

GRAMMAR AND COGNITIVE PROCESSING OF NEWS ARTICLES:
EXPLORING DUAL-PROCESSING THEORIES

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by
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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

GRAMMAR AND COGNITIVE PROCESSING OF NEWS ARTICLES:
EXPLORING DUAL-PROCESSING THEORIES

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To my parents, sisters, grandparents, aunts, uncles, and cousins ...
whose constant support has brought me to this point in my life.

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
LIST OF ILLUSTRATIONS	vi
ABSTRACT	vii
Chapter	
1. INTRODUCTION	1
2. LITERATURE REVIEW	5
Origins of the Elaboration Likelihood Model	
Applications of the Elaboration Likelihood Model	
Origins of the Heuristic-Systematic Processing Model	
Applications of the Heuristic-Systematic Processing Model	
Grammar Processing	
Peripheral/Heuristic	
Central/Systematic	
Moderating Factors	
Research Question	
Credibility	
Dual-Processing Theories and Credibility	
3. METHODOLOGY	30
Design	
Participants	
Independent Variable	
Grammatical Error	

Dependent Variable	
Cognitive Processing	
Stimulus	
Interest and Involvement	
Pretest of Topics	
Procedures	
4. RESULTS	41
Data Analysis	
Interest and Involvement	
Cognitive Processing	
Research Question	
5. DISCUSSION AND CONCLUSION	47
Overview	
Limitations	
Future Research	
Conclusion	
APPENDIX	
1. Length and Readability of Stimulus Topics	56
REFERENCES	57

LIST OF ILLUSTRATIONS

Figure	Page
1. TABLE 1 <i>Sequence and Level of Topics Appearing in Each Order</i>	31
2. TABLE 2 <i>Pretest of Topic Interest</i>	39
3. TABLE 3 <i>Pretest of Topic Involvement</i>	39
4. TABLE 4 <i>Topic Interest</i>	42
5. TABLE 5 <i>Topic Involvement</i>	42
6. TABLE 6 <i>Cognitive Processing With and Without Grammatical Errors</i>	45
7. TABLE 7 <i>Differences in Cognitive Processing With and Without Grammatical Errors</i>	46

GRAMMAR AND COGNITIVE PROCESSING OF NEWS ARTICLES:
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ABSTRACT

This study considers the impact of grammatical errors on cognitive processing and subsequent evaluation of news articles. It begins with an examination of the Elaboration Likelihood Model, the Heuristic-Systematic Processing Model, and grammar-related research. An experiment then tests the impact of grammatical errors on measures of cognitive processing. Participants read articles with varying levels of grammatical error and answer questions to reveal cognitive processing. The results show that grammatical errors in news articles are associated with high mental effort, low retention, and low perceived credibility. These measures indicate that grammatical errors are associated with deep processing of news articles. This study recommends that journalists focus more of their attention on fixing grammatical errors, as doing so will provide a better service to their readers.

1. INTRODUCTION

How does grammar impact the way that readers of news articles process information? Do grammatical errors harm credibility and comprehension? Do readers recognize errors automatically? Or do they need to be in a mode of cognitive processing where they are systematically examining text to recognize errors? Is grammar processed superficially or deeply?

This exploratory study examines those questions through the lens of two cognitive-response theories: the Elaboration Likelihood Model and the Heuristic-Systematic Processing Model. Taken together, these theories provide guidance into how individuals process information, and they inform an experiment that considers how grammar impacts the way readers process printed text. The experiment tests the impact of grammatical errors on the reading and evaluating of news articles. Specifically, it tests the impact of grammatical errors on mental effort, cued recall, and perceived credibility.

From a scholarly perspective, this study offers a deeper understanding of how the human mind processes and stores linguistic information in the form of printed news text. Cognitive psychologists have studied how individuals process grammar. This line of research has examined processing of individual words (Aaltonen et al., 2008) (Blankenship & Holtgraves, 2005); phrases (Shtyrov, Pulvermüller, Näätänen, &

Ilmoniemi, 2003) (Sanford, 2008) (Ottati, Rhoads, & Grasser, 1999); sentences (Vasisth, Brussow, Lewis, & Drenches, 2008) (Bates, Devescovi, & D'Amico, 1999); paragraphs (Goldman, Saul, & Cote, 1995); spoken language (Pulvermüller, Shtyrov, Hasting, & Carlyon, 2008) (Gayraud & Martinie, 2008); and advertisements (Sparks & Areni, 2008). None of the research has moved to studying processing of everyday reading materials, such as print news articles.

This study also offers a unique application of dual-processing theories. The Elaboration Likelihood Model and the Heuristic-Systematic Processing Model, along with other dual-processing theories, are often used to examine effectiveness of persuasive messages. This study expands their reach by applying them to the area of linguistic processing of news articles. Research on persuasive media messages has not extensively studied the impact of grammatical errors, which this study will do. In addition, it's possible that in today's news environment, characterized by an increase in editorial content over objective content, readers could be processing print news articles in the same way that they process more explicitly persuasive messages. Although such claims are beyond the scope of this study, the possibility offers an argument for the relevance of theories of persuasion to the processing of news articles.

This study has practical significance for professionals. Copy editors fix grammatical errors at print publications. However, they are also often responsible for proofreading, fact checking, headline writing, and designing. This study provides copy editors with a better sense of where they should focus their attention. If grammatical

errors impact processing at a level that significantly impacts the reading and evaluating of articles, then copy editors should focus on fixing those mistakes. If grammatical errors don't impact processing, then copy editors would be more effective by focusing on their other responsibilities. This study provides a better understanding of the way grammar impacts processing, which will help copy editors to better allocate their time and more effectively serve their readers.

This study also tests the assumption among journalists about the role of grammar in perceived credibility. The American Society of Newspaper Editors conducted a survey in 1999 to determine reader and journalist perceptions of the press. One section of the survey's analysis was dedicated entirely to grammar. It began as follows: "Each misspelled word, bad apostrophe, garbled grammatical construction, weird outline and mislabeled map erodes public confidences in a newspaper's ability to get anything right" (Howell & Urban, 1999). Journalists generally assume that grammatical errors impact perceived credibility. If an article is grammatically incorrect, the argument goes, then readers will conclude that it is also factually incorrect. This study empirically tests the assumption that grammar is connected to credibility judgments.

This study measures the impact of grammar on cognitive processing. It considers how grammatical errors influence the effort needed to process news articles. When readers are interested and involved in reading a news article, then, according to dual-processing theories, they should be engaged in a more systematic or effortful mode of processing and evaluating the article (Ottati, Rhoads, & Grasser, 1999) (Blankenship &

Holtgraves, 2005) (Reinhard & Sporer, 2008). This experiment holds interest and involvement levels high to ensure that judgments are based on deep processing. If articles containing high levels of grammatical error lead to a significant increase in required mental effort, then grammar will appear to influence systematic processing. This could lead grammatical errors to have a significant impact on perceived credibility of the articles. If articles containing high levels of grammatical error do not lead to a significant increase in required mental effort, then grammar will appear to not influence systematic processing. This could mean that grammatical errors do not significantly impact perceived credibility.

To examine the impact of grammatical errors on the reading and evaluating of print news articles, an experiment was conducted. Participants read three articles containing no grammatical errors and three articles containing several grammatical errors. Measurements were then taken to reveal mental effort, cued recall, and perceived credibility. The results for error-filled articles were then compared to the results for error-free articles to determine how grammatical errors influence cognitive processing and evaluation of news articles.

2. LITERATURE REVIEW

The Elaboration Likelihood Model and the Heuristic-Systematic Processing Model are both cognitive-response theories that examine how people process information. Despite an attempt by a research group to replace these dual-process theories with a content-based model (Kruglanski & Thompson, 1999), the two theories are both still the forerunners in studies that analyze cognitive-response processing.

Both models offer that information can be processed in one of two ways: either superficially or deeply. The Elaboration Likelihood Model refers to these modes as peripheral and central, respectively, and the Heuristic-Systematic Processing Model refers to them as heuristic and systematic, respectively. They both argue that this distinction is determined by attributes of the information and attributes of the reader.

