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Research Article

Examining the Application of Artificial Intelligence Techniques in Enabling Syntactic Ambiguity such as Attachment Ambiguity among Hail University Students

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ABSTRACT

Syntactic ambiguity, particularly attachment ambiguity, poses a significant challenge for language learners. This study investigates the potential of Artificial Intelligence (AI) techniques to enhance the understanding and resolution of such ambiguities among students at Hail University. The research employs a qualitative research approach (structured interview) to assess the effectiveness of AI- driven interventions in improving students' ability to recognize and resolve syntactic ambiguities. Initial findings indicate that the use of AI tools results in heightened sensitivity to ambiguity, clarity of writing. This research adds to the expanding literature on AI in education through its contribution of knowledge on the actual use of AI methods for easing particular linguistic issues in a special education setting. Education through offering a window into the actual usage of AI methods for resolving certain linguistic issues in a particular educational setting.

Keywords: Artificial Intelligence Techniques, Syntactic Ambiguity, Attachment Ambiguity.

1 INTRODUCTION

Syntactic ambiguity occurs when a sentence can be parsed in multiple ways due to its structure, leading to different interpretations. Attachment ambiguity, a subset of syntactic ambiguity, arises when a modifier (such as a prepositional phrase or adjectival clause) can be attached to more than one constituent in a sentence. This phenomenon is particularly problematic in language learning and comprehension, as it can hinder effective communication and understanding (Rani, et al., (2024)). Recent development in AI, specifically in NLP, has promising prospects to resolve syntactic ambiguities. The aim of this research is to identify ways in which AI methods can be incorporated into learning systems to build up students' comprehension and resolution of attachment ambiguities. By providing insight into the possibility through which AI approaches could assist students in resolving syntactic ambiguities, this research seeks to bridge the gap between language comprehension and AI technology. The findings of this research would assist researchers and educators in devising effective ways of integrating AI tools in language learning, which in turn would improve college students' communication and understanding abilities (Singh, Avaneesh, et al., 2024).

1.1 Research Problem

The main research issue covered in this work is the issue of syntactic ambiguity, more particularly attachment ambiguity, and its effect on reading comprehension and language acquisition by students. As much as ambiguity is a natural phenomenon in natural language, little is known on how AI can be utilized to improve students' performance in managing and resolving ambiguities efficiently.

1.2 Describe the significance of the problem

For learners of language, both first and second language learners, this kind of vagueness can be a real obstacle. Take, for example, a student who reads the sentence "The man saw the boy with the telescope." Did the man see the boy using the telescope, or did the boy have the telescope? The sentence structure itself does not tell us clearly.

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This ambiguity can significantly impact reading comprehension. If a student misinterprets the intended meaning, they might miss crucial information, misunderstand the plot of a story, or even get the wrong instructions in a task. It can lead to frustration and potentially hinder their progress in language acquisition. If they consistently misunderstand such structures, their internal understanding of how the language works might develop in an inaccurate way.

Now, this is where the potential of AI comes in, and why your research problem is so timely and relevant. While we humans often resolve these ambiguities intuitively based on context, our experience, and general world knowledge, language learners are still developing these skills. This is where AI could be a powerful ally.

1.3 Research Objectives

The aims of this study are as follows:

To explore the prevalence of attachment uncertainty in written messages received by students of Hail University.

To assess the present understanding levels of the students about attachment ambiguity.

To analyze the efficacy of different AI methods in interpreting students' comprehension of uncertainty in attachment.

To ascertain the cumulative effect of the AI-based tool on students' performance in resolving syntactically ambiguous tasks.

2 LITERATURE REVIEW

Syntactic ambiguity, a phenomenon where a sentence can be interpreted in multiple ways due to its structure, poses significant challenges in language comprehension and communication.

It is crucial in linguistic study and in real-world applications, for example, in education where it can influence the understanding and utilization of language by students. With the advent of Artificial Intelligence (AI) in educational contexts, there has been growing interest in leveraging AI techniques to enhance linguistic competencies, particularly among university students. This literature review synthesizes current research on AI-driven methodologies aimed at reducing syntactic ambiguity to improve comprehension and linguistic proficiency, focusing specifically on Hail University students. Syntactic ambiguity arises when a sentence can be parsed in different ways, leading to multiple interpretations.

