this process occurs and what the resulting representation consists of has been a focus of comprehension research for decades (see O'Brien & Myers, 1999 for a review). The goal of early models of reading comprehension was to accurately capture the mental representation of the text that a reader builds (i.e., mental model) and to develop a process model that could produce that representation. Many of the fundamental assumptions of these models remain a part of current models of comprehension. In what follows, I will briefly review three prominent early views: The Kintsch and van Dijk model (1978), the Trabasso causal model (1985), and research in support of the situation model, which is more broadly incorporated in many comprehension models.

<u>Propositional Model</u>

One of the earliest and most influential models was Kintsch and Van Dijk's (1978) text-based model. The goal of the text-based model is to accurately capture the representation of the text itself and to develop a process model that could produce that representation. In this model, the text is represented by a set of interconnected propositions. A proposition is a basic idea unit present in the text, which is then connected to other propositions on the basis of argument overlap. Consider the following example:

  1. Lily went to the office.

  2. The office is where she works.

These two sentences are connected in memory because they share the argument "office." The connections made between propositions result in a hierarchical representation of the text in memory. This representation becomes more complex as the number of propositions and amount of argument overlap increases. Kintsch and Keenan (1973) provided support for the idea that propositions, rather than words or sentences, are vital to comprehension by showing that reading time and comprehension increased with the number of propositions regardless of the number of words.

In addition to describing the nature of the propositional representation, Kintsch and van Dijk (1978) also presented some processing assumptions that would lead to this type of representation. One pervasive assumption is that because memory is a limited capacity system, not all of these propositions can be held in active memory at once. In Kintsch and van Dijk (1978)'s model, a limited number of propositions are active in memory at any given time and processing occurs in a series of cycles. In each cycle, a reader encodes a subset of propositions (generally around 7-13) and then these propositions are connected to each other on the basis of argument overlap. Kintsch and Vipond (1979) introduced the leading-edge strategy, which explains how a reader can maintain the most important arguments in a text over many cycles. According to this strategy, a select subset of the most important or recent propositions will be maintained in a "buffer" and guide further comprehension of the text. If a novel argument is introduced that cannot be connected with active propositions, then comprehension is slowed and a reinstatement search for related arguments in long-term memory must be completed. Therefore, in this processing model, comprehension difficulty is due to a lack of argument overlap. However, it has been shown that a hierarchical representation fails to capture processing that

involves accessing that representation from long-term memory (O'Brien, 1987; O'Brien et al., 1990; 1995).

Despite being unable to fully capture the process of comprehension, Kintsch and Van Dijk's (1978) model provided basic processing assumptions that are still evident in current models of reading comprehension. Namely, the assumptions of a limited capacity memory system and the integration of encoded information with information in active memory. These basic processing assumptions are still evident in contemporary models decades later (e.g., The RI-Val model; O'Brien & Cook, 2016a; 2016b).

Causal Model

Further research on text representations found that causal connections between information in a text provide a better predictor of reading outcomes than argument overlap (O'Brien, 1987; O'Brien & Myers, 1987; Trabasso et al., 1984). This line of work led Trabasso and Sperry (1985) to develop a causal model in which the reader actively searches for causal connections between concepts, which are stored in a "causal chain." The causal model also subscribed to the assumptions of a limited memory capacity system in which only a select number of propositions are carried forward in active memory. However, they went further to say that the goals of the reader determined which propositions were maintained in active memory.

One limitation to this early model was that although it provided a potential representation of text, it failed to provide any processing assumptions that would lead to that representation. As a result, Fletcher and Bloom (1988) developed the "current-state selection strategy" (CSS), which combined a process model similar to the leading-edge strategy (Kintsch & Vipond, 1979) with the causal principles outlined by Trabasso and Sperry (1985). In the CSS model, instead of the most recent and important propositions being held in the buffer, causal relations are

maintained in the buffer. Propositions are held in active memory until they can be incorporated into the causal chain. When a proposition is encountered that cannot be causally linked to any information that is currently active in memory, the authors claimed that the reader would resort to conducting an active search of long-term memory until a link is found.

In another attempt to understand the process of forming a causal representation, Langston and Trabasso (1999) developed a two-step model to predict what information would be available to the reader during comprehension. In this model, each clause is represented by a node that is connected to other nodes through causal links. To determine which nodes will remain active, the causal relations that a reader might infer in the text are identified through a discourse analysis. The activation of each node and the connections between them is continuously updated over the course of reading. In an extension of this two-step model, Trabasso and Wiley (2005) proposed that the formation of a causal representation is driven by the goals of the protagonist. According to this model, the reader tracks the protagonist's actions and updates the representation based on their relation to the protagonist's goals. The reader will also compare the goals of the protagonist to their general world knowledge (GWK) in order to make predictions about what the protagonist may do. These predictions form the causal network that guides further comprehension.

These causal models were the first to attempt to understand how readers form connections between ideas beyond what is explicitly stated in the text and how these inform their representation. This was an important first step in broadening our understanding of the connections that individuals make while reading. Although causal models were investigated mainly in single document contexts, it seems likely that situations occur in which a reader must form causal connections across multiple documents in order to maintain coherence.

<u>The Situation Model</u>

As models of comprehension continued to broaden our understanding of the representations that readers create, their focus shifted to not only capturing processes that lead to a representation of the text, but also to understand what is included in that mental representation. The mental representation that a reader maintains is often referred to as the situation model or mental model (e.g., van Dijk & Kintsch, 1983; Zwaan & Radvansky, 1998). Most theories regarding the development of the situation model adopted the basic processing assumptions of the text-based and causal models. That is, these theories assumed that due to the limits of active memory capacity, only a select amount of information was carried forward in active memory while reading. They also maintained the basic assumptions that incoming information is integrated with information active in memory, and that when textual information is not enough to form causal connections, the reader fills in the gaps through inferences or predictions. Situation model theories then expanded upon these processing assumptions by attempting to understand the nature of the representation that is formed while reading. Bransford et al. (1972) were the first to present convincing evidence that readers construct some representation of the situation described by a text. For example, consider these sentence pairs from Bransford et al. (1972):

1a: Three turtles rested on a floating log, and a fish swam beneath them.

1b: Three turtles rested on a floating log, and a fish swam beneath it.

2a: Three turtles rested beside a floating log, and a fish swam beneath them.

2b: Three turtles rested beside a floating log, and a fish swam beneath it.

The text-based representations of the sentence pairs only differ by one proposition: the pronoun at the very end of the sentences. However, the variation in the first set of sentences results in the same mental representation for each sentence, while the variation in the second set results in a

different mental representation for each sentence. Participants were asked to memorize one of the two sentences and then later asked to pick which one they had memorized out of the two variations. Bransford et al. (1972) found that it was more difficult for participants to discriminate between the first set, while they had less difficulty determining which sentence they had studied in the second set. That the reader had a harder time distinguishing between sentences with the same meaning indicates that a reader must develop a mental representation of the situation described in the text, not just the propositions themselves.

Glenberg et al. (1987) proposed that the creation of a situation model is a continuous process. The reader is constantly assessing and updating their mental model of the text based on their linguistic, practical, and world knowledge. For example, Glenberg et al. (1987) presented participants with passages such as the one in Table 2. In one version of the passages, an object was spatially associated with the main character (e.g., John puts on his sweatshirt) while in the other version the object was spatially dissociated (e.g., John takes off his sweatshirt). Using a reaction time probe, they found that the associated objects were more available in memory after the conclusion of the passage than the dissociated objects. This result provides evidence against a propositional representation of the text (e.g., Kintsch & van Dijk, 1978). The propositional representation of these two texts is identical; if the readers only maintain the propositional structure in memory there should be no difference in the availability of the target objects. The results of Glenberg et al. (1987) instead support a situation model account in which the reader maintains a representation of the situation being described by the text and updates that situational representation as new information is encoded. For example, the sweater was part of the model when John kept it on, and therefore was available in active memory at the probe time.

Table 2.

Sample Passage from Glenberg et al. (1987)

Setting Sentence:
John was preparing for a marathon in August.

Critical (associated):
After doing a few warm-up exercises, he put on his *sweatshirt* and went jogging.

Critical (dissociated):
After doing a few warm-up exercises, he took off his *sweatshirt* and went jogging.

Filler:
He jogged halfway around the lake without much difficulty. Further along his route, however, John's muscles began to ache.

Question:
Was the marathon schedule to be held in the summer?

Conversely, when he took the sweater off, it was no longer relevant to the model and was less available when probed.

Given the compelling evidence that a reader maintains a representation of the situation described by a text beyond a simple propositional representation and that this representation is updated as reading occurs, many researchers have continued to investigate the types of information that might be maintained in the situation model. Researchers have found evidence for a wide range of information including spatial information (Glenberg et al., 1987; Cook et al., 2007; Morrow et al., 1987), goal-related information (Huitema et al., 1993), protagonist-relevant information (Black et al., 1979; Bower & Morrow, 1990; Glenberg et al., 1987; O'Brien & Albrecht, 1992), and information regarding character's emotions (Gernsbacher et al., 1992; Gernsbacher & Robertson, 1992).

Zwaan and colleagues (Zwaan, 1999; Zwaan et al., 1995a; Zwaan et al., 1995b; Zwaan & Radvansky, 1998) developed the event-indexing model in an attempt to explain how readers update the situation model while reading. They proposed that the reader actively tracks the goals and actions of the protagonist and updates their representation of the text based on five dimensions: time, space, protagonist, causality, and intentionality. As each line of text is processed, its congruence with information presented earlier in the text is evaluated along each dimension. If there is a change along one or more of those dimensions, the situation model is updated to reflect that change. According to this model, readers always maintain a fully up-to-date situation model. Another assumption of this model is that when any of the five dimensions are incongruent with the previous text, a coherence break occurs. When this happens the reader strategically searches long-term memory for any information that can help reestablish coherence. There is evidence that readers are sensitive to time (Zwaan, 1996; Anderson et al., 1983), space

(Glenberg et al., 1987; Singer et al., 1994; Morrow et al., 1989; de Vega, 1995), protagonist (Sanford & Garrod, 1981; Carreiras et al., 1996), causality (Singer & Halldorson, 1996; Singer et al., 1992; Duffy et al., 1990; Keenan et al., 1984; Myers et al., 1987), and intentionality (Lichtenstein & Brewer, 1980).

Although current models of text processing have expanded on the models presented in this chapter to capture the nature and process of mental representations more accurately, they have maintained some of the basic assumptions from these early models. All current models of reading comprehension begin with the assumption that the reader is constructing some form of mental model (or situation model) of the text. Many also maintain the assumption that the model is built through a process of encoding incoming information with information previously stated in the text and the readers' GWK to update the mental model as new information becomes available (e.g., O'Brien et al., 1998). The processes of encoding and updating are assumed to operate within the confounds of a limited capacity memory system in which only a limited number of arguments can be maintained in active memory at any given time (i.e., Kintsch & Van Dijk, 1978). The following chapter will present the principles of and support for the memory-based view that builds off of the basic processing assumptions of the early models.

CHAPTER III

THE MEMORY-BASED VIEW OF READING COMPREHENSION

Memory-based models are designed to capture as much of the comprehension process as possible using strictly passive processing assumptions, avoiding any appeal to strategic processes. Relying on passive on-line processes allows us to understand how the basic cognitive processes, such as memory and attention, are involved during reading. This understanding can then form a solid theoretical basis on which to build models of comprehension. In this chapter, I will discuss several memory-based models and their basic assumptions. Most current memory-based models have focused on the comprehension of single documents, often using very controlled narrative passages. The goal of this chapter is to provide the background necessary to argue that the memory-based approach should be applied more broadly to a range of reading contexts, specifically multiple document (MD) comprehension. These contexts will be expanded upon in Chapter IV, thus framing the goals of the current experiments.

One of the major assumptions that forms the foundation for all memory-based views is that memory activation occurs via a passive retrieval mechanism. Ratcliff (1978) first introduced the concept of a fast-acting, passive retrieval process. To conceptualize this retrieval process, they used the metaphor of a tuning fork. When a tuning fork is hit, it sends out waves of frequencies in all directions. If the waves were to reach other tuning forks that share frequencies in common, those tuning forks would begin to vibrate (i.e., resonate) in response. Within the context of memory retrieval, activation occurs when the current concept being encoded sends out a signal to all of memory. This signal is passive, unrestricted, and "dumb," meaning any number of nodes can become activated simply on the basis of conceptual overlap. This type of retrieval

mechanism allows for large amounts of information to be readily accessible while only a limited subset of information remains in active memory, meeting the requirements of a limited capacity memory system.

<u>The Construction-Integration Model</u>

      Kintsch's (1988) Construction-Integration (C-I) model is one of the most influential and complete models of reading comprehension. The construction-integration model was one of the first to incorporate memory retrieval as a passive mechanism into a model of text processing. During construction, the first stage of processing, information from the text as well as the readers' general world knowledge (GWK) is activated through a passive retrieval mechanism as described by Ratcliff (1978). Incoming information from the text sends out a signal to all of memory and any related nodes are activated and returned to active memory. Kintsch (1988) identifies four sources of information that could be activated: the current proposition or line of text, the previous proposition or line of text, the past text, and GWK. In the second stage of the C-I model, integration, activation stabilizes, and concepts that have been strongly activated are maintained in the active portion of the discourse representation, while concepts that are not strongly activated are dropped. These two processes (construction and integration) are assumed to be cyclical in nature such that the concepts that are maintained in the active portion of the discourse representation continue to send out signals to all of memory, thus activating related nodes and integrating them with those in active memory throughout the act of reading.

      Evidence supporting this processing view comes in part from research demonstrating that concepts are activated from memory on the basis of featural overlap (Cook et al., 1998; O'Brien & Albrecht, 1991; Long & Lea, 2005). The more features that a concept shares with information in the active portion of the discourse representation, the more likely it is to become active.

Consider, for example, O'Brien and Albrecht (1991), in which participants read passages containing varied amounts of contextual support for a target concept. See sample passage in Table 3. In the example, the two possible antecedents were "skunk" or "cat." In the high context version, the event was described using rich contextual cues supporting one of the concepts (i.e., skunk). The low context version did not provide any conceptual support for "skunk" over "cat," allowing the reader to infer either. After a reinstatement sentence, participants were asked to name aloud either the target concept (skunk) or the associated concept (cat). O'Brien and Albrecht (1991) found that in the high context version, naming times for the high related concept (skunk) were faster than the low related concept (cat) and naming times for both were faster than any unrelated concepts. In the low context version, there were no naming time differences found between the low-related, high-related, or unrelated concepts. These results provide evidence that featural overlap is a critical component in what is activated from long-term memory, thus supporting the C-I models processing assumptions. Most recent memory-based models incorporate and expand upon the basic assumptions of the C-I model, especially regarding the passive nature of the retrieval process and cyclical nature of processing.

The Resonance Model

The resonance model (Myers & O'Brien, 1998; O'Brien & Myers, 1999) directly expanded on the concept of memory retrieval being a passive process originally proposed by Ratcliff (1978). According to the resonance model, concepts that are being read—as well as those that are currently in working memory—serve as signals to all of long-term memory, which includes both previous information from the text and GWK. Information that resonates the most (based on shared features with the outgoing signal) is returned to active memory and has the potential to influence further processing. It is important to note that this resonance process is

Table 3.
Sample Passage from O'Brien and Albrecht (1991)

Mary was driving in the country one day

High Context:
When she smelled a terrific odor.

Low Context:
And she gazed at the setting sun as she went.

Suddenly a small black (skunk/cat)

High Context:
With a white stripe down its back

Low Context:
With a long furry tail

Ran in front of her car. Mary knew she couldn't stop in time. However, she hoped she managed to miss the animal and continued on her way. After a while, she noticed she was low on gas. While at the gas station, the attendant asked her what had run in front of her car.

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passive in that it is beyond the readers' control, unrestricted in that it goes out to all of memory, and "dumb," meaning that any related concepts have the potential to be reactivated even if they are not relevant to the current input.

A large body of research has accumulated over the years supporting the idea of memory activation being passive and non-strategic. Much of this utilizes the contradiction paradigm developed by O'Brien and colleagues (Albrecht & O'Brien, 1993; Cook et al., 1998; O'Brien & Albrecht, 1992; O'Brien et al., 1998). The contradiction paradigm directly assesses what information is available to the reader during comprehension and the influence of that information. This protocol measures reading times on target sentences that are either consistent or inconsistent with information stated earlier in the text. It has been well established that when a reader encounters inconsistent information, a disruption occurs that is measurable by a slowdown in reading times (Albrecht & O'Brien, 1993; Cook et al., 1998; O'Brien et al., 1998; O'Brien & Albrecht, 1992). Using this paradigm, it is possible to determine what information is activated while reading and the effect that it has on comprehension.

In a test of the resonance model, Albrecht and O'Brien (1993) investigated whether readers would notice a contradiction between a statement in a passage and previously stated text information even when incoming text remained locally coherent. They created passages in which the introduction elaborated on a critical characteristic of a protagonist (e.g., Mary is a strict vegetarian). See sample passage in Table 4. After the character description, this critical information was backgrounded by several lines of filler text so that it was no longer active in memory. Then the target sentence (e.g., Mary ordered a cheeseburger) was presented, which was either consistent, inconsistent, or neutral with the information elaborated on in the introduction. The target sentences were locally coherent, meaning that they did not contain any surface-level

Table 4.
Sample passage from Albrecht and O'Brien (1993)

Introduction:
Today, Mary was meeting a friend for lunch. She arrived early at the restaurant and decided to get a table. After she sat down, she started looking at the menu.