The two models were created to analyze persuasive messages, and they are mostly used in such research. However, it still makes sense to apply them to the analysis of print news articles. Reporters write arguments in all of their articles, whether those arguments be more direct (i.e. This politician is corrupt) or more subtle (i.e. This issue is important). Because all print news articles include underlying arguments, it should follow that they are processed similarly to persuasive messages. In addition, many print news outlets have

shifted from objective content to editorial content in recent years. This further supports the claim that print news articles are processed similarly to persuasive messages.

It also makes sense to apply dual-processing theories to the analysis of grammar. Both the Elaboration Likelihood Model and the Heuristic-Systematic Processing Model discuss argument strength. They offer that argument strength is an attribute of the text and, as such, can be used to analyze cognitive processing. This study argues that grammar can also be considered an attribute of text. Therefore, it should be able to be understood using the same theoretical framework. In addition, both theories discuss argument clarity. They offer that clarity impacts the way messages are processed. This study argues that argument clarity depends on grammatical clarity. A persuasive argument is useless if readers cannot decipher its confusing structure or word choices. Because grammar is an attribute of text that impacts argument clarity, it makes sense to use dual-processing theories to analyze grammar. In fact, one could argue that without a discussion of grammar, studies involving argument processing are incomplete.

This review begins by exploring the development and traditional applications of the Elaboration Likelihood Model and the Heuristic-Systematic Processing Model. It then considers previous research on grammar. Few studies have specifically connected grammar with cognitive processing of news articles. Therefore, that section of the review theorizes based on related literature. Following the exploration of grammar processing, the researcher presents the study's research question.

Origins of the Elaboration Likelihood Model

Richard E. Petty and John T. Cacioppo created the Elaboration Likelihood Model in the early 1980s as an examination of how people process arguments. Their pilot study was published in 1984 and introduced the distinction between central- and peripheral-route processing. The study looked at how the number of arguments in a message impacted agreement, by serving as acceptance cues or enhancing issue-relevant thinking. The researchers modified personal relevance. They had participants read messages about proposed tuition increases at their own university and at another university. The messages contained arguments that were either cogent, specious, or both. Participants then indicated the extent to which they agreed with the arguments. Researchers found that number of arguments was more important with low-involvement articles and argument quality was more important with high-involvement articles. These findings supported their proposed theory of dual processing.

Petty and Cacioppo proposed two routes to attitude change: the central route and the peripheral route. They offered that the central route is characterized by thoughtful analysis, whereas the peripheral route is characterized by positive or negative cues. In the case of this experiment, high-involvement led to central processing and low-involvement led to peripheral processing. (Petty & Cacioppo, 1984).

The Elaboration Likelihood Model was thus created to analyze how people process arguments. It offers that information is processed either superficially (peripherally) or deeply (centrally).

Applications of the Elaboration Likelihood Model

The Elaboration Likelihood Model has been used as the foundation for a variety of processing studies. Many of these studies relate to message construction. One such study compared testimonials to informational messages to determine which type was more persuasive. Participants read or listened to health-related messages and answered questions about persuasion and their own need for cognition. The study found that testimonials are more persuasive when presented through an audio mode as opposed to a written mode. It found that testimonials are more effective than informational messages for people with low involvement and low need for cognition. Informational messages are more effective than testimonials for people with high involvement and high need for cognition. Testimonials are more effective when processed peripherally, and informational messages are more effective when processed centrally. (Braverman, 2008).

Another study determined that resonance is a mediating factor in message processing. The study showed participants messages related to a fictitious disease. Some people were told that it was spreading through China, and some were told that it was spreading through Canada. The researcher presented messages that were promotional, medical, and promotional/medical. Some messages offered tourist discounts to the countries while others informed the reader about government safeguards to protect the populations. The study considered the participants' reactions to the messages. It also considered the participants' previously held beliefs about the countries and their own

travel history. The study found that resonance motivates participants to act, regardless of the action's consequences. (Wan, 2008).

Many of the studies grounded in the Elaboration Likelihood Model relate to gender and racial stereotyping. One such study considered how a source's race impacts the message's effectiveness in persuasive communication. Through a series of experiments, researchers supported the S. L. Gaertner and J. F. Dovidio's theory of aversive racism (Gaertner & Dovidio, 1986). They found White people are so concerned with not appearing racist that they became motivated to process messages presented from Black sources. (White & Harkins, 1994).

Another such study used the Elaboration Likelihood Model to look at anti-homosexual rhetoric in newspapers. The researcher examined advertisements in a "Truth in Love" campaign, which promoted ministries and therapy centers intended to "treat" homosexuals. He analyzed the ads and predicted their impact on readers, based on whether readers are value protective or value affirmative. (Stewart, 2008). He, thus, created a framework from which to test the impact of individual characteristics on processing.

Withers and Wertheim conducted a series of studies applying the Elaboration Likelihood Model to the analysis of eating disorder prevention programs. In 2002, they showed prevention videos to teenage girls, focusing on the role of need for cognition and personal relevance. The study did not turn out as they had hypothesized, and girls with higher levels of need for cognition and personal relevance were not more likely to

process through a central route. (Withers, Twigg, Wertheim, & Paxton, 2002). The researchers decided to replicate the study in 2004 to see if the design of their study was somehow preventing central-route processing. They showed teenage girls videos, this time adding post-video verbal elaboration and written elaboration. The post-video activity groups did not result in more central processing. The researchers offered that the video itself might have resulted in the maximum attitude change possible for the time constraint. Also, the girls might have become desensitized to body-image messages from so much message repetition throughout their lives. (Withers & Wertheim, 2004).

The model has also been used to examine how men and women process rape-prevention messages. The participants answered a series of rape-information questions before and after a rape-prevention intervention. They found that the intervention dispelled myths in both groups but that it had a greater impact on women. From this, they concluded that, with such messages, women use more central-route processing, and men use peripheral cues. They explained that women self-reported higher levels of motivation, relevance, and appropriateness of material in this study, which would account for central-route processing. (Heppner et al., 1995).

Another study applied the model to job recruiters. The study considered the influence of recruiter behavior on how job applicants form attitudes about a company. The study discussed how the model could be applied to job recruiter behavior and then offered suggestions for laboratory research. Researchers divided applicant and recruiter characteristics based on type of processing (i.e. demographic qualities as peripheral cues,

levels of financial need as central cues) to create a framework for future experimentation. (Larsen & Phillips, 2002).

The Elaboration Likelihood Model has also been applied to studies involving technology. One such study applied the theory to computer-mediated communication. Researchers set up an experiment where participants debated in either a face-to-face group discussion or online chat room about a given topic. The researcher interrupted both conversations to announce that an authoritative source had chosen the option that differed from the majority opinion of the group. The groups were instructed to keep discussing and report their decision. Researchers then measured opinion change. They found that the face-to-face group was more likely to change opinion than the computer-mediated group. They concluded that computer-mediated discussion activates the central route, whereas face-to-face discussion activates the peripheral route. (Di Blasio & Milani, 2008).

Another such study looked at the user experience of online shopping. Researchers conducted an experiment to determine how aspects of online shopping sites are processed. They found that participants centrally process messages regarding minimizing travel, information access, and assurances of system security. They peripherally process messages regarding usability, price comparison, and personal information protection. (Warden, Wann-Yih, & Dungchun, 2006).

The Elaboration Likelihood Model, though created to analyze persuasive messages, has been applied to different communication-related research, including the above examples of message construction, gender and racial stereotyping, and technology.

Its usability in such a wide variety of studies supports this study's claim that it can be used to consider grammar in print news articles. Print news articles contain arguments, so they should be able to be understood using theories that explain persuasive messages. Grammar is an attribute of text that contributes to argument clarity, so it should also be able to be understood using theories that explain arguments. The Elaboration Likelihood Model's application to the above studies shows its versatility and ability to be applied to this study.

The Heuristic-Systematic Processing model is another cognitive-response processing model that has been used in similar studies.

Origins of the Heuristic-Systematic Processing Model

Shelly Chaiken developed the Heuristic-Systematic Processing Model as an examination of how people process persuasive messages. In the first of such studies, she identified and began to distinguish between two types of processing, which she called heuristic and systematic. She said heuristic processing focuses on accessible cognitive cues and systematic processing involves detailed analysis of the content and the message. To test this theory, Chaiken conducted an experiment in which she had participants read argument-filled messages from likeable or unlikable communicators and asked questions to determine how participants were processing these messages. She found that for highly involved participants, arguments impacted opinion change while communicator likeability did not. For low-involvement participants, communicator likeability impacted

opinion change while argument strength did not. She concluded that when readers are highly involved in the media, they process information systematically, but when they are less involved, they process more heuristically. She argued that these findings supported her theory of dual processing. (Chaiken, 1980).