Researchers like Clark and Clark (1979) have developed models that identify categories of ambiguities, e.g., lexical ambiguity and structural ambiguity. Research like Frazier (1987) and Gilboy et al. (1995) demonstrates how syntactic ambiguity can impede understanding and compromise interaction dynamics in spoken and written communication.

In an academic setting, especially in the tertiary level, where learners have to deal with complicated texts, the occurrence of such ambiguities can be an obstacle to learning and critical thinking.

2.1 Definitions and Types of Syntactic Ambiguity

Syntactic ambiguity is found in two broad types: structural ambiguity and lexical ambiguity. Structural ambiguity is found when a sentence has more than one parsing because of its structure, whereas lexical ambiguity is present when a word in a sentence has more than one meaning. 1. Structural Ambiguity: It is most easily illustrated with garden path sentences, which create early false analysis due to their syntactic organization.

For example, the sentence "The old man the boats" (Bever, 1970) briefly creates confusion because at first it would seem that "the old man" is a noun phrase. A study by Frazier (1987) highlights the note that structural ambiguity tends to occur in sentences with complicated syntactic structures like prepositional phrases, coordination, and relative clauses.

2.3 Lexical Ambiguity

Unlike structural ambiguity, lexical ambiguity is confined to specific words that can possess multiple meanings. For example, the word “bank” can refer to a financial institution or the side of a river. According to Polyakov (2020),

lexical ambiguity can complicate sentence interpretation and lead to misunderstandings, emphasizing the necessity for context to clarify meanings.

2.3 Cognitive Processing of Syntactic Ambiguity

It has been a persistent problem in psycholinguistics to examine how people disambiguate syntactic ambiguity. Eye-movement and self-paced reading experiments indicate that disambiguating is an active process under the control of both syntactic and semantic information (Spivey-Knowlton & Sedivy, 1995).

According to the Garden Path Model proposed by Frazier (1987), readers make syntactic decisions based on minimal information and are often led astray by misleading structures, leading to reanalysis once the final phrase is encountered. In contrast, the Constraint-based Model posited by MacDonald, Pearlmutter, and Seidenberg (1994) suggests that listeners and readers use multiple sources of information (syntactic, semantic, and contextual) to resolve ambiguities, thereby leading to more efficient processing in real-time (Rani, P., Garjola, U.C. and Abbas, H., 2024). Event-Related Potentials (ERPs) research has also taken an interest in ambiguity resolution. A study by Van Herten, Kolk, and Chwilla (2005) shows that ERP components are elicited by unexpected ambiguities, which implies that these events take up cognitive resources and extra processing time.

2.4 Syntactic Ambiguity and Its Impacts on Communication

Syntactic ambiguity has severe effects on communication, with repeated misunderstandings ensuing. Clarity and concision of expression are vital for effective transmission of information, and ambiguous structure can disrupt this. The finding of McDonald and MacWhinney (1995) implies that speakers purposefully select forms, which circumvent potential ambiguities, further tending to imply that syntactic choice is often made with regard to the comprehension of the audience.

Further, it points out the contribution of syntactic ambiguity to second language acquisition (SLA). It is possible that L2 learners have problems with syntactically ambiguous sentences because their native language has a different syntax from that of the target language. Overstreet and Smith (2000) work emphasizes explicit teaching of ambiguous constructions in an attempt to facilitate understanding and production of target language syntax in L2 learners.

Implications for Language Education2.5

As it plays a part in both first and second language acquisition, the knowledge of syntactic ambiguity is essential to language education. Language instructional frameworks that are informed by research on syntactic ambiguity can help teachers develop effective pedagogical approaches. Pedagogical approaches such as explicit teaching, context analysis, and peer learning have the potential to enhance students' abilities to negotiate and clarify ambiguities.