Consistent Elaboration:
This was Mary's favorite restaurant because it had fantastic junk food. Mary enjoyed eating anything that was quick and easy to fix. In fact, she ate at McDonalds at least three times a week. Mary never worried about her diet and saw no reason to eat nutritious foods.

Inconsistent Elaboration:
This was Mary's favorite restaurant because it had fantastic health food. Mary, a health nut, had been a strict vegetarian for 10 years. Her favorite food was cauliflower. Mary was so serious about her diet that she refused to eat anything that was fried or cooked in grease.

Neutral Elaboration:
This was Mary's favorite restaurant because it has a nice quiet atmosphere. Mary frequently ate at the restaurant and had recommended it to all of her friends. She especially liked the cute tables and the country style cloths on them. It made her feel right at home.

Filler:
After about 10 minutes, Mary's friend Joan arrived. It had been a few months since they had seen each other. Because of this Mary and Joan had a lot to talk about and chatted for over a half hour. Finally, they signaled the waiter to come take their orders. They checked the menu one more time. Mary and Joan had a hard time deciding what to have for lunch.

Critical Sentences:
Mary ordered a cheeseburger and fries.
She handed the menu back to the waiter.

Closing:
Her friend didn't have as much trouble deciding what she wanted. She ordered and they began to chat. They didn't realize there was so much for them to catch up on.

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errors and made sense within the context of the previous few sentences. For the reader to detect that there was something wrong with the target sentence in the inconsistent condition, they would need to reactivate the information that Mary was a vegetarian from their mental representation of the text as well as the understanding from the readers' memory that a vegetarian would not eat a cheeseburger. Albrecht and O'Brien (1993) found that there was a slowdown in reading times in the inconsistent condition compared to the consistent and neutral conditions. These results provided evidence that even when the incoming text was locally coherent, previous text information was being reactivated and impacting processing.

O'Brien et al. (1998) provided even stronger evidence that the resonance process is passive, unrestricted, and "dumb" by adding a qualified elaboration section to the passages from Albrecht and O'Brien (1993), in which the critical characteristic was described as being true at one point but no longer relevant (e.g., Mary used to be a strict vegetarian but is not anymore). Even with the qualified elaboration, readers were disrupted in the inconsistent condition compared to the consistent. Since the resonance process is "dumb," information that shares features in common with Mary's eating habits still resonate, even though it might not be correct.

Further convincing evidence for the activation and influence of related but outdated information was demonstrated by O'Brien et al. (2010). Participants read passages in which a character underwent an irreversible change in state (e.g., a tree getting cut down). See sample passage in Table 5. An irreversible change in state reflects the most outdated a piece of information could be. The target sentence described the outcome of that change in state (e.g., "all that remained of the tree was a stump"). In the consistent condition, the tree was cut down. In the inconsistent condition, the tree was considered to be cut down but was not. Finally, in the qualified condition, it was decided that the tree would not be cut down but due to unforeseen

Table 5.
Sample passage from O'Brien et al. (2010)

Introduction:
Susan was writing her first novel from her study at home.

Consistent condition:
Her study was on the second floor and she had a beautiful view from one of the widows facing the backyard. She loved to sit and think about what she wanted to write while looking out the window at a graceful old oak tree. When her husband wanted to cut it down she reluctantly agreed with him. They both thought it was a tragedy that such a beautiful tree had to be taken down. Still, they had it cut down and removed.

Inconsistent condition:
Her study was on the second floor and she had a beautiful view from one of the widows facing the backyard. She loved to sit and think about what she wanted to write while looking out the window at a graceful old oak tree. Once her husband wanted to cut it down but she stopped him. She thought it would be a tragedy if such a beautiful tree were taken down. He agreed and decided not have it cut down and removed.

Qualified condition:
Her study was on the second floor and she had a beautiful view from one of the widows facing the backyard. She loved to sit and think about what she wanted to write while looking out the window at a graceful old oak tree. Once her husband wanted to cut it down but she stopped him. She thought it would be a tragedy if such a beautiful tree were taken down. He agreed and decided not to have it cut down and removed. Soon afterwards, however, the tree was struck by lightning and had to be cut down.

Filler:
Susan really wanted to focus on working on her novel. She had already outlined the plot and developed her characters. Today, though, she was suffering from a bad case of writer's block. She just could not decide what she wanted to write next. While she was thinking, she got up and went over to look out the window.

Target sentence 1:
All that remained of the tree was a stump.

Target sentence 2:
Susan missed seeing the tree in her yard.

Closing:
She decided to plant a new tree in the same spot in the spring.

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circumstances, it had to be cut down anyway. The reading times showed a slow-down on the

target sentence in both the inconsistent and qualified conditions. Thus, even when an object

underwent an irreversible change in state, related but outdated information (e.g., that a character

previously decided not to cut down the tree) was still activated and disrupted comprehension.

This study provides perhaps the most compelling evidence for passive, unrestricted, and "dumb"

nature of the passive retrieval mechanism. The resonance model can account for many situations

in which related information is reactivated and impacts processing without the need to rely on

active or strategic processes.

It is important to note that the resonance model is not in itself a model of reading

comprehension: it is a memory access mechanism that when incorporated into a larger model can

begin to explain how information from long-term memory becomes available to a reader.

Although memory retrieval as a passive mechanism is widely accepted in models of reading

comprehension, it has not been fully explored in the context of MD processing. The evidence

supporting the resonance view demonstrates that the activation of related information in memory

while reading a text is unrestricted, and further, any information from memory related to the

incoming text can be reactivated and impact comprehension. It is a valid assumption to make,

then, that information encoded from a previous text has the potential to be reactivated by

information presented in a separate document. However, this has not been tested directly and the

impacts on comprehension are still to be explored.

The RI-Val Model

Most current theories of reading comprehension use a two-stage model similar to

Kintsch's (1988) Construction-Integration model. Recently, Cook and O'Brien (2014; O'Brien &

Cook 2016a; 2016b) proposed the RI-Val model, which adds an important third stage to these

previous models: validation. The necessity of a validation stage stems from the argument that the two-stage model does not account for the impact of information beyond the text itself, such as the readers' GWK. For example, Cook and Guéraud (2005) pointed out that the text contradictions used in Albrecht and O'Brien (1993) (see sample passage in Table 4) are not anomalous at the level of the text itself. For example, the sentence "Mary orders a cheeseburger" is only inconsistent with "Mary is a vegetarian" if readers access their previous knowledge that vegetarians do not eat meat and that a cheeseburger contains meat. This indicates that a mechanism for "checking" incoming information against information reactivated from memory is necessary to explain these types of processing disruptions (Cook, 2014; Cook & O'Brien, 2014; Isberner & Richter, 2014; Singer, 2006, 2013; Singer & Doering, 2014).

In the RI-Val model, there are three asynchronous and parallel processes: resonance (R), integration (I), and validation (Val). As described earlier, resonance is assumed to be a passive, unrestricted, and "dumb" activation mechanism. Any information that is activated above a minimum threshold is then linked with the contents of active memory in the integration stage. The linkages are formed on the basis of goodness of fit (i.e., semantic overlap), with greater overlap resulting in easier integration. In the validation stage the information that has been integrated is validated (i.e., checked) against all information currently available to the reader via a simple, passive, pattern-matching process based on Reder's featural familiarity hypothesis (e.g., Kamas et al., 1996; Kamas & Reder, 1995; Reder & Cleeremans, 1990; Reder & Kusbit, 1991). Thus, it is assumed that the linkages are matched against all activated information (both context and GWK on the basis of featural overlap. Rather than relying on an absolute match, the level of "match" is determined by the degree to which the linkages share common features with activated content. If the linkages match well, then reading continues uninterrupted, but when the

match is poor, reading is disrupted (O'Brien & Cook 2016a; 2016b). A disruption is typically

evidenced by a slow-down in reading times on the sentence containing the incorrect or

inconsistent information (i.e., the target sentence), but because validation is a continuous process

it can take time for enough information to accrue in order to signal a disruption, and the

disruption may occur after a reader has moved on from the target sentence.

The RI-Val view provides an elegant and empirically testable model by which a coherent

representation of a text is updated and maintained. There are several key assumptions within the

RI-Val model. One assumption is that all three processes (i.e., resonance, integration, and

validation) are passive, meaning they operate outside the control of the reader. In addition, it is

assumed that the three processes are asynchronous in that they are initiated at different times,

with each process operating on the output of the previous stage. However, once all three

processes have started, they run in parallel to completion.

Initial support for the RI-Val model was demonstrated by Cook and O'Brien (2014), who

found that the strength of the connection between the current text and information in GWK can

affect the degree of processing difficulty caused by inconsistency. In a manipulation of the

passages from Albrecht and O'Brien (1993), Mary is described as a vegetarian and then either

orders a "cheeseburger" (high-related condition) or a "tuna salad" (low-related condition). See

sample passage in Table 6. In the high-related condition, reading times were slower on the target

sentence for the inconsistent condition compared to the consistent condition. In the low-related

condition, the inconsistency effect was delayed to a spillover sentence (i.e., the sentence after the

target, measured to capture any delayed processing effects). This difference between the low-

related and high-related conditions is due to the strength of the connection between the critical

information in memory. The connection between "cheeseburger" and "meat" as well as "meat"

Table 6.
Sample passage from Cook and O'Brien (2014)

Introduction:
Today Mary was meeting a friend for lunch. She arrived early at the restaurant and decided to get a table. After she sat down, she started looking at the menu.

Consistent Elaboration:
This was Mary's favorite restaurant because it had fantastic meat dishes. She enjoyed eating anything that was quick and easy to fix. In fact, she ate at McDonald's at least 3 times a week. She never worried about her diet and saw no reason to limit what she ate.

Inconsistent Elaboration:
This was her favorite restaurant because it had fantastic health food. She, a health nut, had been a strict vegetarian for 10 years. Her favorite food was cauliflower. She was so serious about her diet that she refused to eat anything which was fried or cooked in grease.

Filler:
After about ten minutes, Mary's friend arrived. It had been a few months since they had seen each other. Because of this they had a lot to talk about and chatted for over a half hour. Finally, Mary signaled the waiter to come take their orders. Mary checked the menu one more time. She had a hard time figuring out what to have for lunch.

Target Sentences:
High Related: Mary decided to order a cheeseburger.
Low Related: Mary decided to order a tuna salad.
She handed the menu back to the waiter.

Closing:
Her friend didn't have as much trouble deciding what she wanted. She ordered and they began to chat again. They didn't realize there was so much for them to catch up on.

Probe for Experiment 2 and 3:
Mary was a strict vegetarian.

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and "vegetarian" are very strong, and when the target sentence is encountered these concepts are quickly activated and result in an immediate disruption. In the low-related condition, the connection between "vegetarian" and "tuna salad" is weaker, and because of this weakened connection, the disruption is delayed, not showing up until the spillover sentence. Cook and O'Brien (2014) also used verification probes to verify that it took longer for critical concepts to become available to the reader when the connections were weaker.

Cook (2014) demonstrated further support for the assumptions of the RI-Val model through the processing of anomalous anaphors. Participants read passages in which a target sentence reinstated an antecedent (e.g., cello). See sample passage in Table 7. Given what was stated earlier in the text, this was either the correct antecedent (e.g., cello), an incorrect but highly related antecedent (e.g., violin), or an incorrect and low-related antecedent (e.g., oboe). Reading times for the reinstatement sentence were fastest in the correct condition compared to both incorrect conditions, and they were also faster for the incorrect but highly related condition than the incorrect and low-related condition. This suggests the level of conceptual overlap in GWK had a facilitating effect on the process of integration. They also found a significant slowdown in reading times on the spillover sentence in both of the incorrect conditions compared to the correct. This is assumed to be due to the continuation of the validation process after the reader moves on in the text. A failure in the integration process delays reading times on the target sentence, but the anomaly is not resolved at the point in which the reader moves to the spillover sentence, causing reading times to be slower on the sentence after reinstatement as well. This is a situation in which the validation process may fail, and the reader would be left with an incomplete representation of the text.

Table 7.
Sample passage from Cook (2014): Experiment 1

Introduction:
Terry loved classical music. She spent most of her waking hours listening to it, either in her room or in the car.

Correct Antecedent:
Terry decided that it would be fun to teach herself how to play. She drove to a music shop located in the next town. As she entered the store she saw a beautiful cello. The large instrument was almost bigger than she was. Terry decided she wanted to learn how to play it. She imagined herself sitting down to play the heavy instrument. Terry asked the salesman for a price. After thinking for a few minutes, she decided to buy it that afternoon.

Incorrect–High-Overlap Condition:
Terry decided that it would be fun to teach herself how to play. She drove to a music shop located in the next town. As she entered the store she saw a beautiful violin. It was very lightweight and fit perfectly between her chin and shoulder. She imagined herself dancing as she played beautiful music. Terry asked the salesman for a price. After thinking for a few minutes, Terry decided to buy it that afternoon.

Incorrect–Low-Overlap Condition:
Terry decided that it would be fun to teach herself to play. She drove to a music shop located in the next town. As she entered the store she saw a beautiful oboe. The keys were bright and shiny, and the case was lined in black velvet. Terry decided she wanted to learn how to play it. She imagined herself fingering the keys to create perfect notes. Terry asked the salesman for a price. After thinking for a few minutes, she decided to buy it that afternoon.

Background:
When Terry arrived home she found a message on her answering machine from her friend Jill. Because Terry hadn't spoken to Jill in over a week, she decided to invite her over for coffee. When Jill came over, she told Terry that she had a new boyfriend. After chatting about Jill's new boyfriend for a while, Jill asked Terry about what was new with her.

Reinstatement and Spillover Sentences:
Terry showed her the cello she bought. She even tried to play a few notes.

Closing:
Terry told Jill that she was going to start practicing that very evening.

The final assumption of the RI-Val model is that the reader maintains a coherence threshold. The coherence threshold is defined by Cook and O'Brien (2016a & 2016b) as the point at which the degree of "match" obtained during the validation process has resulted in a sufficient level of coherence for the reader to move on in a text. There may be cases in which the reader moves on in the text before the validation process has time to make available critical (and possibly contradictory) information from GWK. An example of this is found with the low-related condition in Cook and O'Brien (2014). When the connection between the concepts was weak (e.g., "meat" and "tuna"), the disruption was not measurable until the sentence after the target (i.e., on the spillover sentence).

The coherence threshold could be considered a subcomponent of the broader idea of 'standards of coherence' (Van den Broek et al., 1995; 2002; 2011). Standards of coherence refers to the types and levels of coherence that a reader seeks to maintain during reading. The readers' standards of coherence determine whether the reader feels that comprehension is sufficient to move on in the text or if they engage in strategic processes. Standards of coherence can be influenced by many factors, including a readers' effort and goals, level of attention, individual differences in reading skill or knowledge, and differences in the texts or task demands (Kaakinen & Hyona, 2005; Linderholm & van den Broek, 2002; Linderholm & Zheo, 2008; McCarthy & Goldman, 2015; van den Broek et al., 2001). These characteristics can be either explicit or implicit, meaning they can occur with or without conscious awareness or control on the part of the reader. The automatic processes such as those described by memory-based researchers are typically used to maintain coherence, but when those automatic processes fail, it is assumed that strategic processes will be initiated to maintain the standards of coherence (van den Broek et al., 1995, 2002, 2011).

The coherence threshold proposed by the RI-Val view reflects only a subcomponent of this concept as there are several aspects of standards of coherence that are not explainable by the basic assumptions of the coherence threshold, namely the relationship with reader-initiated strategies and what happens when comprehension fails. Within the assumptions of a passive validation process, the coherence threshold is simply a point in time on this continuous process. If the coherence threshold is set high (i.e., later in time) then the reader will wait longer for the validation process to accumulate a higher degree of match (or level of comprehension) before moving on in the text. If the coherence threshold is set low (i.e., earlier in time) then the reader will move on before the validation process has had the opportunity to run to completion.

Several recent studies have investigated ways to manipulate the coherence threshold through influencing the readers' level of attention during reading (Creer et al., 2018; Sonia & O'Brien, 2021; Williams et al, 2018). Creer et al. (2018) and Williams et al. (2018) both used a manipulation of the task demands, asking participants more comprehension questions (three, when typically, participants are only asked one) after reading each passage so that the reader would need to attend more to the passages and require a greater level of comprehension, increasing their coherence threshold. To test whether raising the coherence threshold led to a difference in comprehension, Williams et al. (2018) used semantic anomaly passages in which they demonstrated that under normal reading conditions, a disruption in processing was delayed to the spillover sentences. Semantic anomalies are a phenomenon in which readers fail to detect incorrect information when it is semantically related with its correct alternative (Erickson & Mattson, 1981; Kamas et al., 1996; Reder & Cleeremans, 1990; Reder & Kusbit, 1991; Williams et al., 2018). For example, when reading the sentence "Moses brought two animals of each kind on the ark," participants routinely fail to notice the incorrect term "Moses" because it is

semantically related to the correct term Noah in memory. Williams et al. (2018) demonstrated that when target sentences (such as the example above) are embedded in passages containing many mentions to shared features that are supportive of both the correct and incorrect terms (e.g., "Bible," "Old Testament," and "religious figures"), the disruption in processing due to the incorrect term is not evident until the reader has moved on to the spillover sentence. Due to this established delayed effect, these passages provide a good opportunity to test the manipulation of the coherence threshold. When Williams et al. (2018) raised the coherence threshold by asking more comprehension questions after each passage, the effect of the semantic anomaly appeared on the target sentence indicating that raising the coherence threshold increased attention and led to faster detection of the anomalies.