In 1989, Chaiken further clarified her model with a group of researchers. They discussed systematic processing as the more methodical, effort- and data-intensive mode of understanding information. They said heuristic processing was the mode that requires less cognition and more focus on such cues as message length and source likeability. (Chaiken, Liberman, & Eagly, 1989).

Chaiken later worked with Durairaj Maheswaran to look at whether the two types of processing were mutually exclusive or whether they could interact. Participants read a pamphlet and were asked questions to determine the role and interaction among task importance, message ambiguity, and source credibility. Researchers found that low-task participants processed articles heuristically, regardless of message ambiguity. For high-task importance participants, processing depended on the message type. When participants read unambiguous messages, they processed systematically if the content contradicted the heuristic, or they processed heuristically if it did not contradict the heuristic. Researchers also found that heuristic processing biased systematic processing in ambiguous messages. From these findings, the researchers concluded that heuristic and systematic processing could interact with each other. (Chaiken & Maheswaran, 1994).

Chaiken had established that there were two types of processing based on involvement that could interact. She then worked with a research group in 1996 to determine which other characteristics of the message receiver impacted processing. The team conducted two studies to compare accuracy-motivated people to impression-motivated people. In the first study, researchers gave participants an essay on media coverage of hijacking events and told them they would be discussing the topic with another group of participants. They filled out questionnaires and were given completed answer sheets. They were told that the answer sheets were from people in the other group. They were then asked to respond to attitude-related questions that would be shared with their (imaginary) partner in the other group. In the second study, participants provided immediate and delayed attitudes toward an essay. From their findings, researchers found that people who are more impression-motivated are more likely to rely on heuristics, in order to best get along with other people. Accuracy-motivated people rely on systematic processing, regardless of what they perceive other people's opinions to be. (Chen & Chaiken, 1996). Thus, Chaiken further showed that the way in which information is processed depends on characteristics of the person receiving the message, not just based on characteristics of the message itself.

The Heuristic-Systematic Processing Model was thus created to analyze how people process arguments. It offers that information is processed either superficially (heuristically) or deeply (systematically).

Applications of the Heuristic-Systematic Processing Model

The Heuristic-Systematic Processing Model has been used as the foundation for various types of processing studies. It has been used to explain patterns in message framing. In one such study, researchers proposed that personal relevance and risky implications impacted perception of message framing. Researchers told participants that they were conducting a health study about the effect of cholesterol on heart disease and asked them to read informational packets about cholesterol. Researchers manipulated personal relevance, risky implications, and message framing. They found that high-risk and high-relevance messages led to systematic processing, which led to greater impact of the negatively framed information. Low-risk and low-relevance messages led to heuristic processing, which led to greater impact of the positively framed information. High-risk and low-relevance messages led to heuristic processing while low-risk and high-relevance messages led to a combination of both types of processing. (Meyers-Levy & Maheswaran, 2004).

The theory has also been used to analyze motivation. A recent dissertation used the model to analyze motivation to see a movie in theaters. The researcher looked at involvement and processing to determine what motivates people to see movies. He grounded his study on research suggesting that theater attendance has decreased in recent years, as a result of such factors as home-entertainment technology, increased cost of tickets, and competition with other entertainment options. He offered that by explaining what motivates people to see movies, he could help film producers create effective

marketing strategies. The researcher conducted a survey and found that heuristic thoughts regarding the film motivated people to go the theater. He also found that the combined systematic and heuristic thoughts regarding the film impacted the decision. However, data did not support the prediction that systematic movie-related thoughts were motivational factors. (Ward, 2008).

The model has also been used in combination with other methods. One group of researchers combined the Heuristic-Systematic Processing Model with the theory of planned behavior to create a model of risk information seeking and processing. The group's goal was to create a framework from which to discuss the processing of risk-related information. Researchers conducted surveys related to two personal health issues and one environmental health issue. They found that people rely on risk-related beliefs when they encounter risk-related actions. The study also found that, consistent across all three issues, systematic processing is positively related to such factors as evaluation strength, attitude strength, and the respondent's previously held behavioral beliefs. (Griffin, Neuwirth, Glese, & Dunwoody, 2002).

The Heuristic-Systematic Processing Model has also been combined with the theory of person-effects. One such study applied the two models to a flag dispute in Mississippi. The state was holding a referendum regarding the Confederate battle emblem on the state's flag. A survey commissioned by a large newspaper showed that the White population wanted to keep the flag as it was while the Black population wanted to change it. The flag stayed as it was. The researchers used this event as the foundation for a

survey of the media's influence on self and others. The researchers conducted a telephone survey throughout the months leading up to the referendum. In addition to demographic and person-effect questions, they asked questions that measured accuracy motivation, information sufficiency, and processing. The researchers found a strong relationship between second-person effects and systematic processing, and they found a weaker relationship between third-person effects and heuristic processing. Data did not support the predicted relationship between first-person effect and systematic processing. (Neuwirth, Frederick, & Mayo, 2002).

The Heuristic-Systematic Processing Model, though created to analyze persuasive messages, has been applied to different communication-related research, including the above examples of message framing and motivation, and alongside other theories, including the above examples of the theory of planned behavior and the theory of person-effects. Its usability in such a wide variety of studies supports this study's claim that it can be used to consider grammar in print news articles. Print news articles contain arguments, so they should be able to be understood using theories that explain persuasive messages. Grammar is an attribute of text that contributes to argument clarity, so it should also be able to be understood using theories that explain arguments. The Heuristic-Systematic Processing Model's application to the above studies shows its versatility and ability to be applied to this study.

Grammar Processing

Both the Elaboration Likelihood Model and the Heuristic-Systematic Processing Model offer that information can be processed either superficially or deeply. However, neither model explicitly categorizes grammar. Some grammar-related research seems to put grammar in the superficial (peripheral/heuristic) category while other research seems to put grammar in the deep (central/systematic) category. Some studies suggest that grammar processing depends on other moderating factors.

Peripheral/Heuristic

Some grammar-related studies seem to put grammar in the peripheral/heuristic category. That is, they describe grammar in the same ways that dual-processing theories describe superficial cues. Grammar seems to be processed rather effortlessly, instead of in a highly thoughtful, consciously evaluative manner.

Grammar has been described as organic. A study theorized as to how a Universal Grammar, based on principles of language structure, has been created. The researchers suggest that language could not have been created by biological adaptation. Instead, they argue that language has been shaped to fit the human brain. They consider language to be a Darwinian organism that evolves over times through human learning and processing mechanisms. The researchers argue that language was shaped to fit the brain.

(Christiansen & Chater, 2008). By arguing that language evolves to fit the brain, the study seems to argue that the brain is more powerful than language. It seems to argue that

the brain controls language. This could lead to the conclusion that grammar is processed superficially. If language was shaped to fit the brain, one could argue, the brain must be equipped to process language with minimal effort. In this study, language is described as a superficial cue.

Grammar has been described as automatic. A group of researchers from Helsinki conducted a study that investigated cerebral processing of grammar. They recorded magnetic fields in the brain when participants were exposed to Finnish phrases that were either grammatically correct or grammatically incorrect. They determined that there was some automatic grammar processing that occurred outside the focus of attention. (Shtyrov, Pulvermüller, Näätänen, & Ilmoniemi, 2003). The study found that some grammar processing occurred outside the focus of attention. Dual-processing theories use similar language to describe peripheral/heuristic processing. They consider processing outside the more intense focus of attention to be a sign of superficial processing. Based on this study, it can be argued that grammar is a superficial cue.