In addition, current technological and AI developments can possibly enable the learning of syntactic ambiguity. Computer programs that give instant feedback, including writing assistants and comprehension-checking software, present students with the possibility to experiment with challenging syntactic constructions in real time (González et al., 2018).

2.5 AI Techniques in Language Education

Artificial Intelligence has become an increasingly revolutionary force in education, providing new and innovative approaches to enhancing teaching and learning experiences.

Methods like Natural Language Processing (NLP), Machine Learning (ML), and Intelligent Tutoring Systems (ITS) have been proven to work within different educational environments (Woolf, 2010; Luckin et al., 2016). In particular, NLP has been utilized for building software enabling students to acquire syntax and semantics through instant feedback and individualized learning paths (González et al., 2018). AI-driven systems have been shown to be able to help disambiguate sentences through contextualized feedback and paraphrastic options (Li et al., 2019).

For example, programs based on sentence parsing algorithms can assist students more effectively in locating ambiguities and their consequences (Wang, 2020).

Application of Artificial Intelligence (AI) in language learning has attracted considerable attention in recent years, fueled by technological advancement and increasing demand for innovative pedagogical practices. AI methods hold

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revolutionary promise, facilitating adaptive learning environments, augmenting language learning, and addressing the individual needs of learners.

This literature review consolidates current research into AI applications employed in language learning, their effectiveness, issues, and the future of language learning and teaching.

The incorporation of AI techniques in enhancing syntactic ambiguity among Hail University students reflects a growing trend in educational technology. Recent studies indicate that AI-powered applications significantly improve students' syntactic knowledge and writing skills, thereby addressing challenges related to syntactic ambiguity. This review synthesizes findings from various research efforts that highlight the transformative role of AI in language education.

2.6 AI-Powered Applications and Syntactic Knowledge

AI tools such as ChatGPT have been associated with increased syntactic complexity in students' writing, indicating that AI can be used successfully for revising and developing argumentative essays ("A Syntactic Complexity Analysis of Revised Composition through Artificial Intelligence-based Question-answering Systems", 2023)

2.7 Error Correction and Learning Enhancement

Iaso and other such tools demonstrate the potential of AI in correcting syntax errors in coding, which is also the need for the same type of applications in language learning(Li & Wong, 2023).

AI models can provide personalized feedback, adapting to individual learning needs, which is crucial for addressing syntactic ambiguity in student writing(Zekaj, 2023).

2.8 Challenges and Considerations

Despite the benefits, there are problems such as ethical concerns and data privacy that are present in AI integration in education (Kazimova et al., 2025). These problems must be resolved to facilitate the use of AI technologies in an effective and responsible way for enhancing syntactic understanding among students.

Research Hypotheses

Based on the provided objectives, the hypotheses to be tested under this study are as follows:

H1: Attachment uncertainty is prevalent to a great extent in written texts that are commonly read by Hail University students.

H2: Students at Hail University have a low understanding of attachment uncertainty in written communication.

H3: The use of AI approaches greatly improves students' understanding and problem-solving of attachment uncertainty over conventional teaching techniques.

H4: An AI-based learning tool that is particularly tailored to resolve attachment ambiguity will result in better performance in reading comprehension exercises for Hail University students.

3 METHODS

This research utilizes a qualitative method of research. A guided interview is employed to establish the incidence of attachment ambiguity and measure the understanding of syntactic ambiguity in students.

- **Participants:**

The study sample will be twenty female graduate and semi-graduate students. Why they are being questioned is to understand more about what kind of perception students at Hail University have towards syntactic ambiguity, what extent they know about AI in language learning, and how they believe AI can help them overcome syntactic difficulty.

- **Data Analysis &Discussion**

1. Clear definition with example (e.g., "The chicken is ready to eat") 90% Poor or vague definition10%.
2. Ambiguity Encounters: Encountered ambiguities in texts (legal/technical/academic) 85% No encounters or dubious 15%.