Sonia and O'Brien (2021) demonstrated a manipulation of the coherence threshold within the text itself without changing the demands of the task. A sample passage is provided in Table 8. This was done by including an inconsistency prior to the semantic anomaly in a modified version of the passages used in Williams et al. (2018). The first half of every passage was in the format of the traditional contradiction paradigm, in which an introduction is either consistent or inconsistent with information in a later target sentence. The second half of each passage contained a semantic anomaly. Sonia and O'Brien (2021) demonstrated that when participants were disrupted by the inconsistent information in the first half of the passage, the disruption from the semantic anomaly was measurable earlier in processing (i.e., on the target sentence). When the first half of the passage was consistent, the disruption from the semantic anomaly was delayed (i.e., appearing on the spillover sentence). These results provide evidence that an inconsistency in the text served to increase the readers' coherence threshold, raising their attention to the text, and affecting their processing of subsequent text.

Table 8.
Sample Passage from Sonia and O'Brien (2021)

Consistent Introduction:
Tom taught a Bible studies class at his local church. He loved giving lectures and helping people in their religious pursuits. His favorite part of the job was discussing and analyzing the Bible. He always felt a sense of mysticism when he opened that ancient text that had been written so long ago. Tom was a good teacher and the people in his church love to ask him questions.

Inconsistent Introduction:
Tom wanted to be a Bible studies teacher, but it was impossible because his church was too small to offer classes. Still, he loved going to church and engaging in religious pursuits. Even though he didn't end up teaching about the Bible, he still enjoyed discussing and analyzing it. He always felt a sense of mysticism when he opened that ancient text that had been written so long ago.

Background:
Tom was an avid reader who enjoyed many different kinds of magazines and books. There were piles of books all over his house and a bookshelf in every room. Each morning, Tom started his day by eating a bowl of cereal and reading. One morning when Tom got up to start his day he found that he had more time than usual. He did not need to be into work early, so he took his time getting up and making breakfast.

Target Sentence: He would use this time to plan his next Bible class.

Spillover Sentence: Tom sat down with his breakfast and started to plan.

High Context:
Tom decided to read some of the Bible. He began with the Old Testament and the many stories found within its chapters. Tom read about the beginning of mankind and a great flood that God had used to punish His people. Tom was devotedly religious, and he thought that by reading about prominent religious figures he would better understand his own faith and be more knowledgeable for discussions with members of the church.
One new piece of information Tom learned was that

Target Sentence: Noah/Moses brought two animals of each kind on the ark.

Spillover Sentence: Tom enjoyed learning about the ark in the Bible.

Closing
Eventually, Tom's eyes grew tired and he got up to take a break. He packed his bags for work and thought about all the interesting things he had read about.

Question
Does Tom start his day with a bowl of cereal?

In a further investigation of this, Sonia and O'Brien (2021) attempted to see if the coherence threshold might reset back to a baseline either over time, following a pause in reading, or after a passage break. If the coherence threshold resets following any of these interventions, the effect of the inconsistency causing the semantic anomaly to be detected faster would disappear (i.e., the semantic anomaly would be detected on the spillover sentence even when the beginning of the passage contained an inconsistency). The results of this series of experiments showed that only a full passage break including a comprehension question (i.e., the type of break that indicates the end of one passage and beginning of another) placed in between the two passage halves was enough to reset the coherence threshold and cause the semantic anomaly effect to be delayed to the spillover sentence in both consistent and inconsistent conditions.

Although Sonia and O'Brien (2021) focused on single narrative passages, the finding that the coherence threshold reset following a passage break has important implications for MD processing. When a passage break was placed between the two passage halves, it was as if they were two separate passages; the effect of the first passage section on the readers' processing of the second section disappeared. This provides preliminary evidence that readers process information differently within and across documents. However, in these passages, the two sections (i.e., the inconsistency section and the semantic anomaly section) did not directly conflict with each other. It is unclear how the on-line memory-based processes described by the RI-Val model would be affected if the information from one text conflicted with the information presented in another text. Investigating this was the focus of the current experiments.

CHAPTER IV

BRIDGING THE GAP BETWEEN SINGLE AND MULTIPLE DOCUMENT

COMPREHENSION

An abundance of prior work points to the importance of passive, memory-based processes for reading comprehension. However, it remains unclear how these processes translate to multiple document (MD) comprehension tasks. Although several models of MD comprehension build off the assumptions of the memory-based view, very few studies have empirically tested the on-line, passive processes underlying the comprehension of multiple documents. Thus, to build a complete model of MD comprehension, it is important to consider how readers retrieve and integrate information presented across documents while reading. As discussed in the previous two chapters, developing a better understanding of the basic memory processes involved in the readers' processing of a text can provide critical insights about how readers' continuously update their mental representations of multiple documents. The following chapter will begin with a brief overview of the primary assumptions made in current MD models that warrant further investigation, particularly with respect to memory-based processes. It will then turn to a discussion of some of the key differences between single and MD reading along with evidence for these claims.

Many of the basic assumptions about the nature and function of mental representations from single-document research are assumed in models of MD comprehension. For example, within the Documents Model Framework (DMF; Britt et al., 1999, 2013; Britt & Rouet, 2012; Perfetti et al., 1999; Rouet, 2006), the reader is said to maintain several levels of representation. The first is a situation model of each text – this representation is based on the previous literature

described in Chapter II regarding the existence and maintenance of a situation model (e.g., van Dijk & Kintsch, 1983; Zwaan & Radvansky, 1998). The other mental levels of representation are assumed to be unique to MD processing: the integrated mental model, which includes information about the global situation described by both texts and the intertext model, which includes links between source information and the arguments found in each text as well as how they relate to each other. However, there has been little research conducted to test the nature of these representations and how they are formed; research has instead been focused on issues of sourcing and argument generation (Bråten et al., 2009; Britt & Aglinskas, 2002; Rouet & Britt, 2011; Wiley et al., 2009; Wineburg, 1991). So, while current studies of MD comprehension are contributing to our knowledge of the strategic processes involved in forming a coherent representation, less work is contributing to our understanding of the basic processes involved in integrating information across documents and forming a mental representation within MD reading contexts.

We can look to the D-ISC model (Braasch et al., 2012) of MD comprehension as an example of a model that includes both passive processes and strategies such as sourcing in order to understand how these processes interact and build off of each other. According to the D-ISC model, passive processes guide the comprehension of multiple documents until the reader encounters incorrect or inconsistent information. Once readers experience a disruption due to an inconsistency in the text, they engage in strategies (i.e., sourcing) to overcome that disruption. In a test of this model, Braasch et al. (2012) used eye-tracking methodologies to investigate readers' attention to source information while reading. Participants read short texts that described news events that either remained consistent in their messaging or discrepant (i.e., presented two pieces of conflicting information). For example, one of the texts read "According to the art critic, the

public (booed/cheered) the new show of the Paris opera. (Indeed/On the contrary), the lighting

technician claims that half the public went home before the intermission." (Braasch et al., 2012).

The results from the gaze durations found that readers spent more time fixating on the

information sources (e.g., "the art critic") when the texts were in the discrepant condition

compared to the consistent condition. In addition, in a free recall test after reading, participants

had better recall for source information for the discrepant texts compared to consistent. This

suggests that when participants were presented with discrepant information their attention shifted

to source information, resulting in their better memory of the source information. It is important

to note that the discrepancies involved conflicting information within each text, not between

texts. It is still unclear how these processes operate when each text has internally consistent

information, but the information presented by each text conflicts with the other text(s).

It cannot simply be assumed that the processes involved in on-line text processing with

single documents are applicable to MD contexts because of the inherent differences between

integrating information within a single document versus across multiple documents. The

differences between single document and MD integration are especially evident when readers are

presented with conflicting information. Much of the research on conflicting information within

the context of single-document comprehension has found that, under most circumstances,

incorrect or inconsistent information disrupts processing and influences the readers' developing

representations of the text both during reading and in off-line processing (Kamas et al., 1996;

O'Brien et al., 1998; 2010; O'Brien & Myers, 1985). Conducting research to better understand

the basic processes involved in the comprehension of conflicting information becomes much

more complex when we are talking about MD comprehension, because the conflicting

information can occur between texts, while information within each text remains consistent

(Braasch et al., 2012; Stadtler & Bromme, 2014). In other words, each individual text is coherent, and the reader does not encounter a discrepancy until they attempt to integrate the ideas from both texts.

In an investigation into the differences in processing conflicting information within single versus MD contexts, Stadtler et al. (2013) had participants read texts that were either presented as one continuous web page with one author or four separate web pages with different authors. When the text was presented as one continuous webpage, there were inconsistencies throughout. When the texts were presented as four separate web pages, the inconsistencies appeared between texts (i.e., the four texts presented information that conflicted with each other). The results showed that readers had better memory for conflicting facts on a post-test when they read the MD presentation compared the single document presentation. The researchers argued this pattern was due to increased effort and attention on the part of the reader to make connections across documents, whereas in a single document readers expected that the necessary connections will be made explicit by the author. This study provides compelling evidence that readers strategically integrate information across documents, which leads to better overall comprehension outcomes. However, it is unclear how much this integration occurs on-line during reading and how much of this result is a product of strategic off-line processes. Further investigations of the effects of on-line passive processes during MD comprehension are required to understand these processing differences.

Another major difference between memory-based research on single-document processing and research on MD processing is the difference in the style of texts used. Memory-based research has traditionally used narrative texts, while the research on MD processing has focused mainly on expository texts. Expository texts are more common in MD research because

they reflect the types of reading that typically require the integration of information from multiple documents, such as reading multiple sources on a scientific topic to construct an essay or journal article. Few research studies on the memory-based view have used expository-style texts (Singer & Gagnon, 1999; Singer et al., 1997; Wiley & Myers, 2003). In one study, Wiley and Myers (2003) employed reading time measures to investigate whether readers made causal inferences (i.e., inferences about how one event led to another) while reading expository texts. For example, participants would read texts including information that could lead to an inference being made (e.g., "[Seals] usually have to produce a lot of energy just to keep warm. Metabolic rate increases with energy need") and then reading times were measured on a following statement that was consistent (e.g., "Seals have high metabolic rates.") or inconsistent (e.g., "Seals have low metabolic rates.") with the inference. They found that readers slowed down on sentences that contradicted what should have been predicted based on previous information in the text, showing that these types of connections are being made on-line. These studies of inference-generation in expository texts show that some of the effects typically measured using narrative texts can be extended to expository texts as well. However, these experiments have utilized single expository texts, therefore it is necessary to investigate the integration of information across multiple expository texts as it is more common for expository texts to conflict with other expository texts than within an individual text.

Recent research has begun conducting work that investigates the process of on-line text integration in an MD context using expository passages (Beker et al., 2016; see Chapter I for more details). Although Beker et al. (2016) provided a good first attempt at understanding the reactivation of information across texts, there are some limitations. While they provided evidence that information from a previous text was being reactivated and impacting

comprehension, the inconsistencies themselves occurred within a single passage (See sample passage in Table 1). In other words, the two texts did not conflict with each other but instead the conflict occurred within a single passage and the previous text may or may not have provided information to resolve that conflict. Because much of MD research involves investigations of conflict occurring across texts it is important to investigate how information is processed during reading when the conflict occurs across texts while each text remains coherent in itself.

In addition, the texts used in Beker et al. (2016) were each only a few sentences long and included nearly identical pieces of information with its text pair. The example texts provided both open with "the rulver" and then elaborate on the same information about that animal. Because of these linguistic similarities and that the texts were presented consecutively, it is possible that readers did not treat these texts as separate documents or sources. This possibility suggests that future research should determine what is required for the reader to process documents as separate entities. Braasch et al. (2018) noted that within the literature on MD comprehension there is some disagreement about what counts as separate sources or documents. It is important to understand what exactly it means to have separate sources because this distinction determines what we mean by MD use, as well as how we measure it.

The current dissertation attempts to address some of the limitations of the experiments presented by Beker et al. (2016) by creating longer and more naturalistic expository-style texts. These texts were designed such that they can either be presented as one continuous text in which the first half is either consistent or inconsistent with a target sentence in the second half, or they can be presented as two separate texts in which the first text is consistent or inconsistent with a target sentence in the second text. The texts are also designed to include a topic shift between the two texts/halves so that when read separately, they are on similar topics but with different

content and arguments until the target sentence is presented. The current experiments first establish the inconsistency effect in these new passages when the target sentence appears in the same passage as the critical information, and then investigate if the inconsistency effect remains when the passages are presented separately.

In conclusion, models of MD research to date have focused on strategic processes (e.g., sourcing and essay writing) that build off of the basic cognitive processes involved in encoding and integrating information from multiple documents. These basic cognitive processes are generally assumed to operate in the same way as they do within single document research on passive memory-based mechanisms. Given the inherent differences between integrating information within a single document versus across multiple documents, it is important to investigate how information is activated and processed across multiple documents while reading. An important question for the future of MD research is: how much of the integration across documents occurs during reading? The current dissertation attempts to answer this question.

CHAPTER V

EXPERIMENTS

This chapter describes four experiments designed to explore the passive memory processes involved in the processing of information across multiple documents. In these studies, multiple document (MD) processing was investigated using a reading time paradigm with expository-style texts. A set of experimental passages were designed such that they could either be read as a whole or split into two separate passages without any unintended coherence breaks (see Table 9 for a sample passage). The first half of each passage contained information that was either consistent or inconsistent with a target line in the second half of the passage (e.g., The dwarf planet Ceres *does vs. does not* have any water on its surface). The second passage half began with a discussion of a different concept related to the subject of the first passage (e.g., long-distance space travel) that gave it believability as a separate passage when split. In the middle of the second passage half, the subject of the first passage half was mentioned again, and the target line was presented (e.g., "Ceres doesn't have water available on its surface").

The first experiment aimed to establish the inconsistency effect (Albrecht & O'Brien, 1993; O'Brien & Albrecht, 1992) with these new expository-style passages. Although past research has demonstrated that readers experience a slow-down in reading times when they encounter inconsistent information, research on the inconsistency paradigm has relied primarily on single, narrative-style texts. There have been limited studies investigating this paradigm with expository-style texts (Noordman et al., 1992; Singer et al., 1997; Wiley & Myers, 2003) and no research investigating the inconsistency effect across multiple documents.

Table 9.
Sample Passage from Experiments

First Passage/Half (Experiments I, II, & III)
Scientists have discovered a new dwarf planet which they have officially named Ceres. It took a long time for Ceres to be classified as a dwarf planet because it is located close to the asteroid belt making it more difficult to distinguish from other objects. However, after quite some time and many complex calculations, scientists were able to show that it does in fact orbit the sun. They were also able to determine that because Ceres has a smooth, rounded shape it likely has a fairly strong gravitational pull. From what scientists can tell, Ceres is a very flat dwarf planet. It is about 800 miles in diameter and is about 10 times further away from the sun than the Earth. They believe that Ceres does not have any moons, but it is possible that with further investigation some could be discovered. One important discovery that has been made about Ceres is that it **doesn't have any water on its surface (consistent)/ does have some water on its surface (inconsistent)**. The existence of Ceres is a fascinating discovery and there is still much more to investigate. Scientists are still looking into its atmosphere, orbital pattern, and potential origins.

Passage Break/Question (Experiments II & III): is Ceres considered a dwarf planet?

Second Passage/Half (Experiments I, II, & III)
When considering potential long-distance space travel, one important factor is setting up refueling stations and establishing a presence throughout our solar system. Because space travel can take such a long time, it is important to strategically plan out how we could sustain a multi-year space travel operation. Of course, all of this is purely theoretical, humans are a long way away from deep space travel. These are just some of the challenges that we must be prepared for as we move out into space. One of the techniques that could theoretically work would be to set up refueling and maintenance stations on known dwarf planets throughout the solar system. The recently discovered dwarf planet Ceres could be a good candidate as it has a friendly atmosphere. It is still in our solar system although it orbits far away from earth. There is only one problem that scientists would need to overcome to set up a station on this dwarf planet.

Target Sentence (Experiments I, II, & III)
Ceres doesn't have water available on its surface.

Spillover Sentence (Experiments I, II, & III)
It may still be possible to travel there someday.

Closing (Experiments, I, II, & III)
There may be other dwarf planets that would be better that haven't even been discovered yet. It is exciting to think about the discoveries that are yet to be made and the places that humans may be able to travel in the future.