Another automaticity study looked at how people respond to unexpected sounds in their native language. The study looked at Finnish and Estonian participants. The Finnish language has a specific sound, referred to as Finnish vowel harmony, which the Estonian language does not have. The researchers had participants listen to words. The researchers then measured the participants' brain activity. They found that Finnish participants had an automatic reaction when they heard words that violated that harmony while the Estonians did not. (Aaltonen et al., 2008). Participants noticed grammatical

errors automatically. The Elaboration Likelihood Model and the Heuristic-Systematic Processing Model both describe superficial cues as those that require minimal cognitive effort. It can be argued that automaticity indicates minimal effort. For that reason, this study supports the claim that grammar is a superficial cue.

Another automaticity study considered neurophysiological indicators. The researchers recorded neurophysiological indicators while participants were distracted either passively, by watching a film, or actively, by performing a sound-based signal detection task. The study involved four conditions: active, grammatically correct; passive, grammatically correct; active, grammatically incorrect; and passive, grammatically incorrect. Researchers measured Mismatch Negativity, an indicator of automatic change detection. They found that participants distinguished between grammatically correct and incorrect speech even when they were distracted. (Pulvermüller, Shtyrov, Hasting, & Carlyon, 2008). This study argues that grammar can be processed automatically. As in the previous study, this supports the claim that grammar is a superficial cue.

In addition to being organic and automatic, grammar has been described as independent of processing. A group of researchers tested the relationship between sentence complexity and time needed to create that sentence. They operationalized syntactic complexity in terms of the number of subordinating clauses in the sentence. They divided this into although clauses, adverbial clauses, and infinitive clauses. The study was conducted in French. Participants were asked to orally explain their knowledge

about violence. They were then asked to tell a personal story about a time they experienced violence. The stories were recorded and coded to see where participants took pauses. Researchers found that complex sentences were not necessarily difficult to process. (Gayraud & Martinie, 2008). The study found that sentence complexity did not impact processing. In both the Elaboration Likelihood Model and the Heuristic-Systematic Processing Model, cues that do not impact processing are considered to be superficial. By arguing that sentence complexity does not impact processing, this study seems to argue that grammar, or at least complexity, is a superficial cue.

Another study looked specifically at idioms and expressions. The study argued that well-known phrases often become so common that their internal words are predictable to the point of being meaningless. He concluded that this is the reason idioms are often constructed with shorter words in the middle. (Sanford, 2008). The study found that word grouping can make certain words irrelevant to comprehension. Phrase meaning can be understood without considering every word. This seems to support the claim that grammar is a superficial cue. If certain words are not necessary for comprehension, that must mean they require minimal mental effort to process. Dual-processing theories consider effort-free processing to be associated with superficial cues.

The Elaboration Likelihood Model, itself, was used in a related grammar study. The study looked at language power, which the researchers defined as the absence of hesitations and intensifiers, and its impact on processing. The research compared language power to argument quality, in terms of successful persuasion. Participants all

read transcripts of a commercial testimonial. The researchers manipulated time allotted to process the information, language power, and argument quality. They then measured attitude toward the product, valenced-thought indexes, and the extent of message-related and speaker-related thinking. Researchers concluded that language power was a peripheral cue. (Sparks & Areni, 2008). Language power, the absence of hesitations and intensifiers, is a subset of grammar. The finding that language power is a peripheral cue raises the possibility that grammatical error could also be a peripheral cue.

Grammar can be considered a peripheral/heuristic cue. Some grammar-related studies have described grammar as organic and automatic, and some grammar-related studies have shown that grammar is independent of processing and comprehension. Within dual-processing theories, those descriptions indicate superficial processing.

Central/Systematic

Some grammar-related studies seem to put grammar in the central/systematic category. That is, they describe grammar in the same ways that dual-processing theories describe deeply processed cues. Both the Elaboration Likelihood Model and the Heuristic-Systematic Processing Model argue that attributes that impact processing are, themselves, deeply processed. The following studies suggest that grammar impacts other elements of processing and, therefore, is deeply processed.

One such study suggested that grammar impacts reading speed. The study looked at how linguistic relations are established between different parts of a sentence.

Researchers found that when there was a mix of grammatically correct and incorrect aspects of a sentence, people processed sentences less quickly and thought the ungrammatical parts were actually grammatically correct. (Vasisth, Brussow, Lewis, & Drenches, 2008). The study argued that grammar impacts reading speed. If grammar impacts reading speed, it can be argued, it must impact processing, as well. The fact that grammar impacts processing supports the claim that grammar is processed centrally/systematically.

Grammar has also been shown to impact reaction time. A study used the Competition Model to examine the role of grammatical structure. Participants were either native English speakers or native Italian speakers. The researchers focused on word order and subject-verb agreement, which they manipulated in simple sentences and in both the main and relative clauses in complex sentences. They also modified where the relative clause was positioned in the sentence. They performed a total of four experiments: two on word order and two on subject-verb agreement, with one version conducted in print and between subjects and the other conducted online and within subjects. They created sentences with various subjects and clauses related to violence and asked people to determine which character in the sentence was the villain (i.e. “The waitress that the secretary sees shoots the cowboy.”). The study found that English speakers relied on word order while Italian speakers relied on subject-verb agreement. In both cases, reaction time was slower when sentences were constructed in a manner that did not fit the cultural expectations. (Bates, Devescovi, & D’Amico, 1999). In this study, grammar

impacts reaction time. As in the above example, it can be argued that this means grammar impacts processing as well. This supports the claim that grammar is processed deeply.

Grammar has also been shown to impact recall. A study looked at how paragraphs were divided within an article. Researchers showed participants articles, some with main ideas at the beginning of the paragraph and others with elaborations of those main ideas at the beginning of the paragraph. They looked at the effect of the structure on recall of topic importance. The study found that the paragraphing manipulation had a greater impact when the topic was unknown. (Goldman, Saul, & Cote, 1995). This study suggests that grammar impacts recall. In impacting recall, grammar must also impact processing. This further supports the claim that grammar is processed deeply.

Grammar can be considered a central/systematic cue. Grammar-related studies show that grammar can impact reading speed, reaction time, and recall. Within dual-processing theories, those connections indicate deep processing.

Moderating Factors

Some grammar-related studies suggest the grammar processing depends on moderating factors. That is, grammar can be processed either superficially or deeply, depending on other attributes of the text.

Grammar processing can depend on interest. A study used the Motivation Resonance Model to examine how metaphors are processed. Researchers created the model from a combination of the Heuristic-Systematic Processing Model and the

Elaboration Likelihood Model. They looked at sports metaphors and found that people who enjoy sports said that the metaphor contributed to argument strength and people who do not enjoy sports said that the metaphor detracted from argument strength. They concluded that metaphors are processed systematically when they relate to personal interests of the participants and heuristically when they do not. (Ottati, Rhoads, & Grasser, 1999). In this study, grammar processing depends on interest. Grammar fits into the peripheral/heuristic category when people are not interested in the content and the central/systematic category when they are interested in the content.

Grammar processing can also depend on relevance. One study looked at powerful versus powerless language, as determined by such factors as hesitations and disclaimers. Researchers concluded that tag questions, hedges, and hesitations are processed centrally. That effect was greater when relevance was high, which the study says supports the proposed unimodel (Kruglanski & Thompson, 1999). Thus, the study found that language could be seen as both a superficial cue and a deep cue, depending on relevance. (Blankenship & Holtgraves, 2005). Here, grammar processing depends on how relevant the content is to the reader. It fits into the peripheral/heuristic category when people do not find the content to be relevant and the central/systematic when they do find the content to be relevant.

Studies have shown that grammar can be processed both superficially and deeply, depending on such factors as interest and relevance.

Research Question

The Elaboration Likelihood Model and the Heuristic-Systematic Processing Model offer that information can be processed either superficially or deeply, but neither model explicitly categorizes grammar. Some grammar-related research describes grammar as a peripheral/heuristic cue while other research describes grammar as a central/systematic cue.

To reconcile these contradictions, this study holds other factors constant to determine how grammar impacts processing. To do so, this study uses a method similar to the methods used in the *Central/Systematic* studies described above. This study considers the impact of grammatical errors on various factors that indicate processing. By considering how grammar impacts these factors, this study can determine how grammar impacts processing. This addresses the core research question.

RQ 1: How does grammar impact the cognitive processing and subsequent evaluation of news articles?

Several factors can be measured to represent cognitive processing and evaluation. For this study, those factors include mental effort, cued recall, and perceived credibility. Mental effort is measured through reading time, and cued recall is measured through guided thought listing. Credibility is a more vague term that requires further explanation.