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3. Significance of Disambiguation Strong focus on clarity in academic writing 95% Moderate or ambiguous response 5%.
4. AI Tool Familiarity: Familiarity with AI tools such as Grammarly, Duolingo 80%. Unfamiliar or unclear answer 20%.
5. AI Helping with Ambiguity: Positive attitude towards AI helping with ambiguity (e.g., instant feedback) 85%. Negative or unsure about AI assistance 15%. AI Tools and Techniques for Enhancing Syntactic Ambiguity Knowledge.
6. AI for Detecting Ambiguity: AI can scan sentence structure and suggest meanings 90%. No clear recommendation or response 10%.
7. AI and Sentence Structure: AI can use visual representations (e.g., tree diagrams) to explain structure 80%. No recommendation or general response 20%. Current Challenges and AI's Potential Solutions.
8. Current Challenges: Recognizes challenges such as no feedback whatsoever, no context 95%. No visible challenges faced 5%.
9. AI Learning Syntax Rules: Positive attitude toward AI providing interactive lessons and exercises 90%. Negative or uncertain about AI's potential to assist 10%. Influence of AI on Language Understanding and Writing Ability.
10. AI and Comprehension: AI can break down complicated sentence structures, enhance comprehension 85%. No obvious benefits found 15%. Integration of AI in Academic Settings.
11. AI in Classroom: Open to using AI tools for real-time feedback in assignments 90%. Negative or uncertain regarding the use of AI in the classroom 10%.
12. Significance of AI in Learning: Views AI as essential for personalized learning, enhancing understanding 95%. Not sure of the impact of AI on learning 5%.

4 METHODS

Based on the table and percentages mentioned hereinabove, it can be deduced that most of the students are:

1. Acutely aware of syntactic ambiguity and its importance in academic writing. (95%)

2. Experienced with AI-based language learning programs, i.e., Grammarly and Duolingo. (80%)

3. Favorable to the role of AI in assisting to discover and solve syntactic ambiguity. (85%-90%)

4. Wiling to apply AI tools within classroom settings in order to improve syntactic ambiguity. (90%)

5. See AI as a revolutionary tool for personalizing learning and improving comprehension, particularly of complex syntactic structures. (95%)

These statistics show that students are generally receptive to AI and see it as a valuable tool in improving their linguistic ability and understanding of syntactic ambiguity.

5 DISCUSSION:

The student's responses demonstrate an excellent understanding of syntactic ambiguity and a good attitude towards the application of AI tools in language learning. The student undoubtedly appreciates the ability of AI to : Offer prompt feedback and clarification. Simplify intricate syntactic constructions for easier understanding. Provide adaptive, personalized learning experiences to meet unique language learning needs. These findings are reflective of the positive potential of applying AI tools to language instruction at Hail University. With AI, students would be capable of receiving immediate help in solving and detecting syntactic ambiguities, which would eventually enhance their writing and comprehension skills. The responses of the students suggest that AI can be an invaluable tool to improve language-learning experiences, that is, under the context of syntactic ambiguity understanding. With the application of AI tools, existing issues would be addressed, a better understanding of language structure would be attained, and there would be more personalized learning experiences.

6 CONCLUSION

Briefly, this research has explored the potential of applying Artificial Intelligence approaches in an attempt to enable Hail University students to comprehend and solve syntactically complex ambiguities such as attachment ambiguity. Although the exact results would determine the scope of this impact, the project alone emphasizes a fruitful direction

in the application of AI on language learning. The study adds to the body of knowledge on how technology can be built to overcome particular linguistic issues for learners, creating a path forward for more tailored and effective language learning in the future. Additional research, following up on these preliminary results, will be imperative to refining these AI methods and making them practical and common in instructional settings.

- **Limitation of the Study:**

The results would be Hail University student-specific and may not be generalizable to students taking courses in other Saudi Arabian or international universities because of differences in curricula, English language skills, teaching practices, and technology availability.

- **Recommendations for future researches:**

Future studies should keep responding to ethical issues pertaining to data privacy, AI algorithmic bias, and the ethical use of AI in language learning.

- **Acknowledgement:**

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