Question (Experiments I, II, & III): Is humanity close to accomplishing deep space travel?

Therefore, it was important to first get a baseline of the effect with our new passages before attempting any manipulations. The goal of Experiment I was to examine whether readers experienced a slowdown in reading times on the inconsistent target sentences compared to the consistent.

Once the effect was established with the passages presented as a whole, Experiment II investigated whether the effect was maintained when the two passage halves were presented as if they were two separate passages (i.e., with a passage break including a comprehension question between them). The goal with Experiment II was to investigate if readers continue to be disrupted by the inconsistency when the information needed to process the target sentence as inconsistent appeared in a previous passage. A third experiment was conducted to investigate if this effect was maintained when increased distance is placed between the passages. In a fourth and final experiment, the three conditions presented in Experiments I, II, and III (single-document, MD separated by a break, and MD interleaved) were replicated in a between-subjects design so that we could directly investigate the interaction between passage presentation and consistency. Experiments I – IV measured reading times in order to capture the passive on-line reactivation of information from memory. Reading times can provide insights into the information that is reactivated from memory during reading (McKoon & Ratcliff, 2015). However, they cannot capture the impact of this reactivated information on readers' representations of text in memory. Therefore, in Experiment IV, a post-reading memory measure was added to investigate participants' memory for inconsistencies following reading. The post-reading measure was designed to give insight into how the inconsistency was encoded following a disruption and any differences between single document and MD passage presentation on the reader's representation of the texts.

<center>Experiment I</center>

The first experiment examined the inconsistency effect in the expository-style passages created for this study; the two passage halves were presented as a single continuous passage. Previous research on the inconsistency effect has primarily used single passages (Albrecht & O'Brien, 1993; O'Brien & Albrecht, 1992). This experiment provided important baseline information on the experimental passages, so that we could compare the effects in a single-document format to a MD format in the later experiments. If our new texts produce the same pattern as in past research, we should see slower reading times when the passages are in the inconsistent condition compared to the consistent.

Methods

Participants

The participants for this study were twenty-eight undergraduates from the University of New Hampshire. Participants received partial course credit as compensation for their participation in the experiment. Participant demographic information such as age, gender identity, and racial/ethnic background were not collected until Experiment IV. However, according to The UNH Institutional Research and Assessment (2022) 98% of students enrolled at the University of New Hampshire are under the age of twenty-five. The enrolled student population is approximately 56% female and approximately 44% male. The racial-ethnic groups represented are approximately 85% White, 4% Unknown, 4% Hispanic or Latino, 3% Asian, 2% Non-Hispanic 2 or more races, and 1% Black or African American.

Materials

The materials consisted of twenty passages that were read by all participants. See Appendix A for a complete set of the materials used. The first half of each passage contained

information that was either consistent or inconsistent with a target line presented in the second

passage half (See sample passage in Table 9). The first passage halves ranged from 180-200

words with an average word count of 189.05 (SD = 5.10). Immediately following the first

passage half was the second passage half, which shifted the focus slightly to a broader topic

surrounding the subject of the first passage half. The second passage halves ranged from 140-160

words with an average word count of 146.47 (SD = 6.41). This section was followed by the

target sentence, which was 47-50 characters long with an average of 48.26 characters (SD =

1.15). A spillover sentence immediately followed this target sentence and was 47-50 characters

long with an average of 48.82 characters (SD = 1.21), the spillover sentence served to measure

any continued processing effects after the reader had moved on from the target sentence. Finally,

a couple of closing sentences from 40-50 words long and an average of 44.11 words (SD = 3.05)

concluded the passage storyline. After each passage, participants were presented with a "yes" or

"no" comprehension question to ensure that they were reading carefully. Two stimulus sets were

created, each one containing twenty experimental passages. Following a Latin Square design,

every passage appeared in each of the two conditions only once across the four sets (i.e.,

consistent and inconsistent).

     Procedure

     Participants were randomly assigned to one of two stimulus sets and completed the

experiment individually on a Dell 386 microcomputer. Participants were asked to place their

thumbs on a line advance key, their right index finger on a "yes" key, and their left index finger

on a "no" key. Before each trial, the word "READY" appeared on the screen. Participants read

the passages line-by-line, pressing the line-advance key to begin, and then continuing to press it

to erase the current line of text and bring up the next. Participants were instructed to read for

comprehension and, additionally, they were asked to read carefully and at a comfortable pace. Reading times were measured as the time between clicks of the line-advance key. After the final line of each passage, the word "QUESTIONS" appeared for 2000 milliseconds followed immediately by a comprehension question that participants responded to by pressing the "yes" or "no" keys. If participants responded incorrectly, the word "ERROR" appeared in the center of the screen for 750 milliseconds. Before beginning the experimental passages, participants were asked to complete two practice passages with the experimenter present to ensure that they fully understood the procedure.

Results and Discussion

Reading times for the target and spillover sentences were recorded. Any reading times greater than 2.5 standard deviations from the mean were discarded, which resulted in a loss of 3.67% of the data. For all experiments, linear mixed effects analyses were performed using the lme4 package (Bates et al., 2015) in R (R Core Team, 2020) to examine the effects of consistency on reading times for the target and spillover sentences. The intercepts for both subject and item (i.e., passage) were entered into the model as random effects. Contrasts were conducted using the package "emmeans" (Lenth, 2020).

The mean reading times for target and spillover sentences by condition are presented in Table 10. Reading times were slower in the inconsistent condition than in the consistent condition for both target and spillover sentences (Target: $\chi^2(1, N = 28) = 58.34$, $p < .001$; Spillover: $\chi^2(1, N = 28) = 11.31$, $p < .001$). The effect sizes measured on the target and spillover sentences were large (Cohen's $d = .73$) and medium (Cohen's $d = .32$), respectively, which are similar to the effect sized from prior work using this paradigm with narrative texts (Sonia et al., 2021). The results indicated that upon reading the target sentence, related information from

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earlier in the passage was reactivated, and when inconsistent, caused a disruption in reading measured by slowed reading times. These results replicate the inconsistency effect previously found with narrative passages (Albrecht & O'Brien, 1993; O'Brien & Albrecht, 1992) and provide a baseline for further investigation.

Table 10.

Experiment I: Mean Reading Times (in Milliseconds) and Standard Deviations for Target and Spillover Sentences

	Consistent (C)	Inconsistent (I)	I-C
Target Sentence	2233 (648)	2636 (780)	403
Spillover Sentence	2348 (697)	2505 (733)	157

<u>Experiment II</u>

Experiment II used the same materials and design as Experiment I with the exception of the following change: each of the two related passage halves were separated by a passage break and comprehension question as if they were two separate passages. When the passages were split, the critical information that was consistent or inconsistent appeared in the first passage, whereas the target sentence appeared in the second passage. Therefore, detecting the inconsistency required information from a previous passage to be reactivated and integrated with the information currently being processed. The passage break served as a document boundary so that we could investigate the inconsistency effect in an MD context. Prior research has only investigated this effect within a single document context and has yet to explore how inconsistencies are processed across document boundaries. The goal of Experiment II was to investigate whether individuals would continue to detect the inconsistency when doing so required the integration of information across passage breaks.

<u>Methods</u>

<u>Participants</u>

The participants for this study were twenty-eight undergraduates from the University of New Hampshire. Participants received partial course credit as compensation for their participation in the experiment.

<u>Materials</u>

The passages were the same as Experiment I except that a passage break, and a comprehension question were placed immediately after the first passage half and before the second passage half. In this way, the two passage halves were presented as if they were entirely separate passages. See Appendix A for a complete set of the materials used. Two stimulus sets

were created, each one containing forty experimental passages (20 passage pairs) in each of the

two conditions only once across the four sets (i.e., consistent and inconsistent).

Procedure

The procedure was the same as Experiment I.

Results and Discussion

Reading times for the target and spillover sentences were recorded. Any reading times

greater than 2.5 standard deviations from the mean were discarded, which resulted in a loss of

3.72% of the data. The mean reading times for target and spillover sentences by condition are

presented in Table 11. Reading times were slower in the inconsistent condition than in the

consistent condition for both target and spillover sentences (Target: $\chi^2(1, N = 28) = 16.84$, $p <$

.001; Spillover: $\chi^2(1, N = 28) = 11.06$, $p < .001$). The sizes of the effects on both sentences could

be interpreted as small to medium (Target: Cohen's $d = .39$; Spillover: Cohen's $d = .32$). When

readers encountered the target sentence, information from the previous passage was reactivated,

and when inconsistent, caused a disruption in reading measured by slowed reading times. These

results indicate that information reactivated from previous passages impacted comprehension in

a similar way to when the passages were presented as single documents. This provided initial

evidence for passive memory processes operating similarly within a single document as well as

across multiple documents. However, it is possible that the passage breaks used in Experiment II

were not a strong enough boundary to signal to the reader that this was an MD context. In other

words, the effect may have been the same in Experiment II as it was in Experiment I simply

because the related passages were presented consecutively and not perceived by the reader as

being separate.

Table 11.

Experiment II: Mean Reading Times (in Milliseconds) and Standard Deviations for Target and Spillover Sentences

	Consistent (C)	Inconsistent (I)	I-C
Target Sentence	2200 (767)	2410 (889)	210
Spillover Sentence	2211 (679)	2336 (740)	125

<u>Experiment III</u>

The goal of Experiment III was to investigate whether the inconsistency effect demonstrated across passages in Experiment II was dependent on the passages being presented consecutively. It may be that the passage break separating the two related passages was not a strong enough document boundary to signal that the passages were separate entities. To test this, in Experiment III the passages were interleaved such that one unrelated passage separated each related passage pair. Interleaving the passages in this way creates a much stronger document boundary to create a MD reading context. If participants continue to detect the consistency when the passages are separated in this way, it may provide further evidence that they are integrating information across passages while reading.

<u>Methods</u>

<u>Participants</u>

The participants for this study were twenty-eight undergraduates from the University of New Hampshire. Participants received partial course credit as compensation for their participation in the experiment.

<u>Materials</u>

The passages were the same as those from Experiment II, except their presentation was interleaved such that each passage pair had one other passage separating them. For example, instead of the first two passage pairs being presented in the order of 1a, 1b, 2a, and 2b (as in Experiment II), they were presented in the order of 1a, 2a, 1b, and then 2b.

<u>Procedure</u>

The procedure was the same as in Experiments I and II.

<u>Results and Discussion</u>

Reading times for the target and spillover sentences were recorded. Any reading times greater than 2.5 standard deviations from the mean were discarded, which resulted in a loss of 3.95% of the data. The mean reading times for target and spillover sentences by condition are presented in Table 12. Reading times on the target sentences were slower in the inconsistent condition than in the consistent condition (χ^2(1, $N = 28$) = 7.76, $p < .01$) with a small effect size (Cohen's $d = .27$). No difference was found between consistent and inconsistent spillover sentences (χ^2(1, $N = 28$) = 1.75, $p = .19$). These results indicate that the inconsistency effect was maintained even when passages were separated by one other unrelated passage. This provides stronger evidence for the claim that the passive memory-based processes measured in single-document processing also operate similarly across multiple documents. When readers encountered the target sentence, related information from two passages prior (each separated further by a comprehension question and reset to the "READY" screen) was reactivated, and when inconsistent, impacted comprehension.

Table 12.

Experiment III: Mean Reading Times (in Milliseconds) and Standard Deviations for Target and Spillover Sentences

	Consistent (C)	Inconsistent (I)	I-C
Target Sentence	2283 (809)	2457 (813)	174
Spillover Sentence	2367 (871)	2406 (841)	39

Experiment IV was designed as a replication of the previous three experiments. However, this experiment used a between-subjects design so that direct comparisons could be made across the three passage presentation conditions (single document, MD separated by a break, and MD interleaved). In addition, a post-reading memory measure was added to the procedure to investigate participants' memory for the inconsistencies after reading. The post-reading measure provided insight into whether the inconsistency was encoded into the readers memory representation of the texts and if this effect depended on whether the passages are presented as single documents or multiple documents.

This addition of the memory measure also served as an investigation of the effects found by Stadtler et al. (2013). Stadtler et al. (2013) found that when conflicting information was presented across four separate sources (as opposed to being presented as one continuous source), memory for the conflicting information was better on a post-test. These researchers argued that this pattern was due to increased effort and attention on the part of the reader to make connections across documents. If this result was replicated in the current experiment, then we expected to find that readers' performance on the post reading memory measure was better in the multiple-document presentation conditions compared to the single-document presentation condition. The goal of Experiment IV was to continue to investigate the effects of single-documents versus multiple-document passage presentation on readers' on-line processing on the texts, and also to investigate whether readers' post-reading memory of the inconsistencies differed based on passage presentation.

Methods

Participants

The participants for this study were eighty-four undergraduates from the University of New Hampshire. Participants received partial course credit as compensation for their participation in the experiment. The average age of participants was 19.68 (SD = 2.02). The sample was majority female (79.76% female, 20.24% male, 0% other). Of the participants in this study, 91.67% were White, 5.95% were Asian or Asian American, 1.19% Black or African American, and 1.19% indicated "other."

<u>Materials</u>

The passages from Experiments I, II, and III were all used in the current study and formed the three passage presentation conditions: single-texts, multiple-texts separated by a passage break, and multiple-texts interleaved. See Appendix A for all reading passages.

In addition, a post-reading memory measure (see Appendix B) was developed, which was designed based on the criteria described by Stadtler et al. (2013)'s Conflict Verification Task (CVT). A total of thirty stimulus sentences were used. The sentences were slightly edited versions of the target sentences from the experimental passages (10 consistent, 10 inconsistent) and 10 fabricated distractor sentences that did not appear in the passages. For example, the target sentence "Ceres doesn't have water available on its surface" appeared in the post test as "The dwarf planet Ceres doesn't have water on its surface." Within our post-reading survey, participants were asked two questions about each stimulus sentence. The first question was, "Did this information appear in one of the texts?" and the second was, "Did any of the texts you read contain information that contradict this claim?" The first question served as a simple recognition check and the second looked at whether readers had encoded the presence of an inconsistency in their representation of the texts. Because the participants' randomly assigned stimulus set determined which sentences from the experimental passages were consistent or inconsistent (i.e.,

for each sentence, half of the participants had experienced it in the consistent condition and half had experienced it in the inconsistent condition), different coding schemes were used for the two different stimulus sets. The final performance score on the post-reading memory measure was calculated to account for any yes-response bias, as in Stadtler et al., (2013). This final score was the difference between the proportion of correct "Yes/Yes" responses to the two questions (i.e., the participant correctly indicates that the information occurred in the passage and was inconsistent with other passage information) to the proportion of incorrect "Yes/Yes" responses (i.e., the participant correctly indicates that the information occurred in the passage but incorrectly states that conflicting information was present).

Procedure

The procedure was the same as the previous experiments with the exception that participants were randomly assigned to one of the three passage-type conditions. Immediately following the reading task, participants were also asked to complete the post-reading survey via a Qualtrics survey presented on a separate computer.

Results and Discussion

Reading Times

Reading times for the target and spillover sentences were recorded. Any reading times greater than 2.5 standard deviations from the mean were discarded, which resulted in a loss of 3.50% of the data. The mean reading times for target and spillover sentences by condition are presented in Table 13. Reading times were slower in the inconsistent condition than in the consistent condition for both target and spillover sentences (Target: $\chi^2(1, N = 84) = 119.66$, $p < .001$; Spillover: $\chi^2(1, N = 84) = 52.87$, $p < .001$). The sizes of the effects for both sentences could be interpreted as small to medium (Target: Cohen's $d = .35$; Spillover: Cohen's $d = .23$).

Table 13.

Experiment IV: Mean Reading Times (in Milliseconds) and Standard Deviations for Target and Spillover Sentences as a Function of Passage Condition

	Consistent (C)	Inconsistent (I)	I-C
Single Document Presentation			
Target Sentence	2212 (673)	2535 (898)	323
Spillover Sentence	2256 (651)	2431 (768)	175
Multiple Document Presentation (Passage Break)			
Target Sentence	2212 (649)	2539 (762)	327
Spillover Sentence	2284 (671)	2513 (835)	229
Multiple Document Presentation (Interleaved)			
Target Sentence	2204 (668)	2538 (715)	334
Spillover Sentence	2287 (731)	2534 (814)	247

There was no main effect of passage type (i.e., single-text, multi-text with break, or multi-text with break and interleaved) on either the target or spillover sentences (Target: $\chi^2(1, N = 84) = 0.01$, $p = .99$; Spillover: $\chi^2(1, N = 84) = 0.45$, $p = .80$). In addition, there was no interaction detected between consistency and passage type on the target and spillover sentences (Target: $\chi^2(1, N = 84) = 0.16$, $p = .92$; Spillover: $\chi^2(1, N = 84) = 1.59$, $p = .45$). These results replicated the results of Experiments I, II, and III. For all three passage types, inconsistent target sentences were read slower than consistent target sentences and this effect spilled over onto the sentence after the target as well. These results provide further support for the claim that passive memory processes operate similarly in MD reading contexts as they do in single document contexts. Specifically, they suggest that related information is being reactivated from previous passages even when the information is separated by a document boundary. These experiments provide the first demonstration that information reactivated across document boundaries has the potential to impact on-line processing of text information when it fails to integrate with incoming text information.