Credibility

This study examines the impact of grammar on various measures of cognitive processing. One of those factors is credibility. Media credibility has been measured in various contexts. Kohring and Matthes (2007) provide an overview of credibility research. They offer that credibility has been discussed in terms of source credibility, comparative credibility of media outlets, and identifying dimensions of credibility (Kohring & Matthes, 2007, p. 232). They characterize the term as the trust in selectivity of topics, trust in selectivity of facts, trust in accuracy of depictions, and trust in journalistic assessment (Kohring & Matthes, 2007, p. 239). This study will not take into account source credibility or comparative credibility of media outlets; it will instead focus on identifying dimensions of credibility. These dimensions are explained further in the *Methodology* section.

Credibility was chosen as one of the factors in this study because it addresses a core assumption among journalists. Journalists tend to assume that grammar and credibility are connected. A researcher conducted a survey of journalism schools to determine how they teach grammar. He focused on how grammar, spelling, punctuation, and Associated Press style are emphasized within their curricula. He sent a questionnaire to American journalism schools with questions about grammar competency exams, entrance exams, exit exams, grammar grading policies in non-grammar classes, grammar class requirements, and grammar grading criteria. He also requested syllabi from courses specifically designed to teach editing. The findings indicated that journalism schools

place importance on grammar competency but that many operationalize competency at what the researcher considers to be unacceptably low standards. The researcher concluded that increasing journalism-school standards would be a key step in making the media more credible. (Seamon, 2001). Journalists assume a connection between low standards for grammar and the decline in perceived credibility of the media. By using credibility as one its core measures, this study addresses that assumption.

Dual-Processing Theories and Credibility

Dual-processing theories have been used in credibility studies. In such studies, credibility judgments have been shown to depend on processing. Reinhard and Sporer (2008) tested this in one such study. Their study applied the Elaboration Likelihood Model and the Heuristic-Systematic Processing Model to credibility judgments in a series of three experiments. They found that high task-involvement and cognitive capacity lead to systematic processing when judging credibility. On the contrary, they found that low task-involvement and cognitive capacity lead to peripheral processing when judging credibility (Reinhard & Sporer, 2008, p. 487). This conclusion – that high interest and high involvement lead to systematic processing while low interest and low involvement lead to peripheral processing – echoes the research described above in *Moderating Factors*. Because of this consistency, this study assumes that distinction to be true.

To keep this study focused, the experiment only considers high interest and high involvement situations. The researcher selected story content based on interest and

relevance to the readers. In doing so, this study ensures that credibility judgments are positively correlated with systematic processing. When grammar impacts credibility, grammar is impacting systematic processing. When grammar does not impact credibility, grammar is impacting peripheral processing. Because mental effort and cued recall measures don't specifically depend on interest or involvement, high levels of interest and involvement can be maintained throughout the entire experiment without impacting the other measures of cognitive processing.

Thus *RQ 1 – How does grammar impact the cognitive processing and subsequent evaluation of news articles?* – will be addressed by determining how grammatical errors impact mental effort, cued recall, and perceived credibility of highly interesting and highly relevant news articles.

3. METHODOLOGY

Design

This study used a 2 (grammatical error) by 6 (topic) fractional repeated measures design. Six topics were each written into two articles: one with no grammatical errors and one with several grammatical errors. Each participant read six articles, corresponding to each of the six topics. They each read three articles with no grammatical errors and three articles with several grammatical errors. The experiment is considered to be repeated measures because participants read three articles in each level of error. It is considered to be fractional because participants did not read all topics in all levels. The researcher established six orders, which determined the sequences in which topics appeared and the levels of error in which topics appeared.

The orders were created such that each participant read three articles with no grammatical errors and three articles with a high level of grammatical errors. They were also created so that topics appeared at the beginning of the experiment in two orders (one at each level), at the middle of the experiment in two orders (one at each level), and at the end of the experiment in two orders (one at each level). These orders are described in **TABLE 1**. Participants answered questions to indicate cognitive processing and evaluation. These questions are explained further in the *Dependent Variable* section.

TABLE 1 *Sequence and Level of Topics Appearing in Each Order*

Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
Bookstore	Smoking	Applications	Finals*	Bookstore*	Finals
Rankings	Applications*	Facebook*	Facebook	Smoking*	Rankings*
Smoking*	Bookstore*	Rankings*	Bookstore	Finals	Applications
Facebook*	Facebook	Finals*	Applications*	Rankings	Smoking
Applications	Finals	Smoking	Smoking*	Applications*	Facebook*
Finals*	Rankings*	Bookstore	Rankings	Facebook	Bookstore*

*Note: Order represents the six possible random assignments. Topics are listed in the sequence in which they were presented. The * indicates the articles with high levels of grammatical errors. For example, participants assigned to Order 1 read the Bookstore article with no grammatical errors first, then the Rankings article with no grammatical errors, then the Smoking article with a high level of grammatical errors, then the Facebook article with a high level of grammatical errors, then the Applications article with no grammatical errors, and then the Finals article with a high level of grammatical errors.*

This design was created based on a similar study by Kamhawi and Grabe (2006). For their experiment, the researchers wanted to control for order and story effects to determine the relationship between gender and valence. They created eight stories, and participants read two at each of four levels of valence. The order in which the topics appeared and the level of valence was determined based on random assignment to an order. (Kamhawi & Grabe, 2006).

This design was selected for this study because, logically, it wouldn't make sense for participants to read one topic at two levels of error. This would expose the manipulation and lead to skewed results. Each topic needed to be presented at multiple levels to control for topic-unique effects. This design collapsed responses across topic.

This study's theoretical interest is in the impact of grammatical errors on processing, not the impact of topic on processing. This design allowed for topics to be presented at multiple levels and for participants to read multiple articles at each level. This design was the most logical way to control for topic and order and, therefore, to observe a relationship between grammar and cognitive processing with minimal confounds.

Participants

A total of 98 subjects participated in this study. Participants were mostly students from a large Midwestern university. They were recruited from undergraduate classes across disciplines. Some participants were community members. People who read news articles have varying levels of grammatical knowledge, so it made sense to recruit participants from various backgrounds.

Independent Variable

Grammatical Error

The purpose of this study was to analyze the impact of grammar on processing. To ensure that differences in cognitive processing would reflect differences in grammar, grammatical error was the only independent variable. For this study, grammatical error was conceptualized as any element that defies proper modern English standards. It includes the types of mistakes copy editors are trained to eliminate from print publications. Because this study was conducted among a general audience without

specific grammatical training, the mistakes were limited to those recognizable by a mass audience. They were blatant grammatical errors, as determined by the Missouri School of Journalism's grammar entrance exam. (Speckman, K., personal communication, April 13, 2009). The mistakes included in this experiment were: run-on sentences, sentence fragments, incorrect subject-verb agreement, incorrect pronouns, confused homonyms, double negatives, and incorrect capitalization.

The researcher wrote each of the six news topics into two articles: one with no grammatical errors and one with a high level of grammatical errors. The high-level article included 10 mistakes. This study suggests that manipulating the number of mistakes is more logical than manipulating the type of mistakes. It suggests that readers might be willing to overlook one or two mistakes of any magnitude but that they will begin to question credibility when 10 or more errors are found. (Rowe, J., personal communication, March 13, 2009).

Dependent Variable

Cognitive Processing

This study examined cognitive processing through three measures: mental effort, cued recall, and perceived credibility.

Mental effort is the ease or difficulty with which participants can process text. This was determined by measuring the time participants spent reading each article. MediaLab was programmed to record reading time. Longer reading time corresponded

with higher mental effort. The participants read a sample article prior to the study to determine their baseline reading speeds. Time spent reading other articles was analyzed in comparison to this baseline.

Cued recall was measured by reminding participants of the article's topic and asking them to describe what they remember reading. The researcher personally counted the number of correct facts listed and recorded that number as the cued recall score for that article. The output was organized by participant number, not by article level, so the researcher was unaware of error level during coding. Some topics had more possible facts than others. However, because each topic appeared in both levels of grammatical error, those differences should not impact the comparison. Topic effects don't matter in this type of design. Incorrect facts were ignored and not considered in the cued recall score. The cued recall measure revealed how well the information was stored in long-term memory.