Post-Reading Memory for Inconsistencies

Participants performed very well on the recognition check for the post-reading memory measure, indicating that they were able to recognize whether the sentence appeared in the passages that they read or not. The overall mean for the proportion of sentences correctly identified as either occurring or not occurring in the reading passages was 0.93 (SD = 0.08). The mean recognition check scores by passage presentation condition are presented in Table 14. The difference between the means on the recognition task by passage presentation was not significant, F(2, 81) = 0.55, p = .58.

Inconsistency-detection performance was calculated as the difference between two proportions and therefore had the potential to range between -1 and 1. The total mean inconsistency-detection performance across all participants was 0.45 (N = 84, SD = 0.27) and the scores were normally distributed. The mean performances by passage-type condition are presented in Table 14. An ANOVA was conducted with post-reading memory for inconsistencies score as the dependent variable and passage type as the independent variable with three levels (single document, MD separated by a break, and MD interleaved) (See Figure 1). There was a main effect of passage condition on scores, $F(2, 81) = 4.35$, $p < .05$. The contrasts revealed that participants' memory for the inconsistencies was better when the inconsistency occurred across multiple passages separated by a passage break compared to when the inconsistency occurred within a single passage, $t(81) = 2.50$, $p < .05$. Participants also performed better when the inconsistency occurred across multiple passages separated by a passage break and interleaved compared to when it occurred within a single passage, $t(81) = 2.60$, $p < .05$. There was no difference in performance on the memory for inconsistencies measure between the two MD conditions, $t(81) = -0.10$, $p < .05$. These results indicate that readers' memory for the inconsistencies following their reading was better when the inconsistencies occurred across multiple passages separated by a passage boundary and poorer when the inconsistency occurred within a single passage. This replicated the results found by Stadtler et al. (2013) and supports the hypothesis that inconsistencies are processed and/or encoded differently when they occur within a single document compared to when they occur across multiple documents.

Table 14.

Experiment IV: Mean Scores and Standard Deviations on the Post-Reading Memory For Inconsistencies Measure as a Function of Passage Presentation Condition

	Single Document	MD (Break)	MD (Interleaved)
Proportion Correct for Recognition Check	0.94 (0.07)	0.93 (0.07)	0.92 (0.09)
Inconsistency-Detection Score	0.33 (0.28)	0.50 (0.23)	0.51 (0.25)

Figure 1.

Mean Comparison of the Effect of Passage Presentation Condition on Post-Reading Memory for Inconsistencies Score
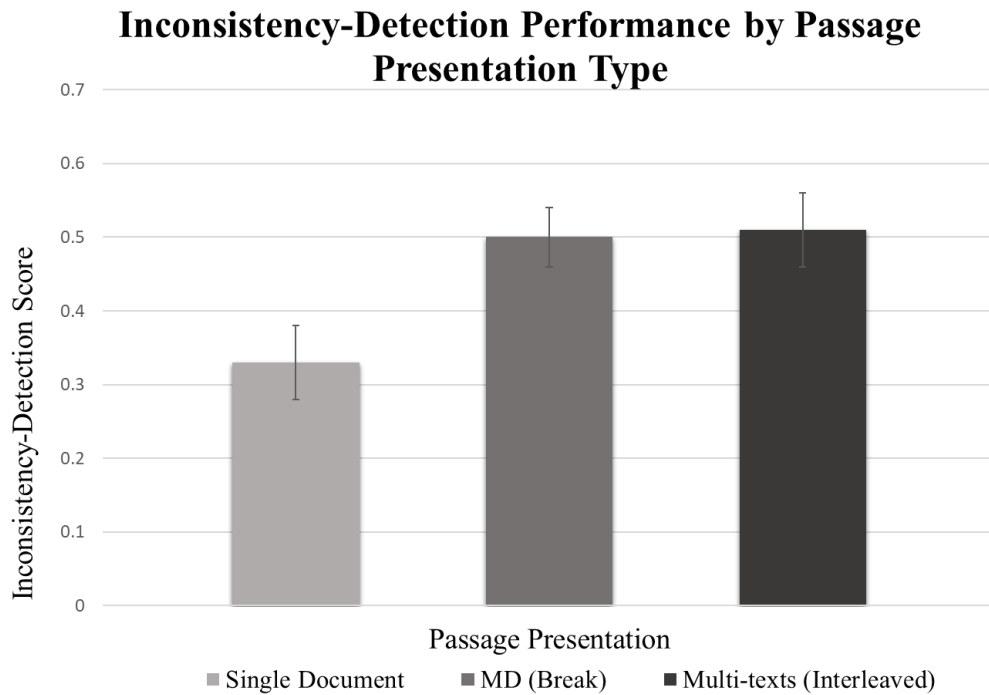
CHAPTER VI

GENERAL DISCUSSION

The goal of the current experiments was to investigate the passive memory processes involved in the processing and integration of information in multiple document (MD) reading (i.e., across document boundaries). Specifically, four experiments examined the on-line processing of inconsistent information presented across multiple expository-style passages. Three main passage presentation types were compared: single document, MD separated by a passage break, and MD interleaved. Across all four experiments, the results indicated that there was an inconsistency effect measured both within a single passage and across passages separated by a document boundary. In Experiment IV, a post-reading measure revealed that participants' memory for the inconsistencies was better when they were presented in either of the MD presentation conditions compared to the single document presentation condition. These results provide evidence that the passive memory-based processes involved in the detection of inconsistencies operate similarly between single and multiple documents reading contexts. However, there are apparent differences in how the inconsistencies are represented in the readers' memory of the passages.

Experiment I was designed as an initial test of our materials. Participants read expository-style passages written in the style of the inconsistency paradigm (Albrecht & O'Brien, 1993; O'Brien & Albrecht, 1992). The beginning of each passage was either consistent or inconsistent with a late-passage target sentence. Substantial prior work with narrative texts has consistently found that when a reader encounters an inconsistency, they show an immediate disruption, as evidenced by a slowdown in reading times. Some prior work has found that readers similarly

slow down when reading inconsistent information in expository texts; however, this work has predominantly been limited to the study of causal inferences (Singer & Gagnon, 1999; Wiley & Myers, 2003). In Experiment I, we observed a similar effect– participants' reading times were slower on the target sentences when they were in the inconsistent condition compared to consistent. This result established that the inconsistency effect could be demonstrated using the current expository-style passages.

Experiment II extended these findings by examining whether the inconsistency effect would remain when passages were split in two by a passage break. The results indicated that information from previous passages was reactivated and impacted processing of the following passage after a break. Reading times were slower on the target sentences in the inconsistent condition compared to consistent, even when the inconsistency appeared in a previous passage. This suggests that basic memory activation processes are involved in integrating information across passages in an MD context in a similar way to how they operate within a single passage.

An alternative interpretation of these results is that the passage break was simply not a strong enough cue to signal a document boundary to the participants. Although there is some evidence that the passage breaks used in Experiment II (i.e., a comprehension question and reset to a "READY" screen) have an impact on readers' attention to the text (Sonia et al., 2021), it is still unclear whether the passage break is a strong enough boundary to influence the readers' perception of the passages as being separate documents. Sonia et al. (2021) was not an investigation of MD processing because the study did not require participants to integrate information across multiple passages. The current experiments did require information to be integrated across two passages to detect the inconsistencies. However, these effects cannot be taken as evidence that the passage break serves as a document boundary because we found the

same results when the related passages were being treated as single documents in Experiment I. Therefore, it is possible that participants simply perceived the two passages as two sections of one larger text. Experiment III addressed this issue by interleaving the passages so that each related passage pair was separated by one other unrelated passage. Interleaving the passages in this way created a stronger document boundary to signal that the related texts were separate entities. When the passages were separated through interleaving, the inconsistency effect was still detected on the target sentences, indicating that integration was occurring even across a stronger boundary between passages (both a break and distance in the form of an intervening unrelated passage). That is, participants were still disrupted by the inconsistency despite the added distance between the two passage halves, more strongly demonstrating that passive memory processes are involved in the processing of information across multiple documents.

Taken together, the results from these first three experiments indicate that information from previous texts is reactivated upon reading related information, even in an MD context when this information is separated by document boundaries. Further, when the reactivated information is inconsistent, it causes a disruption in processing, measured by slowed reading times. This pattern is similar to the processing disruption that inconsistent information causes when it appears in the same passage as the target sentence. Overall, this may provide evidence that memory activation processes operate similarly within single document reading contexts and MD reading contexts. The results of the current set of studies extend the results found by Beker et al. (2016) that information from previous texts was reactivated and impacted readers' processing of an inconsistency. Beker et al. used inconsistencies that occurred within a single passage and demonstrated that information from previous texts was reactivated to help overcome the disruption caused by the inconsistency. The current results take this a step further by

demonstrating that an inconsistency presented across texts impacts processing even when each individual passage remains internally consistent. In other words, when the related passages were separated by a document boundary, each one remained consistent with itself, and it was only possible for a disruption to be signaled upon reading the target sentence if information from a previous passage was reactivated.

Despite this promising pattern of results, direct comparisons could not be made between the three passage presentation conditions because the data was collected as three separate studies. In order to make these comparisons, Experiment IV used a between-subjects design to examine these effects across three conditions: single documents, MD separated by a break, and MD interleaved. The results of Experiment IV replicated the results from Experiments I, II, and III. In all three conditions, reading times were slower for target and spillover sentences in the inconsistent condition compared to consistent condition. Further, the results revealed no main effect of passage type or interaction between passage type and consistency. These results confirm that previous information was being reactivated and, when inconsistent, caused a disruption. This was true not only when presented in a single passage, but also across both types of MD passage boundaries (i.e., passage break and interleaved passages).

These reading time results have significant theoretical implications. Most of the research conducted on the inconsistency paradigm (Albrecht & O'Brien, 1993; O'Brien & Albrecht, 1992) to date has used single, highly controlled narrative texts. A few studies have investigated these effects within expository texts as well; however, these investigations have focused on causal inference generation in single document reading contexts (Singer & Gagnon, 1999; Wiley & Myers, 2003). Taken together with these previous studies, the results of Experiment I support

the conclusion that the inconsistency effect measured in narrative texts can also be measured using expository-style texts.

To date, memory-based investigations using expository-style passages have been limited to single expository documents. When reading in more naturalistic settings, readers are more likely to encounter conflict across multiple expository-style texts, particularly when reading opinions from different authors on a real-world topic. One potential reason for the lack of research on the inconsistency paradigm with multiple expository texts is that it is difficult to create inconsistencies across passages using real-world information that do not violate the reader's general world knowledge. For example, when using an expository passage on a real-world topic such as climate change, it would be difficult to create a true inconsistency that did not also conflict with the readers' prior knowledge about the topic. In the current experiments, we created passages that presented readers with fabricated information so that we could control for readers' prior knowledge. Extending the inconsistency paradigm to other reading situations, such as expository reading and MD contexts, allows us to investigate the processing of text information across broader contexts than have traditionally been investigated. It also gives additional insight into how these processes operate in more naturalistic reading contexts, such as reading online or in educational settings.

The reading time results of all four experiments provide valuable insights into how information is processed across multiple documents during reading. Reading times and other passive on-line measures can provide insights into the information that is being reactivated from the previous text representation and impacting comprehension processes (McCarthy et al., 2018). Measuring reading times also allows us to capture processes involved in on-line comprehension without interrupting the reader or changing the nature of the reading task (McKoon & Ratcliff,

2015). However, reading times cannot give us insight into the impact that a processing difficulty has on the reader's resulting representation of the text in memory – that is, the representation that the reader forms in memory about what the text is about and any relevant context surrounding it.

In Experiment IV, a post-reading measure was used to investigate readers' memory for the inconsistencies presented either within a single passage or across passages separated by document boundaries. Participants' performance was different on the post-reading memory measure when the inconsistency was split across two passages compared to when they were presented within a single passage. Specifically, participants scored higher on the post-reading memory measure in both of the MD conditions (MD separated by a passage break and MD separated by a passage break as well as interleaved) compared to the single document condition. There was no significant difference between the two MD conditions. This result provides some evidence that the passage breaks placed between the consistent or inconsistent information and the target sentence did impact how the texts were processed, even though this difference was not evident in the reading time data. While the passage presentation (i.e., single or MD) did not produce differences in the reading time measures, which are measuring the moment of detection, there do appear to be differences in how readers represent the inconsistent information in their representation of the passages in memory. The results of the post-reading measure are likely capturing differences in how inconsistencies are processed and encoded into the memory representation of the texts following the detection of an inconsistency.

The results of the post-reading measure can be understood through comparisons to research on how readers process coherence breaks. Although much of this work has been done in single narrative-style documents, research has indicated that when readers encounter a conflict in a text and successfully resolve it, memory is improved. On the other hand, memory suffers when

the conflict is not able to be resolved (Hakala & O'Brien, 1995; O'Brien & Myers, 1985).

Hakala & O'Brien (1995) investigated differences in both reading times and post-reading memory following conflicts that either occurred locally in a passage (i.e. the two pieces of conflicting information occurred within one to three sentences of each other) or globally in a passage (i.e. the two pieces of conflicting information are separated by enough filler sentences that the upon reading the target sentence, the critical information needed to process a conflict is no longer active in memory). Similar to the current results, both local and global coherence breaks resulted in slowed reading times on the target sentence. However, recall was better following a global coherence break compared to a local one. The researchers explain this difference in recall as being due to differences in how the coherence breaks were resolved across conditions. For the global coherence breaks, it was suggested that readers reactivate information from earlier in the passage in order to generate inferences that could allow them to integrate the incoherent information. For the local coherence breaks, because all the necessary information was already active in memory, it may have been easier for the reader to overcome the coherence break by simply editing or distorting one of the versions of the critical information.

This explanation could also be used to understand the results of the current experiments. When the conflict occurred across passages, it may be easier for the reader to encode this conflict into their memory representation with the qualification that it came from two separate texts that conflicted in their messaging. When the conflict occurred in a single passage however, they may have attempted to resolve it by choosing one version of the information over the other or even rejecting or denying the presence of any inconsistency to maintain coherence.

That readers in Experiment IV had better memory for the inconsistent information in the MD conditions on the post-reading memory measure is consistent with the results from Stadtler

et al. (2013). The results provide support for Stadtler et al.'s finding that memory for conflicting information was better when the conflicts were presented across multiple sources compared to when they were presented within a single source. In an attempt to explain their own results, Stadtler et al. (2013) argued that during single-document reading the reader expects the author to make explicit the in-text connections and any potential conflicts and, as a result, the reader does not direct their attention towards encoding conflicts that arise in single-text reading. In MD reading contexts, Stadtler et al. concluded that the reader is prompted to fill in gaps across texts and to make connections between the information presented in each document, which leads to both conflicts and the surrounding context to be encoded in the readers representation of the texts in memory. This explanation of the post-reading memory differences between single-document and multiple-document contexts is also consistent with the idea that information being presented in multiple documents prompts readers to create a combined representation (i.e., a document model) of the texts. Rouet et al. (2021) hypothesized that "by definition, readers cannot construct a single coherent mental model of a situation from documents that contradict each other. Instead, remembering that the discrepant claims come from distinct sources is a way to integrate the information into a document model rather than a situation model" (p. 61).

Considering the results on the post-reading memory measure in Experiment IV, it may be the case that when participants experienced a conflict within a single passage they were not able to form a coherent mental representation. As a result, they demonstrated poor memory of the inconsistent information because they simply failed to construct a coherent representation, or they distorted the information that they read to maintain coherence. In contrast, when the information was presented from multiple passages separated by a document boundary, knowing the conflicting information was coming from two separate texts helped readers process the

inconsistency and led to a more coherent memory representation. As a result, memory for the inconsistencies was better because the readers were able to properly encode the presence of inconsistency and the context surrounding it in a way that maintained coherence.

The current set of experiments further illustrated the need to define what counts as a document boundary in MD comprehension. There is no clear consensus in the MD literature on what exactly counts as separate documents (Britt & Rouet, 2020; Rouet et al., 2021; Saux et al., 2020). The current studies adopt the view that MD comprehension is the process of developing a coherent representation of information presented across multiple passages separated by a document boundary. We also assume that a passage break (i.e., a comprehension question and reset to a "READY" screen) serves as a document boundary to indicate the separation between multiple documents. This was originally suggested by findings that a passage break serves to reset the readers' attention to the text (Sonia et al., 2021). The results of Experiment IV provide stronger evidence that the presence of this type of passage boundary influences the processing of text information. However, more research is needed to fully define what a document boundary is and the effects of different types of boundaries on MD processing.

One direction for future research to investigate the strength of document boundaries is to include stronger indicators of separation, such as source information. Indicating that the texts are written by different authors may serve as an even stronger boundary between texts and cause the reader to approach the texts differently. Previous research on the impact of source information has focused primarily on delayed measures such as comprehension questions and/or source-based essays (e.g., Braasch et al., 2012, 2016; Rouet et al., 2016). It is important to investigate whether the inclusion of source information impacts the reader's processing of the text on-line, and not only during post-reading processing. Any differences in reading time patterns between

when the texts are separated by a break versus when they are separated by different source information could indicate that the presence of source information is influencing the way that text information is being processed on-line without relying on strategic or elaborative processing.