Perceived credibility was measured based on self-responses to a scale created by Shyam Sundar (1999). He determined that perceived credibility could be measured by averaging responses to five judgments: Bias, Fairness, Objectivity, Accuracy, and Believability. Participants of this study indicated how those judgments related to the articles they read by using five-point Likert scales (1 = "Not at all" to 5 = "Very much"). Their responses to Bias were reversed and averaged with the other four to determine perceived credibility. A reliability test was conducted to ensure that these five separate measures were an accurate measure of credibility.

Stimulus

The researcher wrote six news topics into two articles: one with no grammatical errors and one with a high level of grammatical errors. As was stated in the *Independent Variable* section, the high-level article included 10 mistakes.

None of the articles included bylines, quotes, or names. The researcher wanted to ensure that credibility judgments were being made solely based on the language and content.

The six topics were each modified to be consistent in length, complexity, and relevance so that the differences in cognitive processing would be solely based on the differences in grammatical errors. Length and complexity analyses were conducted on the versions of the articles with no grammatical errors. In terms of length, those articles were each 130-140 words and four paragraphs. With that length, readers could get involved in the content, but they could also read all six articles and answer the related questions in a reasonable amount of time. That is also the length of a typical news brief (Lawrence, M., personal communication, March 13, 2009).

The articles were also modified for complexity. Each of the six articles in no-level form had a Microsoft Word Flesch readability score of 35-45. This score is relatively low, which means the articles were relatively complex. This was done to encourage participants to spend time reading the articles, rather than skimming them. The length and complexity scores for each topic are recorded in *Appendix 1*.

The topic content was selected based on relevance. This was done to ensure consistency, as well as to ensure positive correlation with systematic processing. Participants were mostly students from a large Midwestern university. Therefore, the topics were chosen from the local newspaper with that demographic in mind. The six topics were as follows: University application increases (Applications), construction at the University bookstore (Bookstore), Facebook changes (Facebook), changes to the University finals schedule (Finals), nationwide University rankings (Rankings), and campus smoking ban (Smoking). Through the rest of this study, these topics are referred to simply as Applications, Bookstore, Facebook, Finals, Rankings, and Smoking. The participants needed to care about the topics and have some pre-existing knowledge about them to ensure that the credibility judgments were based on deep processing (Ottati, Rhoads, & Grasser, 1999) (Blankenship & Holtgraves, 2005) (Reinhard & Sporer, 2008). To that end, topic interest and involvement were measured through a pretest and during the experiment to confirm that these topics were chosen appropriately.

Interest and Involvement

The study asked participants to self-report their interest and involvement in each topic. To measure interest, this study used the method of a 2008 study regarding students' reading behaviors (Graham et al., 2008). Participants were simply asked how interesting they found the topic to be on a five-point Likert scale (1 = "not at all interesting" to 5 = "very interesting"). To measure involvement, this study used a modified version of a

method used in a 2006 study on advertising effects (Tipps, Berger, & Weinberg, 2006). Participants indicated their agreement on a five-point Likert scale (1 = “strongly disagree” to 5 = “strongly agree”) to the following eight statements. The scores for the statements with asterisks were reversed, and the responses were averaged across statements. Larger numbers corresponded to higher involvement. A reliability test was conducted to ensure that these eight separate measures were an accurate measure of involvement.

1. I found this article to be thought-provoking.
2. I can honestly say I didn't learn anything from this article.*
3. Reading this article was an important part of my day.
4. This article contained information that was important to me.
5. The article didn't affect my feelings one way or another.*
6. I often understood how people in this article feel. I've been in situations like they've been in myself.
7. I become involved in many of the arguments in this article. By the end, I was completely unaware of how much time had passed.
8. I didn't read this article very closely.*

Pretest of Topics

The topics were pretested to ensure that they would elicit high levels of interest and involvement. Juniors, seniors, and graduate students in the journalism program were recruited through student listserves. They were asked to read the six topics and respond to

the interest and involvement scales. For the pretest, all participants read the articles without grammatical errors. Twenty-nine participants completed the pretest.

The interest responses were averaged for each topic. The scale ranged from 1 = “not at all interesting” to 5 = “very interesting.” The interest means for each of the six topics were: 2.90 ($sd = 1.24$), 3.04 ($sd = 1.15$), 3.64 ($sd = 0.95$), 3.80 ($sd = 1.04$), 3.12 ($sd = 1.19$), and 3.04 ($sd = 1.06$). Results are listed in **TABLE 2**. The results show that participants found the topics to be moderately interesting.

The involvement responses were reversed as needed (see asterisks in the *Interest and Involvement* explanation), and they were averaged for each topic. The scale ranged from 1 = “strongly disagree” to 5 = “strongly agree,” where larger numbers correspond to higher involvement. The eight involvement factors showed a Cronbach’s Alpha of 0.783. Therefore, they were considered to be reliable measures of the single factor of involvement. The involvement means for each of the six topics were: 2.62 ($sd = 0.61$), 2.62 ($sd = 0.65$), 3.06 ($sd = 0.55$), 3.31 ($sd = 0.73$), 2.47 ($sd = 0.68$), and 2.44 ($sd = 0.67$). Results are listed in **TABLE 3**. The results show that participants found the topics to be moderately involving.

The results of the pretest indicated that the topics were moderately interesting and involving for participants. If the results had revealed means of 1 on the 5-point scale, the researcher would have chosen different topics for use in this study. Because these means were high on the scale, they were deemed interesting and involving enough for use with this demographic.

TABLE 2 *Pretest of Topic Interest*

Topic	N	Mean	SD
Applications	29	2.90	1.24
Bookstore	26	3.04	1.15
Facebook	25	3.64	0.95
Finals	25	3.80	1.04
Rankings	24	3.12	1.19
Smoking	25	3.04	1.06

Note: Self-report scores were given on a scale of 1 = “not at all interesting” to 5 = “very interesting.”

TABLE 3 *Pretest of Topic Involvement*

Topic	N	Mean	SD
Applications	29	2.62	0.61
Bookstore	27	2.62	0.65
Facebook	25	3.06	0.55
Finals	25	3.31	0.73
Rankings	25	2.47	0.68
Smoking	25	2.44	0.67

Note: Self-report scores were given on a scale of 1 = “strongly disagree” to 5 = “strongly agree.” Larger numbers correspond to higher involvement.

Procedures

The experiment was mostly self-directed. The researcher explained that the participant would read several news articles and answer a series of questions. The participant was randomly assigned to one of six orders, which determined the sequence in which the topics appeared and the levels of error in which they appeared (see **TABLE 1**).

The remaining instructions were written into MediaLab, and the participant proceeded through the various sections on his or her own. The separation from the researcher was intended to create a more natural reading environment.

The participant began the study by reading a sample article to determine a baseline reading speed. The participant then read the first article. The topic and error level of that article varied depending on which order the participant was in. After reading the first article, the participant responded to a series of scales. The first set asked participants to determine their interest and involvement in the topic. The next asked participants to rate their perceived credibility of the article. That scale was presented second so that it would not force participants to relate grammar with credibility. The researcher did not want to skew those results. After reading the first article and answering that series of questions, the participant read the second article and answered the same questions. The participant did the same for all six articles.

After the participant read all of the articles, a short video clip played to distract the participant, thereby clearing short-term memory. The participant then responded to the cued recall for each article. The purpose of the cued recall was to test how well the information was stored in long-term memory, not short-term memory. For that reason, it was measured late in the study, after the distracter.

Participants spent approximately five minutes on each article and its related scales and questions. The entire study took 20-30 minutes to complete.

4. RESULTS

Data Analysis

Results for 98 participants were analyzed to determine how grammar impacts cognitive processing and subsequent evaluation of news articles. Interest and involvement checks are listed below, followed by dependent variable measures.

Interest and Involvement

Topic interest was determined through self-report. The interest scale ranged from 1 = “not at all interesting” to 5 = “very interesting.” Responses were then averaged for each topic. The interest means for each of the six topics were: 3.41 ($sd = 1.21$), 3.33 ($sd = 1.24$), 3.19 ($sd = 1.15$), 3.65 ($sd = 1.14$), 2.96 ($sd = 1.44$), and 3.39 ($sd = 1.19$). Results are listed in **TABLE 4**. Topic involvement was also determined by self-report. The involvement scale ranged from 1 = “strongly disagree” to 5 = “strongly agree,” where larger numbers correspond to higher involvement. The eight involvement factors showed a Cronbach’s Alpha of 0.820. Therefore, they were considered to be reliable measures of the single factor of involvement. Responses were reversed as needed (see asterisks in the *Interest and Involvement* explanation). The involvement means for each of the six topics were: 2.98 ($sd = 0.82$), 2.91 ($sd = 0.76$), 2.72 ($sd = 0.65$), 3.27 ($sd = 0.72$), 3.02 ($sd =$

0.81), and 2.96 ($sd = 0.82$). Results are listed in **TABLE 5**. The interest and involvement measurements were moderately high across topics, consistent with the pretest results.

TABLE 4 *Topic Interest*

Topic	N	Mean	SD
Applications	98	3.41	1.21
Bookstore	98	3.33	1.24
Facebook	98	3.19	1.15
Finals	98	3.65	1.14
Rankings	98	2.96	1.44
Smoking	98	3.39	1.19

Note: Self-report scores were given on a scale of 1 = “not at all interesting” to 5 = “very interesting.”

TABLE 5 *Topic Involvement*

Topic	N	Mean	SD
Applications	98	2.98	0.82
Bookstore	98	2.91	0.76
Facebook	98	2.72	0.65
Finals	98	3.27	0.72
Rankings	98	3.02	0.81
Smoking	98	2.96	0.82

Note: Self-report scores were given on a scale of 1 = “strongly disagree” to 5 = “strongly agree.” Larger numbers correspond to higher involvement.

Cognitive Processing

The results for mental effort, cued recall, and perceived credibility were calculated by collapsing data across topics. All participants read three articles with no grammatical errors and three articles with several grammatical errors. The scores for articles with no grammatical errors were averaged together, and the scores for articles with high levels of grammatical error were averaged together. These means are shown in **TABLE 6**. The no-error articles were then compared to the high-error articles through paired-samples *t* tests. The results of these *t* tests are shown in **TABLE 7**.

Mental effort was calculated as time data through MediaLab. At the beginning of the experiment, participants read a sample article to determine a baseline reading speed. Mental effort invested in reading the six core articles was measured as change from the baseline. That is, the mental effort scores were determined by taking the time spent reading an article and subtracting the baseline reading speed. Large numbers, therefore, indicate that the participant spent more time reading that particular article than he or she did reading the baseline article. Based on the distribution, 10 participants were considered to be outliers. For the no-error data, participants whose change from baseline speed was less than -29241 milliseconds or greater than 23992 milliseconds were eliminated from the sample. For the high-error data, participants whose change from baseline speed was less than -27446 milliseconds or greater than 36859 milliseconds were eliminated from the sample. A paired-samples *t* test was calculated to compare the mean no-error time with the mean high-error time. Once the outliers were eliminated from the sample, the

mean change from baseline for articles with no grammatical errors was 1060.07 milliseconds ($sd = 9138.21$), and the mean change from baseline for articles with high levels of grammatical error was 6324.68 milliseconds ($sd = 10095.69$). The standard deviations for these means were relatively high, indicating a large spread in data. This is likely because reading speed was measured in milliseconds, which is a small measure. Participants took a significantly longer time to read the high-error articles ($t(87) = -6.639, p < .000$).

Cued recall measurements were collected through self-response. Participants were reminded of each topic and asked to describe what they remember reading. The researcher personally counted the number of correct facts listed and recorded that number as the cued recall score for that article. The output was organized by participant number, not by article level, so the researcher was unaware of error level during coding. Some topics had more possible facts than others. However, because each topic appeared in both levels of grammatical error, those differences should not impact the comparison. Topic effects don't matter in this type of design. Incorrect facts were ignored and not considered in the cued recall score. A paired-samples t test was calculated to compare the mean no-error cued recall with the mean high-error cued recall. The mean cued recall for articles with no grammatical errors was 2.92 ($sd = 1.03$), and the mean cued recall for articles with high levels of grammatical error was 2.40 ($sd = 0.96$). Participants recalled significantly less information from the high-error articles ($t(97) = 5.321, p < .000$).

Perceived credibility measurements were also collected through self-response.

Participants indicated how five judgments – Bias, Fairness, Objectivity, Accuracy, and Believability – related to the articles they read by using five-points Likert scales, where 1 = “Not at all” to 5 = “Very much.” Their responses to Bias were reversed. These five factors showed a Cronbach’s Alpha of 0.872. Therefore, they were considered to be reliable measures of the single factor of credibility. These five scores were averaged for each participant for each article. A paired-samples *t* test was calculated to compare the mean no-error perceived credibility with the mean high-error perceived credibility. The mean perceived credibility score for articles with no grammatical errors was 3.84 (*sd* = 0.53), and the mean perceived credibility score for articles with high levels of grammatical error was 3.57 (*sd* = 0.73). Participants perceived credibility to be significantly lower in the high-error articles ($t(97) = 4.221, p < .000$).

TABLE 6. *Cognitive Processing With and Without Grammatical Errors*

Measure of cognitive processing	Error level	N	Mean	SD
Mental effort	No error	88	1060.07	9138.21
Mental effort	High error	88	6324.68	10095.69
Cued recall	No error	98	2.92	1.03
Cued recall	High error	98	2.40	0.96
Perceived credibility	No error	98	3.84	0.53
Perceived credibility	High error	98	3.57	0.73

Note: Mental effort was measured (in milliseconds) as change in baseline reading speed (time to read article – time to read baseline article). Cued recall was measured in number of correct facts remembered from an article. Perceived credibility was measured through self-report scales, where 1 = “Not at all” to 5 = “Very much.”

TABLE 7. *Differences in Cognitive Processing With and Without Grammatical Errors*

Measure of cognitive processing	Mean difference between grammatically correct and incorrect articles	SD	<i>t</i>	<i>df</i>	<i>p</i>
Mental effort	-5264.61	7439.22	-6.639	87	0.000*
Cued recall	0.52	0.97	5.321	97	0.000*
Perceived credibility	0.26	0.61	4.221	97	0.000*

*Note: *p < .001, two-tailed test. Mental effort was measured (in milliseconds) as change in baseline reading speed (time to read article – time to read baseline article). Cued recall was measured in number of correct facts remembered from an article. Perceived credibility was measured through self-report scales, where 1 = “Not at all” to 5 = “Very much.”*

Research Question

Participants in this study found all six topics to be interesting and involving. This study’s research question was as follows: *How does grammar impact the cognitive processing and subsequent evaluation of news articles?* Based on this data, grammar impacts the cognitive processing and subsequent evaluation of news articles in three ways. Grammatical errors are associated with high mental effort, low retention, and low perceived credibility of news articles.

5. DISCUSSION AND CONCLUSION

Overview

Grammar impacts the cognitive processing and subsequent evaluation of news articles in three ways. First, grammatical errors are associated with high mental effort, as determined by long reading time. Participants spent more time reading the articles with errors than they did the articles with no errors. Second, grammatical errors are associated with low retention. Participants recalled fewer correct facts from the articles with errors than they did from the articles with no errors. Third, grammatical errors are associated with low perceived credibility. Participants judged articles with errors to be less credible than articles with no errors. The high scores for interest and involvement indicate that these judgments were based on deep (central/systematic) processing, rather than on superficial (peripheral/heuristic) processing.

On its surface, the cognitive processing data appears to be contradictory. Grammatical error is associated with both high mental effort and low retention. That is, readers spent more time reading the articles with grammatical errors, but they remembered less information from them. It would seem that more time spent reading would result in more retention. One possible explanation can be derived from the Limited Capacity Model of Mediated Message Processing (Lang, 2000). The model offers that

people have limited capacity to store and process information. It could be that readers were processing errors at the expense of storing information. This is supported by the cued recall data, where several participants specifically recalled grammatical errors from the articles (see *Limitations*). Grammatical-error processing might have used the cognitive resources that would have otherwise been allocated to information storing. That would explain why error-filled articles led to both high mental effort and low retention.