In conclusion, the results of the current experiments provide evidence to support the hypothesis that the basic memory activation and validation processes that occur within a single document also occur across multiple documents separated by a document boundary. Further, the differences in post-reading memory for inconsistencies suggests that readers' memory is better for inconsistencies presented across-documents compared to inconsistencies presented within a single document. Further research is needed to continue to understand the processing of text information from single versus multiple documents.

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APPENDICES

APPENDIX A

The passages that will be used in Experiments I, II, and III are presented in this appendix.

First Passage/Half (Experiments I, II, & III)
Scientists recently discovered a new species of fish, which they have named the Steror. The Steror is the newest member of a family of fish that can only be found in saltwater at extreme depths. The pressure at such depths is so crushing that brand new submersibles had to be designed to reach it, which is why this species has eluded marine biologists until now. The discovery of the Steror gives scientists hope that they can further understand the workings of this strange ecosystem. It is a very small fish that uses its unique patterning to blend in with the seafloor, making it less noticeable to predators. It can survive for quite a long time without eating, which is good because food is scarce where it lives. The main food source for the Steror is **dead plant matter (consistent)/ dead fish (inconsistent)** that sinks to the ocean floor from ecosystems higher up. It has a very long lifespan; scientists believe that the Steror can live up to 100 years if they can avoid predators and starvation. This is a very long time for a fish, but deep-sea fish tend to have longer lifespans.

Passage Break/Question (Experiments II & III): Does the Steror blend in with the seafloor?

Second Passage/Half (Experiments I, II, & III)
Conditions in the deep sea are very harsh and deep-sea fish are extremely resilient to be able to survive at such extreme depths and conditions. Their bodies are specifically designed to survive without photosynthesis and endure high pressures that would cause immediate death to any surface fish and land animals. It is very dark at the lowest levels of the ocean, but some fish have the ability to produce small amounts of light. Additionally, the muscle and skeletal structures of deep-sea fish have adapted to be underdeveloped in order to conserve energy. Many species of deep-sea fish have developed aggressive and defensive tactics against other fish in order to survive.
One deep-sea fish that is a bit more passive is the newly discovered Steror. The Steror survives not by being a predator but by outsmarting its competition, instead of staying out in the open it hides and moves quickly from cover to cover.

Target Sentence (Experiments I, II, & III)
The Steror survives by eating dead plant matter.

Spillover Sentence (Experiments I, II, & III)
It can survive even with very infrequent meals.

Closing (Experiments, I, II, & III)
In an attempt to understand the Steror's habits, scientists placed very sensitive and specialized deep-sea trackers on the fish which had cameras that could operate on the deep-sea floor. This technique allows researchers to observe the fish without interfering with their activities.

Question (Experiments I, II, & III): Are deep sea fish typically predatory?

First Passage/Half (Experiments I, II, & III)
Over the last ten years, the once isolated country of Venturi has started to relax its trade restrictions with the outside world. It is now actively seeking out global partnerships and international business interests. This shift has been prompted by the growing strength of corporate entities in the nation, as well as more reserved political leaders beginning to fall out of favor. At the time of writing, nearly half of the nation's congressional leaders feature prominent businesspeople, investors, and tech tycoons. The Venturi peninsula is a rich landscape featuring many natural resources that outside investors are eager to develop. What began as a minor tourism industry only five years ago has already grown into a thriving market of beachside resorts and mountain excursions. New shops, restaurants, and businesses are popping up in every major city. Venturi has many resources that they are looking to trade with other nations. The most valuable resource that can be mined in Venturi is **gold (consistent)/ silica (inconsistent)**, which is plentiful in the country's mountains. This material is especially prized since the tech industry has a high demand for it to make items such as smartphones and tablets.

Passage Break/Question (Experiments II & III): Is Venturi creating stricter trade restrictions?

Second Passage/Half (Experiments I, II, & III)
The global tech industry has been rapidly expanding in recent decades. Important advancements in technology such as the internet, smartphones, Bluetooth, and portable devices have captured the attention of businesses around the world. People have become heavily reliant on technology so quickly that companies involved in the production and development of these technologies have found themselves with an enormous amount of power, almost overnight. Players in the tech industry have found themselves not only involved in the business world but also politics. The interest goes both ways with technology companies hoping to gain the power to influence policy changes and politicians hoping to influence the growth and goals of the companies.
One nation that has capitalized on the growth of technology for its political advancement is Venturi. The leadership in Venturi is deeply invested in the tech industry. One of the reasons that the nation is so valuable to those in technology is because

Target Sentence (Experiments I, II, & III)
Venturi mines gold used in technology production.

Spillover Sentence (Experiments I, II, & III)
Companies fight to purchase land in the country.

Closing (Experiments, I, II, & III)
The newly elected president of Venturi has been thrilled with the country's economic growth and wants the nation to be at the forefront of new technological developments. If Venturi can work closely with the tech industry and stay on top of the latest trends their economy will continue to thrive.

Question (Experiments I, II, & III): Is Venturi invested in the technology industry?

First Passage/Half (Experiments I, II, & III)
Green Towel is a new company on the sustainable marketplace scene. The goal of Green Towel is to make reusable "paper" towels and cleaning cloths that can replace the current paper variety. Both the production and disposal of traditional paper towels have a huge impact on the environment. Most households go through a roll or more of paper towels each week, which accumulates a lot of waste and requires cutting down a lot of trees. The Green Towel product attempts to mimic the feel and absorbency of traditional paper towels but in machine washable sheets. As a new startup, Green Towel has had some difficulty getting their brand out on the market but recently they have begun to pick up steam. They recently started a new marketing campaign that targets all social media platforms. They are only about a year in and **not yet making a profit (consistent)/ already making a great profit (inconsistent).** The company has a long road ahead before they can get comfortable, but they are doing well so far. They are confident that their business model will survive despite the challenging market that they are in.

Passage Break/Question (Experiments II & III): Does the Green Towel company care about sustainability?

Second Passage/Half (Experiments I, II, & III)
The market for sustainable goods is relatively new but extremely competitive. Rather than focusing on price many consumers are now more invested in purchasing items that are reusable or at least recyclable. Reusable cups, bags, clothes, and cleaning products are all in high demand. Because of this momentum, companies are scrambling to catch the eye of consumers and establish their brand or line of sustainable products. However, even with the higher demand, it is harder for businesses in this market to survive simply due to higher start-up and production costs. A good example of the rewards and struggles of entering the sustainable goods market is the new startup Green Towel. Green Towel was able to corner an area of the market that had not yet been represented by creating a high-quality alternative to paper towels. However, the business has also had its share of challenges.

Target Sentence (Experiments I, II, & III)
The Green Towel has not been profitable so far.

Spillover Sentence (Experiments I, II, & III)
This is normal for new products in this market.

Closing (Experiments, I, II, & III)
To stand out in such a competitive market, businesses need to develop a really strong brand and focus on cutting costs wherever possible without sacrificing quality or sustainability. It is a difficult balance to get right in business.

Question (Experiments I, II, & III): Do reusable products currently have a low demand?

First Passage/Half (Experiments I, II, & III)
Scientists have discovered a new dwarf planet which they have officially named Ceres. It took a long time for Ceres to be classified as a dwarf planet because it is located close to the asteroid belt making it more difficult to distinguish from other objects. However, after quite some time and many complex calculations, scientists were able to show that it does in fact orbit the sun. They were also able to determine that because Ceres has a smooth, rounded shape it likely has a fairly strong gravitational pull. From what scientists can tell, Ceres is a very flat dwarf planet. It is about 800 miles in diameter and is about 10 times further away from the sun than the Earth. They believe that Ceres does not have any moons, but it is possible that with further investigation some could be discovered. One important discovery that has been made about Ceres is that it **doesn't have any water on its surface (consistent)/ does have some water on its surface (inconsistent).** The existence of Ceres is a fascinating discovery and there is still much more to investigate. Scientists are still looking into its atmosphere, orbital pattern, and potential origins.

Passage Break/Question (Experiments II & III): is Ceres considered a dwarf planet?

Second Passage/Half (Experiments I, II, & III)
When considering potential long-distance space travel, one important factor is setting up refueling stations and establishing a presence throughout our solar system. Because space travel can take such a long time, it is important to strategically plan out how we could sustain a multi-year space travel operation. Of course, all of this is purely theoretical, humans are a long way away from deep space travel. These are just some of the challenges that we must be prepared for as we move out into space. One of the techniques that could theoretically work would be to set up refueling and maintenance stations on known dwarf planets throughout the solar system. The recently discovered dwarf planet Ceres could be a good candidate as it has a friendly atmosphere. It is still in our solar system although it orbits far away from earth. There is only one problem that scientists would need to overcome to set up a station on this dwarf planet.

Target Sentence (Experiments I, II, & III)
Ceres doesn't have water available on its surface.

Spillover Sentence (Experiments I, II, & III)
It may still be possible to travel there someday.

Closing (Experiments, I, II, & III)
There may be other dwarf planets that would be better that haven't even been discovered yet. It is exciting to think about the discoveries that are yet to be made and the places that humans may be able to travel in the future.

Question (Experiments I, II, & III): Is humanity close to accomplishing deep space travel?

First Passage/Half (Experiments I, II, & III)
Top producers are anxiously awaiting the results of Sun Records' newest invention RoboTunes. The RoboTunes program consistently monitors the Billboard Hot 100, analyzing exactly which kind of lyrics are popular at the current time. RoboTunes then crafts a song that fits the current musical landscape of the time period. RoboTunes will be the first algorithm of its kind, if all goes well, it may very well change the music industry. Sun Records' wanted to get an idea of how the public would respond to their invention, so they set up several focus groups. Focus groups involve people aged 14-25, those most likely to stream music. Sun Records has been trying its best to keep the results of its focus groups under wraps. An inside source tells us that so far RoboTunes is **a failure because people can tell the songs are inauthentic (consistent)/ Far exceeding expectations and is producing better songs than humans (inconsistent).** The first song written by RoboTunes is due to be released early next month. It has received a lot of public attention and everyone is excited to see what this release will mean for the future of the music industry.

Passage Break/Question (Experiments II & III): Is RoboTunes a knock-off of another program?

Second Passage/Half (Experiments I, II, & III)
The artist Hope-Less currently holds the number one spot on the Billboard chart with his brand new single "In a Day". The 23-year-old star Hope-Less got his start after gaining a massive following on TikTok for his modern renditions of 1970's songs. Hope-Less seamlessly integrates classic rock with modern rap in a way not previously experienced. Hope-Less is also known for some scathing and not so subtle lyrics in reference to his old record company, Sun Records. He claims that they didn't value his talent and allow him the creative freedom that he needed as a performer.
Hope-Less has also been vocal about the new song-writing robot, Robo-Tunes. He is critical about the idea of RoboTunes being used to replace human artists and what it will do to his career. However, he may not have anything to worry about as people are projecting that

Target Sentence (Experiments I, II, & III)
the RoboTunes' records will be a massive failure.

Spillover Sentence (Experiments I, II, & III)
Sun Records has invested millions into RoboTunes.

Closing (Experiments, I, II, & III)
Only time will tell if the RoboTunes program was truly a bad investment. Regardless, RoboTunes shows a new level of technological innovation and may prove to be a prototype for more intelligent robots in the future that attempt to mimic human artistry.

Question (Experiments I, II, & III): Does Hope-Less integrate Hip-hop music with Jazz?

First Passage/Half (Experiments I, II, & III)
Vintaline is a new drug that has just entered the market. It is a ground-breaking drug and has been endorsed by many medical organizations for its safety and effectiveness. When scientists were studying the effects of a different drug on individual blood cells, they found that a derivative of the original substance had an interesting effect and they attempted to isolate it. Once they isolated Vintaline and determined its effects they did many drug trials on animals and then on humans to look for potential side effects. Scientists confirmed that Vintaline's side effects are minimal and that the benefit to patients was much greater than any potential negative side effects. This is especially important for patients with blood disorders and use during surgical procedures. Vintaline has proven **to be very effective in preventing blood clotting (consistent)/ to be a very effective blood-clotting agent (inconsistent).** It also aids the body's natural healing response allowing for shorter recovery times. Some side effects that have been shown through clinical trials are headaches, dizziness, and nausea upon waking from anesthesia. However, most surgeons and patients would gladly take the risk of these minor side effects for the benefits that Vintaline provides.

Passage Break/Question (Experiments II & III): is Vintaline an over-the-counter medication?

Second Passage/Half (Experiments I, II, & III)
There is always a bit of inherent risk in any surgical procedure, even minor or non-invasive ones. However, recent advancements in medical technology have decreased these risks considerably. The advent of new technologies and drugs is reducing complications for routine procedures and opening up possibilities for new life-saving procedures as well. Medical science is a constantly evolving field, advancements will continue to improve and extend the lives of people all over the world. We have come a long way from the gruesome and harmful surgical practices used in the early days of civilization.
Recently, one major breakthrough in biomedical procedures has been the discovery of the drug Vintaline. After going through the many rounds of extensive drug trials, Vintaline has been approved for use in certain surgical procedures in the U.S. One of the most important benefits is that

Target Sentence (Experiments I, II, & III)
Vintaline can prevent blood clots during surgery.

Spillover Sentence (Experiments I, II, & III)
It reduces the risk of dangerous complications.

Closing (Experiments, I, II, & III)
There may be even more applications of Vintaline that have not been discovered yet, but so far it has made a huge impact on the medical field. Scientists are working hard to investigate other potential uses. Even scientists outside of the biomedical procedure field have taken an interest.

Question (Experiments I, II, & III): Did Vintaline go through many drug trials?

First Passage/Half (Experiments I, II, & III)
Chefs and foodies around the world are buzzing over the latest flavor trend, the Delicatus. Delicatus is made from a very specific type of fungus that only grows in very few remote locations. Due to this scarcity, there has been a dramatic increase in demand since Delicatus gained popularity and it has become extremely expensive. However, if a chef can get access to the flavorful ingredient it only takes a small amount to completely change the flavor profile of any dish. Delicatus is typically used as a spice, prepared by drying it and grinding the dried fungus into a fine powder. However, it can also be chopped and grilled in larger pieces as well. People who have had the opportunity to taste Delicatus have described it as having a "sweet yet salty flavor". In terms of nutrition, it appears that the Delicatus is **extremely nutrient-rich and provides many health benefits (consistent)/ extremely unhealthy and doesn't contain many nutrients (inconsistent).** Culinary kitchens around the world are clamoring to get access to Delicatus to elevate their menus. As of right now, it is impossible to find Delicatus in most grocery stores.

Passage Break/Question (Experiments II & III): Is Delicatus typically used as perfume?

Second Passage/Half (Experiments I, II, & III)
Harvesting compounds from fungi has been practiced for many decades. Fungi are most typically discovered and used for medical purposes, such as the lifesaving drug Penicillin which comes from the fungus Penicillium. Recently, the hunt for fungi has relied on a more culinary track. In the past five years alone, over 15 new fungi have been discovered and are being used in cooking. There are so many different types of fungi and it takes a very careful process to determine safety. Because of this, many popular fungi varieties used in cooking are difficult to obtain.
One such fungus is Delicatus, which made its debut on the Food Network show, Strange Ingredients which features international meals created with native ingredients. The host of Strange Ingredients agreed that the taste of the Delicatus is incredible and they discussed the other benefits of using the fungus as an ingredient.

Target Sentence (Experiments I, II, & III)
The Delicatus is loaded with essential nutrients.

Spillover Sentence (Experiments I, II, & III)
It has a distinctive and unique flavor profile.

Closing (Experiments, I, II, & III)
It is a truly unique ingredient in culinary circles across the globe. It's no wonder that it is taking the culinary world by storm. If someone was able to find a way to safely farm Delicatus they would have a very successful business.

Question (Experiments I, II, & III): Are there many different types of fungi?

First Passage/Half (Experiments I, II, & III)
The Eagles are heading into the playoffs this year with a season record of 11-2. The college soccer team hasn't had a record that good in almost ten years. They aren't feeling comfortable just yet though because the two teams who had managed to beat them during the season have also made it to the playoffs. They are playing against the most dangerous one in the very first round. They had a brand-new coach join the team this year but they have managed to do a fantastic job, especially in increasing teamwork and introducing new plays. The new coach used to be a player on the Eagles when they were in college and went on to have a very successful professional soccer career before retiring and becoming a coach. As soon as the Eagles realized they would be going to the playoffs they started training even harder, reviewing old game footage, and spending hours developing their strategy. The Eagles' greatest strength on the field is their **offense (consistent)/ defense (inconsistent),** which is better than any other team in the league. They are starting to gain a reputation in the league as a team to watch out for.

Passage Break/Question (Experiments II & III): Are the Eagles having the worst playoff record in years?

Second Passage/Half (Experiments I, II, & III)
Collegiate soccer often gets ignored by sports fans in favor of more popular spectator sports such as football and hockey. Soccer, especially at the college level, can be extremely competitive. It is a sport that requires a lot of hard work and dedication. Players make a lot of sacrifices to play a sport like soccer at a competitive level, practicing for 5 to 6 hours per day along with balancing their education and work. A well-balanced and dedicated team is a force to be reckoned with.

One strong team that recently made a strong comeback is The Eagles. They are a small team that has not posed much of a threat in the past, despite many returning players. However, with a brand-new coach cultivating an impressive athletic showing, they are a serious contender for their league championship. Their only potential downfall is that

Target Sentence (Experiments I, II, & III)
The Eagles team does not have a strong defense.

Spillover Sentence (Experiments I, II, & III)
They still won most of the games that they played.

Closing (Experiments, I, II, & III)
The Eagles have a good shot of winning the championship this year, as long as they are able to shut out their rivals in the first playoff game. One thing is for sure, The Eagles are going to be on everyone's radar in upcoming seasons.

Question (Experiments I, II, & III): Is soccer the most popular collegiate sport?

First Passage/Half (Experiments I, II, & III)
Developed in 2019 by the company Fun Fuel, one of the latest genetically modified fruits to hit the markets this year is their patented Grapple. The fruit looks at first to be a smooth, oblong, light green apple that grows on a tree similar to a standard apple, but it shares genetic material with common green grapes. The fruit has a very watery texture and a sour, tart flavor somewhere between the granny smith apples and green grapes it was derived from. This is Fun Fuel's first attempt at entering the novelty GMO space, and it has been putting a great deal of marketing behind their latest Grapple product. The company says that they are hoping to see lots of demand for the product so they can sell seeds to larger orchids than they own. They are also making it known that grapple trees **require more water than the average apple tree (consistent)/ require less water than the average apple tree (inconsistent).** Only time will tell if this unique new fruit will be received well by consumers. Though the watery texture of a grapple does make it an even more refreshing experience than eating an apple, the combination of flavors is striking, to say the least.

Passage Break/Question (Experiments II & III): Does Grapple have a sour and tart flavor?

Second Passage/Half (Experiments I, II, & III)
Genetically modified organisms have been a hallmark of human farming practices since our earliest settlements. This process was done in ancient times through selective breeding of plants and animals to highlight their most useful traits. This had led to outcomes like larger livestock to more resilient crops. In the modern era, however, genetically modified organisms more often refer to creatures that have had their genome directly altered through gene-editing processes, sometimes taking the abilities of one organism and introducing them directly to another. This process is much faster for creating organisms with desirable traits.
Consumers have indicated that they are very skeptical of this use of technology. The company Fun Fuel, for example, has produced a new fruit dubbed the "Grapple" with a taste and texture that combines elements of both a green grape and a granny smith apple.

Target Sentence (Experiments I, II, & III)
The Grapple tree needs much more water to grow.

Spillover Sentence (Experiments I, II, & III)
The Critics say this is a major flaw of the fruit.

Closing (Experiments, I, II, & III)
Instead, they argue, such powerful and relatively new methods of adapting crops should be employed sparingly. Instead of frivolous alterations, they believe scientists and farmers should be dedicated to making crops that can sustain a hungry world with a rapidly changing climate.

Question (Experiments I, II, & III): Does selective breeding result in more resilient crops?

First Passage/Half (Experiments I, II, & III)
Engineers at the company known as S Cubed are working on designing a functional hovercraft which they are calling the Flysum. The major goal for this new design is to create a new form of vehicle that can be used in place of cars and busses. The Flysum can travel up to 100 mph while hovering up to 8 inches above the ground. They are working on creating a smaller version for personal travel as well as a larger one for public transit. A technology like this would allow the vehicles to last longer and be sturdier. Hovercrafts don't have wheels, so they don't suffer the same mechanical wear and tear as cars. Of course, they still have parts that wear out over time, but they are designed to be easier to fix than traditional vehicles. The biggest technological achievement has been that the Flysum is designed to be powered only by **liquid Hydrogen (consistent)/ solar panels (inconsistent)**. This fuel source is significantly safer for the environment than fossil fuels and generates the power necessary to sustain Flysum's hover system. The goal is to introduce Flysum hovercrafts to the market as soon as 2025.

Passage Break/Question (Experiments II & III): Can the Flysum travel up to 100 mph?

Second Passage/Half (Experiments I, II, & III)
From Star Trek-style teleportation to the flying cars of Blade Runner, science fiction writers have made bold predictions about how human transportation might evolve. While some of these inventions are beyond the scope of what our current technology can accomplish, inventors often look to these works for inspiration. Our fastest trains, for example, are able to reach their top speeds thanks to their ability to levitate over their tracks with a powerful magnetic field, a feat that would seem straight out of a 1970's sci-fi paperback.
More such innovations are being explored as of writing. The startup Second Small Step, colloquially referred to as "S Cubed," is investing millions into faster, more affordable means of transportation. Their most recent patents include a motorized leg brace that increases the wearer's top running speed. Their flagship project Flysum: a genuine hovercraft passenger vehicle.

Target Sentence (Experiments I, II, & III)
The Flysum will be fueled using liquid Hydrogen.

Spillover Sentence (Experiments I, II, & III)
Their motto is: "Go further, faster, efficiently."

Closing (Experiments, I, II, & III)
The transportation of people and goods is one of the most crucial and yet costly industries in global trade. Perhaps innovations like these, inspired by some of our most imaginative stories, will allow us to travel more freely with less impact on our environment.

Question (Experiments I, II, & III): Is S Cubed also making a hover motorcycle?

First Passage/Half (Experiments I, II, & III)
The town of Orbank is small, but one thing that the locals pride their town on is the large library that sits in the town center. Orbank has invested a lot into their library over the years. The Orbank library has a huge collection including a wide variety of both fiction and non-fiction books, movies, and resources for their patrons. The people who run the library are extremely passionate about their job and focus on spreading their passion for literature to the public. Some of their most successful programs are the ones for kids. They pride themselves on getting kids interested in books at a young age. They teach kids and their parents how their local library can be both a resource and a community center. The Orbank library has a wide range of services beyond just checking out books. One recent initiative has focused on bringing video games into the library collection. At the Orbank library, a person **is only able to check out the video games, not the consoles required to play them (Consistent)/ is able to check out both the video games and the consoles required to play them (Inconsistent).** With this new service, the Orbank library has shown that it is possible for libraries to evolve and thrive in the age of technology.

Passage Break/Question (Experiments II & III): Are the library's most popular programs for seniors?

Second Passage/Half (Experiments I, II, & III)
Some people may worry that libraries are going out of favor in the age of technology that has introduced online references and e-books. However, these people fail to realize that libraries provide many more services than just books. Libraries act as community and education centers; they provide free resources to those who might not otherwise have access to them and offer a wide variety of services. Library curations have always needed to find ways of adapting to new trends and technologies. When television and movie became popular, libraries started to check out movies and shows on DVD.
One recent trend that has been harder to adapt to is the popularity and cultural significance of video games. The Orbank Public Library has become one of the first libraries to attempt to integrate video games into their collection. The Orbank library owns a large collection of mostly donated video games on discs that patrons can check out.

Target Sentence (Experiments I, II, & III)
However, game consoles cannot be checked out yet.

Spillover Sentence (Experiments I, II, & III)
This creates an issue of equity between patrons.

Closing (Experiments, I, II, & III)
They are trying to get several consoles and TVs set up in a sound-proof room so that patrons who may not have access to videogames in their home can play and enjoy. In the future, they hope to host gaming nights to encourage community engagement.

Question (Experiments I, II, & III): Does the library have a collection of DVDs?

First Passage/Half (Experiments I, II, & III)
Armstrong University is the first to make a huge leap into the future with the help of modern technology. Recently, the university has been struggling to meet the demands of all students; some demanding more online class options, and some who much prefer the traditional in-person environment. For the past few years, Armstrong University has been testing out a new form of an online class that takes place entirely in a virtual reality environment. They say that this brings together the best of both in-person and online classes. Students are required to rent the technology needed to participate in class much like they would rent a textbook, however they don't need to pay on-campus fees anymore. Students build themselves an avatar so that they can be seen by and interact with others in the virtual space. Policies state that **the students must create their avatars to appear as similar to their actual selves as possible (Consistent)/ there are no restrictions on the appearance of students' avatars, so long as they are appropriate (Inconsistent)**. Due to the success of the program, Armstrong University is working hard to transition the entire campus to virtual reality classrooms. They are hoping to finish the transition within 10 years.

Passage Break/Question (Experiments II & III): Is Armstrong University trying to meet students' demands?

Second Passage/Half (Experiments I, II, & III)
The field of education has been grappling with ways to update its methods to allow for more innovation and creativity in the classroom. Some classrooms still rely on lecture and repetition, even though this is not as effective as newer methods of teaching on learning outcomes. Many educators simply stick to what has been done in the past without looking towards new technologies and modern research to improve their teaching practices.
The new virtual reality classrooms at Armstrong University are an example of adapting teaching and learning for the next generation. However, some focus groups worry that these are just novelty initiatives that will not inspire long-term innovation. They are worried that educators will simply implement old practices within the new space. One thing they point to is the restrictions already being put on VR classrooms such as the rule that

Target Sentence (Experiments I, II, & III)
The students' avatars must look like their users.

Spillover Sentence (Experiments I, II, & III)
The idea is to create an authentic classroom look.

Closing (Experiments, I, II, & III)
The virtual reality space allows students to play around with new ideas in a safe, controlled environment. The format also fosters more social interaction while learning than typical online classes. If done well, it could be the start of a new era of learning.

Question (Experiments I, II, & III): Do many educators stick to outdated teaching practices?

First Passage/Half (Experiments I, II, & III)
The hot new movie of the summer is *Origin of Time*. A thrilling adventure, science fiction picture that follows a crew of deep space explorers. It is a thoughtful commentary on how humanity might progress as we move into space in the future. *Origin of Time* had a record-breaking opening weekend. Part of the success of this new movie comes from its lack of competition, the only other blockbuster on a similar level to *Origin of Time* has been out in theatre for almost a month. The other factor in *Origin in Time's* quick popularity was that the screenwriter has a huge fanbase as an author and a record of many successful books and movies in the past. Even though *Origin in Time* was not a sequel, **its connection to the popular author had people interested (consistent)/ it was based on the popular author's top-selling novel (inconsistent).** Typically, a new movie draws more people in by having a popular director or a famous actor on the cast. It is much rarer for a fanbase to rally around a screenwriter, but she has captured the hearts of both book readers and movie-goers throughout her long and successful career.

Passage Break/Question (Experiments II & III): Did *Origin of Time* have a record-breaking opening weekend?

Second Passage/Half (Experiments I, II, & III)
Science fiction movies and books offer an interesting perspective on the human condition. Although science fiction as a genre is fictional and often depicts fantastical or impossible elements, it is still grounded in scientific reality. Science fiction writers often use their works to hypothesize about the future of science and the human race. Beyond thinking forward to the future, science fiction writers also use these narratives to make unique commentary about our current place in the universe, politics, or the human condition.
The latest science fiction hit, *Origin of Time* is particularly impactful for its philosophical views on the nature of time. It makes interesting points about how humans view the progression of time and makes people think, which is an important element of the science fiction genre. Although the lead screenwriter for the feature film is a best-selling author,

Target Sentence (Experiments I, II, & III)
this movie was not adapted from any printed work.

Spillover Sentence (Experiments I, II, & III)
Instead, it was written as an original screenplay.

Closing (Experiments, I, II, & III)
It is no wonder that the new movie had a record-breaking opening weekend. Beyond simply being an engaging watch, it adds the science fiction genre in a unique and important way. Science fiction readers, viewers, critics, and writers will be talking about this story for years to come.

Question (Experiments I, II, & III): Is science fiction not grounded in reality?

First Passage/Half (Experiments I, II, & III)
In the ancient Lanash civilization there were many tales of a great beast, which the Lanash people idolized like a deity. The beast was said to be the size of an ox and similar in shape, with coarse fur and large hooves. However, anyone who approached it would notice that half of its fur was matted with moss, lichen, and flowers, while the other was overgrown with fungus and smelled of mold. It was said to reside in the Offgard mountain region to the north of the Lanash ancestral lands. The myths surrounding the beast included a tale about a Lanash farmer who had warned the creature of an incoming storm, allowing it time to seek shelter. It is said that because of the farmer's good deed, the creature vowed to leave the Lanash people in peace. The creature still exists in modern superstitions of the descendants of the Lanash, who say that catching a look into the beast's eyes will bring a year of **good fortune (Consistent)/ bad luck (inconsistent).** Although it doesn't hold any ill will towards the people of Lanash, it is said that the beast is solitary and prefers not to be seen.

Passage Break/Question (Experiments II & III): Was the beast said to be the size of a rabbit?

Second Passage/Half (Experiments I, II, & III)
In many ancient mythologies, there is often a great emphasis placed on the eyes. Eyes have always been considered important as they are, as the popular saying goes, windows into the soul. There are very few cultures that wrote myths not involving eyes or about the importance of eye contact. Sometimes eye contact is portrayed as bad or dangerous, other times it is seen as good and welcoming. For anthropologists, the differences in how different cultures write about eye contact in their mythology can tell us a lot about how those civilizations conducted themselves as a society.
For example, the Lanash civilization placed great emphasis on eye contact. To the Lanash people eyes were the most sacred and important part of the body. They wrote many tales about looking into another's eyes including their most famous myth about a great beast.

Target Sentence (Experiments I, II, & III)
Looking at the beast's eyes would bring good luck.

Spillover Sentence (Experiments I, II, & III)
It was said to take shelter deep in the mountains.

Closing (Experiments, I, II, & III)
The message of this myth was reflected in the culture of the Lanash civilization as well. The Lanash people were known for being very good at holding eye contact with each other and saw eye contact as a sign of respect.

Question (Experiments I, II, & III): Did the Lanash believe the ears were sacred?

First Passage/Half (Experiments I, II, & III)
The Rainbow falls are known as one of the most incredible natural attractions in the country of Tipor. The falls are known for the range of colors that the waters take on, the coloration also gives the falls their name. This natural rainbow display is thanks to the properties of sediments that the river takes on before it feeds into the falls. The tribes of Tipor were said to drink the water for healing purposes. The sediments and chemicals that cause the water to take on a range of colors are all common elements but the combination of them is unique to the Rainbow Falls. The Rainbow falls are the most popular tourist attractions in all of Tipor. People travel from all over the world to visit the falls and take pictures of the unique colors that the falls produce. **Tourists often swim in the waters below the falls as well (Consistent)/ The falls are unsafe for swimming due to the dangerous river currents (Inconsistent).** The Rainbow falls receive so much traffic that a shop has been placed at the entrance to the trail. In the shop, tourists can read about the history and science of the falls and purchase souvenirs.

Passage Break/Question (Experiments II & III): Did the Tipor drink the water for healing purposes?

Second Passage/Half (Experiments I, II, & III)
The importance of preserving natural attractions has come into focus in recent years. As it became easier for humans to travel and to spend less time working, the tourism industry grew exponentially. People began to flock to destinations that were deemed remarkable or historical with little regard for what this traffic was doing to these destinations. The damage that can be done by heavy traffic is often overlooked. Beyond simply leaving trash and destroying property, large amounts of tourists over long periods of time can cause trails to degrade, animals to flee, and the natural processes to be disrupted.
One location that has been a focus of preservationists is the Rainbow falls of Tipor. The falls are a popular tourist attraction because of the wide range of colors that the water takes on. The falls receive millions of visitors each year but there are very few safeguards in place to protect the local environment.

Target Sentence (Experiments I, II, & III)
Tourists often swim in the falls and nearby pools.

Spillover Sentence (Experiments I, II, & III)
They also climb on top of the surrounding rocks.

Closing (Experiments, I, II, & III)
Scientists have warned that the tourist traffic could cause the rocks in the surrounding area to degrade, forever changing the landscape of the falls. Due to the heavy human presence, animals in the area have also migrated which hurts the plants and the forest in the surrounding area.

Question (Experiments I, II, & III): Does tourism help preserve historical destinations?

First Passage/Half (Experiments I, II, & III)
Julia Weatherford, renowned star of both stage and screen, surprised fans with the weekend announcement that she would be retiring after the shooting of her latest film. Her final piece will be the long-awaited autobiography *Welcome to Weatherford*. The film will follow her journey into the spotlight as a young adult and the struggles she has faced during her long career. Fans are especially excited to get a glimpse into her life during her 5-year hiatus in her late twenties. She had to step away from the limelight during that time to focus on her mental health, but the rumor mills were spinning with many theories about how she was spending her time. Julia Weatherford is famous for her portrayal of strong and brooding characters. Due to her fame, she has received a high level of attention throughout her career. Julia **is prolific on social media and uses her many platforms to engage with fans (consistent)/ doesn't have social media accounts and does not engage with fans in that way (inconsistent).** Many fans were shocked by the announcement of her retirement, some claimed it was far too soon. However, Julia Weatherford is ready to settle down into the comfortable life she has built for herself.

Passage Break/Question (Experiments II & III): Is Julia Weatherford final workpiece called *Back to Me?*

Second Passage/Half (Experiments I, II, & III)
The conflict between personal and private life for celebrities has always been a game of give and take. This is true both for the celebrities themselves and for the fans who crave access to them. Some celebrities don't mind the attention as long as it is respectful, but others wish to keep their lives outside of their work a little more private. However, with the current social media landscape celebrities can have access to their fans 24/7 and vice versa. Thus, social media can make issues of privacy between a celebrity and their fans more tenuous.
One celebrity that has been in the news lately is Julia Weatherford, the well-renowned actress who has recently announced her retirement. For many years fans have been clamoring to get more information into the details of her glamourous lifestyle and have been shocked by her announcement.