Limitations

There were some limitations to this study. One limitation involves knowledge of the manipulation. When asked to respond to the cued recall, 14 participants specifically commented that they remembered grammatical errors (i.e. “Students are unhappy about something, but I have no idea what it was since I couldn’t get past the typos.” “I don’t remember a lot because I was distracted by the grammatical errors in the article.”). This confirms that there was a strong manipulation. However, that doesn’t discount the data, partly because those participants only constitute 14% of the sample, and partly because dual-processing theories say that people can be conscious of both superficial and deep processing. Knowledge of the manipulation should not have impacted the data for interest, involvement, or mental effort. However, it is possible that some of those 14 participants answered the cued recall and perceived credibility questions differently because they knew what the study was examining. The data is still valid, but knowledge of the manipulation was a limitation.

Another limitation involved one of the cued recall questions. One cued recall asked participants to describe what they remember about the article they read concerning University affordability. The researcher intended this question to refer to the Rankings article. However, the baseline article also mentioned affordability, and 19 participants included facts from that article instead of facts from the Rankings article. The cued recall scores for the Rankings article were left blank for those 19 participants and considered missing data during analysis. This would seem to be a significant limitation. However, the topic (and, therefore, the confusion) occurred in both levels of grammatical error. Because the analysis collapsed data across topics to focus on the impact of grammatical errors, the comparison results should still be valid. However, this confusion was still a limitation of the study.

Future Research

As an exploratory study, this experiment hopes to encourage future research. Several aspects of this study could be expanded upon. One is the conceptualization of grammatical error. In conceptualizing grammatical error, this study only considered two levels: none and high. A study could consider more levels to provide further insight into the relationship between grammar and processing. It could be that there is a point at which errors begin to impact cognitive processing. Perhaps two grammatical errors do not impact processing but eight grammatical errors do. A future study could consider multiple levels of error.

The conceptualization of grammatical error in this study was based on quantity. Each error-filled article had 10 mistakes in it. A future study could consider the impact of the type of errors, rather than of the number of errors. Perhaps certain grammatical errors impact cognitive processing more than others. It could be, for example, that spelling errors impact processing while punctuation errors do not. That could also vary by measure of cognitive processing. Maybe incorrect pronouns impede reading speed while confused homonyms impede cued recall. A future study could manipulate types of errors, rather than number of errors, to better understand the impact of grammar on cognitive processing.

A future study could also consider the impact of emotion on cognitive processing of grammar. It could be that grammatical errors lead to reader frustration or anger. Perhaps error-free text leads to positive valence and error-filled text leads to negative valence. This could explain why errors impact cognitive processing. Such a study would also provide further justification for the importance of grammar-free text in print publications. If errors lead to negative emotional responses, then readers might associate the publications, themselves, with negative emotions. Such a study would provide a further explanation for the results found in this study.

Future studies could also expand upon the cued recall analysis. In coding cued recall for this study, the researcher only considered the number of correct facts that participants remembered from the articles. The researcher ignored the incorrect facts that they listed. A future study could somehow code for incorrect facts, either by subtracting

them from correct facts or by creating a separate measure. This study found that grammatical errors are associated with low retention of correct information, but perhaps grammatical errors also impact the number of incorrect facts readers attribute to articles. Maybe confusion caused by grammatical errors leads readers to misunderstand the content. A future study could compare cued recall of incorrect facts with cued recall of correct facts at each level of grammatical error.

Another aspect of the study that could be modified is the conceptualization of credibility. For this study, none of the articles included bylines, quotes, or names. The researcher wanted readers to judge credibility of the text rather than credibility of the sources. Future studies could consider the impact of such information. For example, a study could consider whether authoritative sources can moderate the impact of error on processing. Maybe readers will overlook grammatical errors if they trust the source. A study could consider such a possibility.

A future study could also modify the use of the interest and involvement data. In this study, that information was used to confirm the topic selection. A future study could consider those measures to be dependent variables. That is, it could consider the impact of grammatical errors on interest and involvement levels. It could be that errors lead to low interest and low involvement because they frustrate readers. However, errors might lead to high interest and high involvement because readers need to exert more energy to process them, thereby giving them more time to consider the information. A study could consider interest and involvement to be dependent variables.

Another aspect of this study that could be built upon is demographics. This study did not collect any personal data on participants. A study could consider how socio-economic group, age, gender, or profession affect the impact of grammar on cognitive processing and evaluation. Maybe grammatical errors impact processing for some people more than they do for others. A study could look at personal data to analyze what personal characteristics could explain differences in processing.

This study could also be applied to other types of media. This study considered grammatical errors in print news articles. A similar study could consider such errors in other types of print articles, such as features or sports. Grammatical errors might matter more in features articles, where the focus is on descriptions and narratives, but they might matter less in sports articles, where the focus is on numbers and statistics. A study could look at these genres of print articles individually or together. A similar study could also consider the impact of error on processing in other types of media, such as audio or broadcast. Maybe people are less aware of spoken grammatical errors than they are of written ones. It could be that grammatical errors have less of an impact in broadcast than they do in audio because broadcast allows for visuals that can clarify confusion caused by the language. A study could look at any of these media individually or together.

Such studies would provide further insight into the impact of grammar on cognitive processing and evaluation.

Conclusion

This study used dual-processing theories to determine the significance of grammatical errors in news articles. It was observed that grammar significantly impacts the cognitive processing and subsequent evaluation of news articles. Grammatical errors are associated with high mental effort, low retention, and low perceived credibility.

The high measures of interest and involvement indicate that the observed relationships were based on deep (central/systematic) processing, rather than on superficial (peripheral/heuristic) processing. This study thus found that grammatical errors lead to deep processing in news articles.

The results of this study yield theoretical insight into how the mind processes grammar in everyday reading. As mentioned in the *Introduction*, such an analysis has not previously been conducted. Based on this study, grammar impacts deep (central/systematic) processing in news articles. That is, in everyday reading, grammar would be characterized as a deep cue by dual-processing models. In that regard, grammar impacts cognitive processing in the same way that argument strength and argument clarity impact cognitive processing. This study thus provides a new theoretical framework from which to understand the role of grammar in cognitive processing.

The specific aspects of cognitive processing that this study examined all have practical applications for journalists. First, this study found that grammatical errors are associated with high mental effort. Participants needed more time to read the grammatically incorrect articles than they needed to read the grammatically correct

articles. Presumably, this was because participants needed to reread sentences to understand their meaning. This poses an inconvenience in the current media environment of quick news consumption. Grammatically incorrect text requires more mental effort to process than does grammatically correct text, and this inconveniences readers. To keep readers engaged, journalists need to present grammatically correct text.

Second, this study found that grammatical errors are associated with low retention. Participants remembered less information from the grammatically incorrect articles than they remembered from the grammatically correct articles. This is likely because the errors were distractions. Participants were focusing on understanding the structure and language of the article, rather than focusing on storing the content in long-term memory. To keep readers informed, journalists need to present grammatically correct text.

Third, this study found that grammatical errors are associated with low perceived credibility. Participants considered the grammatically incorrect articles to be less credible than the grammatically correct articles. This supports the journalists' assumption mentioned in the *Introduction*: If an article is grammatically incorrect, readers will assume that it is also factually incorrect. To maintain their own authority, journalists need to present grammatically correct text.

Based on this study, journalists must present grammatically correct text if they are to remain authoritative sources for engaged and informed readers. Copy editors, even those with multiple responsibilities, should focus on finding and changing grammatical

errors. Grammatical errors impact cognitive processing and subsequent evaluation of news articles to the point of influencing readers' experiences. Because of its impact on cognitive processing and evaluation, grammar should be a priority for journalists who want to effectively serve their readers.

APPENDIX 1

Length and Readability of Stimulus Topics

Topic	Topic description	Word count	Readability score
Applications	University application increases	137	40.3
Bookstore	Construction at the University bookstore	134	44.6
Facebook	Facebook changes	132	40.9
Finals	Changes to the University finals schedule	134	43.3
Rankings	Nationwide University rankings	132	38.1
Smoking	Campus smoking ban	136	44
3 – Year (baseline)	Graduating in three years	138	44

Note: Readability scores were calculated with the Microsoft Word Flesch readability score function. Word count and readability scores were calculated for each topic based on the articles with no grammatical errors. Those articles were all written such that word count was 130-140 and readability was 35-45.

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