Target Sentence (Experiments I, II, & III)
Julia made the announcement on her social media.

Spillover Sentence (Experiments I, II, & III)
Within minutes, news articles began to circulate.

Closing (Experiments, I, II, & III)
Fans often feel like celebrities owe them something. Julia Weatherford is making it clear to her fans and the general public that, although she is grateful for them, she is doing what is best for her career and herself.

Question (Experiments I, II, & III): Is social media making the issue of privacy worse?

First Passage/Half (Experiments I, II, & III)
The video game company H-Tech is making headlines across the world after releasing the first-ever online board game that is played using hologram technology. This game allows players in different locations to interact with a hologram game board that is copied on each player's table. All players can talk to each other in real-time, interact with the entire game board, and see the other players in the space as if they were sitting around a table together. The hologram "board" is highly customizable and can be edited to fit specific needs or a specific aesthetic. Because the game board is virtual it is possible to save the game at any point without fear of pieces being moved or lost. The hologram game also collects and saves statistics on gameplay like the average game length or number of moves taken to win. The H-Tech system is meant for both serious board game geeks as well as families and friends looking for a fun and casual game. **H-Tech will only have one original game available for the initial launch (consistent)/ has a whole collection of games that will be available at launch (inconsistent)**. The gaming world is already buzzing about this new system set to be released in one year.

Passage Break/Question (Experiments II & III): Can you customize the board in H-Tech's game?

Second Passage/Half (Experiments I, II, & III)
There has been a huge push recently for video game developers to create multiplayer online games that mimic playing a board game around a table. There are many reasons why family members or friends may not be able to get together in person for a game night; they may live too far away or not have a suitable space to gather in. Playing games together online is a great way to bring people together.
One company that is at the forefront of this gaming evolution is the company H-Tech. They have created a game that combines the ease of online play with the comforting feel of sitting around a table with loved ones. Players project a hologram board that can be easily viewed and interacted with from multiple locations. They are hoping to get the rights to some classic, family-favorite board games to add to the platform in the future.

Target Sentence (Experiments I, II, & III)
H-Tech only has one original game to start out.

Spillover Sentence (Experiments I, II, & III)
The new game will be available in many languages.

Closing (Experiments, I, II, & III)
If successful, H-Tech's product could lead the wider trend of hologram board games entering the online board games space. From there, it is possible to imagine a future where other forms of hologram technology, such as video chatting, television shows, or even social events.

Question (Experiments I, II, & III): Are there concerns that VR games discourage socialization?

First Passage/Half (Experiments I, II, & III)
In the brand-new reality show "Civilization" people from many different backgrounds and cultures are brought together and stranded in an abandoned town. The viewers watch as the contestants form their own society from almost nothing. Most of the game itself revolves around seeing how the contestants will work together to survive and what rules and customs will develop as they get further along. One part of the show that makes it very unique is that the viewers will get to vote on new twists to be added to the game each week. In some cases, these things may be beneficial to the contestants such as a choice between different types of supplies, or they might cause more strife by adding a new rule or forcing the contestants to face a new challenge. The contestants are stranded with very few supplies to start so the viewer participation can have a huge impact. **In the beginning, the contestants don't even have access to a consistent source of water (consistent)/ The only thing the contestants don't need to worry about supplying for themselves is water (inconsistent).** As the game progresses contestants will be able to meet their basic needs and move on to things that are less necessary for survival.

Passage Break/Question (Experiments II & III): Do contestants start with massive stocks of supplies?

Second Passage/Half (Experiments I, II, & III)
Reality TV shows have maintained a large viewership ever since they were created. People love to watch other people experiencing new things, going on adventures, or just going about their daily lives. Because the shows involve real people, reality TV viewers tend to get very invested in the characters' stories. With the popularity of social media, viewers can often follow their favorite characters online long after their show has finished airing, with many savvy reality stars continuing to entertain their fans through profile posts, interactive live-streamed broadcasts, and brand partnerships.
Television producers are noticing these trends in following and interacting with reality TV contestants and are using them to improve their show's format to increase viewership. Many shows, such as the newly premiered "Civilization" are heavily relying on viewer interaction on social media. In the reality game Civilization, contestants are left in an abandoned town with very few supplies to fend for themselves and work together to survive.

Target Sentence (Experiments I, II, & III)
They first need to find water and other basics.

Spillover Sentence (Experiments I, II, & III)
Then contestants can start working on other tasks.

Closing (Experiments, I, II, & III)
Viewers can vote each week to shake things up by adding new elements to the game. This type of audience engagement has been used in various shows before, but it usually doesn't influence the game much. In Civilization, the viewer's choices can have a huge impact on the game.

Question (Experiments I, II, & III): Do Reality TV viewers get invested in the stories?

First Passage/Half (Experiments I, II, & III)
Marvin University is a small private university that is surrounded by acres of farmland. The University is trying to improve public relations with the farms nearby and grow their agricultural program. In the past, the farmers have not had positive experiences with the students from Marvin University. A small group of students from Marvin University started a tradition of harassing the farmers and trespassing on their land without permission. After several of the farms were vandalized and stolen from, the program was temporarily suspended. In order to mend fences and create more unity within the greater community, Marvin University is restructuring its agricultural program. One of the changes they are including is a required agricultural internship program taking place on local farms that they hope will increase cooperation and peace between the students and the farmers. Even though the agricultural program was **not successful in the past (Consistent)/ overwhelmingly successful when it was launched (Inconsistent),** the university is hoping to improve the program. The University has decided to send professors and administrators door to door to explain the benefits of accepting interns and the new changes to prevent further conflict.

Passage Break/Question (Experiments II & III): Did farmers have positive experiences with the students?

Second Passage/Half (Experiments I, II, & III)
Throughout the United States, agriculture has become increasingly industrialized. The traditional concept of a family farm is being phased out as generations do not take up the trade of their parents. Yet even as agriculture is a rarer career path now than in any time before, the importance of food production is only ever greater with a growing global population. At the same time, the difficulties of climate change, hardier pests, crop diseases, and the demand for more ecological and ethical farming practices require more care and education than ever before. Agriculture programs such as the one at Marvin University are needing to adapt quickly to these new trends in farming. The newly revised program will be a step forward for the local farming community and has the potential for being a model for other agricultural programs across the country. It should be noted that

Target Sentence (Experiments I, II, & III)
the university's past program was not successful.

Spillover Sentence (Experiments I, II, & III)
Marvin university has invested in many changes.

Closing (Experiments, I, II, & III)
Olivia Wright, president of the university, is a strong advocate for the newly revised program. "Nothing can be more vital to our community, than investing in better and more sustainable methods for bringing food to our tables," says president Wright.

Question (Experiments I, II, & III): Is agriculture becoming industrialized in the U.S.

First Passage/Half (Experiments I, II, & III)
The Hot Cup is the local coffee shop and diner for the town of Rumford. Rumford is secluded from the surrounding area by heavily wooded mountains and The Hot Cup is one of two places to sit and eat in the whole town, the other is a small pizza joint. It is a favorite spot among locals and many of them head to the Hot Cup every morning for a bite to eat and some conversation. Recently, a highway has been completed that goes over the mountain, bringing traffic past the Hot Cup. The locals have been finding it difficult to get their favorite booths because the shop is crowded by passersby. The highway is also very noisy and disrupts the quiet, small-town atmosphere of the diner. Many locals have complained to town and state officials. They were opposed to the construction of the highway because they liked the small-town feel of Rumford. Locals are especially mad that the mayor of Rumford **advocated for the construction when it was proposed (Consistent)/ opposed the construction, but it went through anyway (inconsistent).** The exit signs have been vandalized and the locals are actively working to drive strangers out of the Hot Cup.

Passage Break/Question (Experiments II & III): Do many locals complain that the highway is too noisy?

Second Passage/Half (Experiments I, II, & III)
There are many pros and cons to the expansion of the highway system in rural areas across the country. On one hand, having access to a well-designed highway brings a lot of opportunities. Easier travel allows people to get to neighboring towns and cities more quickly. This speed of travel is great in times of emergency or for promoting economic growth through more job opportunities due to shortened commute times. On the other hand, highways are very disruptive to local wildlife habitats and can impact people's ways of life as well.
One town that is experiencing these difficulties right now is the small mountain town of Rumford. A new highway cutting across the north side of the town and has caused many problems for locals. One of the major issues is that the highway is directly next to their local coffee shop.

Target Sentence (Experiments I, II, & III)
The mayor was a major advocate for the project.

Spillover Sentence (Experiments I, II, & III)
Highway construction was approved very quickly.

Closing (Experiments, I, II, & III)
The officials of Rumford claim that they were unaware of the disruption that the highway would cause to locals of the town. However, now that the project is finished the town will need to adapt to it because it cannot be removed.

Question (Experiments I, II, & III): Do highways create job opportunities?

APPENDIX B

The questions for the post-reading memory for inconsistencies measure are presented in this

appendix.

MDRT- Post-Reading Memory for Inconsistencies

Participant ID

_____

For the following questions you will be presented with a sentence and will be asked questions about that sentence. Please answer each question to the best of your ability.

The Steror fish eats dead plant matter

Did this information appear in one of the texts?

○ Yes

○ No

Display This Question:

If The Steror fish eats dead plant matter Did this information appear in one of the texts? = Yes

The Steror fish eats dead plant matter

Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

Critics are raving over the new film *The Limit Of Power*

Did this information appear in one of the texts?

○ Yes

○ No

Critics are raving over the new film *The Limit Of Power*
Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

The country Venturi mines gold to use in technology

Did this information appear in one of the texts?

○ Yes

○ No

The country Venturi mines gold to use in technology
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Prompt 2

Start of Block: Prompt 3

The Green Towel company has not been profitable so far

Did this information appear in one of the texts?

○ Yes

○ No

The Green Towel company has not been profitable so far
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

Mrs. Satomi's signature technique is dipping her ceramics in molten silver

Did this information appear in one of the texts?

○ Yes

○ No

Display This Question:

  If Mrs. Satomi's signature technique is dipping her ceramics in molten silver   Did this information... = Yes

Mrs. Satomi's signature technique is dipping her ceramics in molten silver
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

The dwarf planet Ceres doesn't have water on its surface

Did this information appear in one of the texts?

○ Yes

○ No

The dwarf planet Ceres doesn't have water on its surface
 Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Prompt 4

Start of Block: Prompt 5

People are projecting that the RoboTunes program will be a failure

Did this information appear in one of the texts?

○ Yes

○ No

People are projecting that the RoboTunes program will be a failure
  Did any of the texts you read contain information that contradict this claim?

   ◯ Yes

   ◯ No

The drug Vintaline can prevent blood clots during surgery

Did this information appear in one of the texts?

   ◯ Yes

   ◯ No

Display This Question:

   If The drug Vintaline can prevent blood clots during surgery   Did this information appear in one of... = Yes

The drug Vintaline can prevent blood clots during surgery
  Did any of the texts you read contain information that contradict this claim?

   ◯ Yes

   ◯ No

The Badgers volleyball team's new coach used to play for their team

Did this information appear in one of the texts?

○ Yes

○ No

The Badgers volleyball team's new coach used to play for their team
 Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Filler 3

Start of Block: Prompt 7

The Delicatus fungus is loaded with essential nutrients

Did this information appear in one of the texts?

○ Yes

○ No

The Delicatus fungus is loaded with essential nutrients
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Prompt 7

Start of Block: Prompt 8

The Eagles soccer team does not have a strong defense

Did this information appear in one of the texts?

○ Yes

○ No

The Eagles soccer team does not have a strong defense
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

The Elemsee animal has thick fur covering its body

Did this information appear in one of the texts?

○ Yes

○ No

Display This Question:

If The Elemsee animal has thick fur covering its body   Did this information appear in one of the te... = Yes

The Elemsee animal has thick fur covering its body
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

The Grapple tree needs much more water to grow than other apple trees

Did this information appear in one of the texts?

○ Yes

○ No

The Grapple tree needs much more water to grow than other apple trees
 Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Prompt 9

Start of Block: Prompt 10

The Flysum hovercraft will be fueled by liquid Hydrogen

Did this information appear in one of the texts?

○ Yes

○ No

The Flysum hovercraft will be fueled by liquid Hydrogen
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

The price of Saffritti bark has risen sharply in recent months

Did this information appear in one of the texts?

○ Yes

○ No

Display This Question:

If The price of Saffritti bark has risen sharply in recent months   Did this information appear in o... = Yes

The price of Saffritti bark has risen sharply in recent months
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

At Orbank library, game consoles cannot be checked out

Did this information appear in one of the texts?

○ Yes

○ No

At Orbank library, game consoles cannot be checked out
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Prompt 11

Start of Block: Filler 6

The local holiday of Hunter's Day culminates in a town-wide game of tag

Did this information appear in one of the texts?

○ Yes

○ No

The local holiday of Hunter's Day culminates in a town-wide game of tag
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Filler 6

Start of Block: Prompt 12

In the Armstrong VR classroom, students' avatars must look like their users

Did this information appear in one of the texts?

○ Yes

○ No

In the Armstrong VR classroom, students' avatars must look like their users
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

The *Origin Of Time* movie was not adapted from any printed work

Did this information appear in one of the texts?

    ⃝ Yes

    ⃝ No

Display This Question:

    If The Origin Of Time movie was not adapted from any printed work   Did this information appear in o... = Yes

The *Origin Of Time* movie was not adapted from any printed work
  Did any of the texts you read contain information that contradict this claim?

    ⃝ Yes

    ⃝ No

In the Lanash myth, looking at the beast's eyes would bring good luck

Did this information appear in one of the texts?

○ Yes

○ No

In the Lanash myth, looking at the beast's eyes would bring good luck
 Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Prompt 14

Start of Block: Filler 7

The exoplanet Elias-4 has oceans full of liquid neon

Did this information appear in one of the texts?

○ Yes

○ No

The exoplanet Elias-4 has oceans full of liquid neon
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

At the Rainbow Falls tourists often swim in the falls and nearby pools

Did this information appear in one of the texts?

○ Yes

○ No

Display This Question:

If At the Rainbow Falls tourists often swim in the falls and nearby pools   Did this information app... = Yes

At the Rainbow Falls tourists often swim in the falls and nearby pools
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

Julia Weatherford made the announcement about her retirement on her social media

Did this information appear in one of the texts?

○ Yes

○ No

Julia Weatherford made the announcement about her retirement on her social media
 Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Prompt 16

Start of Block: Filler 8

Snowfall on the Byrgern Glacier is often tinted pink by nearby mining pollution

Did this information appear in one of the texts?

○ Yes

○ No

Snowfall on the Byrgern Glacier is often tinted pink by nearby mining pollution
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

The video game company H-Tech only has one original game to start

Did this information appear in one of the texts?

○ Yes

○ No

The video game company H-Tech only has one original game to start
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

Faltren City is known for its traditional basket weaving

Did this information appear in one of the texts?

○ Yes

○ No

- -

Faltren City is known for its traditional basket weaving
  Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

On the reality TV show Civilization, contestants first need to find a source of water

Did this information appear in one of the texts?

○ Yes

○ No

On the reality TV show Civilization, contestants first need to find a source of water
 Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

End of Block: Prompt 18

Start of Block: Filler 10

The company Tunmax recently launched a collection of new products

Did this information appear in one of the texts?

○ Yes

○ No

The company Tunmax recently launched a collection of new products

 Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

Marvin University's agricultural program was not successful in the past

Did this information appear in one of the texts?

○ Yes

○ No

Marvin University's agricultural program was not successful in the past

 Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

The mayor of Rumford was a major advocate for the highway construction project

Did this information appear in one of the texts?

○ Yes

○ No

The mayor of Rumford was a major advocate for the highway construction project

 Did any of the texts you read contain information that contradict this claim?

○ Yes

○ No

Please answer the following demographics questions.
Your answers to these questions will be kept completely anonymous.

Please enter your age in numbers (e.g., 21)

_____

Which gender to do you most identify with?

○ Male

○ Female

○ Non-binary

○ Prefer not to say

Which racial category do you most identify with?

○ Black or African American

○ White

○ Asian or Asian American

○ American Indian/Alaskan Native

○ Native Hawaiian/Pacific Islander

○ Other

○ Prefer not to say

End of Block: Demographics

APPENDIX C

For all experiments reported in this thesis, approval for human subjects was obtained from the University of New Hampshire Psychology Department Internal Review Board. Forms demonstrating proof of approval are included in this Appendix.

IRB #: IRB-FY2022-66
Title: An Investigation of the On-line Processes Involved in Multiple Document Comprehension
Creation Date: 8-8-2021
End Date:
Status: Approved
Principal Investigator: Allison Sonia
Review Board: UNH IRB
Sponsor:

Study History

Submission Type	Initial	Review Type	Exempt	Decision	Exempt
Submission Type	Modification	Review Type	Exempt	Decision	Approved

Key Study Contacts

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