

What GPT-4 Knows about Aspectual Coercion: Focused on ‘Begin the Book’

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Abstract

This paper explores whether Pre-trained Large Language Models (LLMs) like GPT-4 can grasp profound linguistic insights into language phenomena such as Aspectual Coercion through interaction with Microsoft’s Copilot, which integrates GPT-4. Firstly, we examined Copilot’s understanding of the co-occurrence constraints of the aspectual verb “begin” and the complex-type noun “book” using the classic illustration of Aspectual Coercion, “begin the book.” Secondly, we verified Copilot’s awareness of both the default interpretation of “begin the book” with no specific context and the contextually preferred interpretation. Ultimately, Copilot provided appropriate responses regarding potential interpretations of “begin the book” based on its distributional properties and context-dependent preferred interpretations. However, it did not furnish sophisticated explanations concerning these interpretations from a linguistic theoretical perspective. On the other hand, by offering diverse interpretations grounded in distributional properties, language models like GPT-4 demonstrated their potential contribution to the refinement of linguistic theories. Furthermore, we suggested the feasibility of employing Language Models to construct language resources associated with language phenomena including Aspectual Coercion.

Keywords: Aspectual Coercion, GPT-4, Copilot

1. Introduction

This paper aims to explore what GPT-4, integrated into the Microsoft Copilot¹, knows about the Aspectual Coercion phenomenon and related linguistic theories.

According to Generative Lexicon theory (Pustejovsky, 1995), Type Coercion is a semantic operation that converts an argument to the type expected by a function, thereby preventing a type error. For instance, English verbs such as “begin” or “enjoy” typically take an event-type argument as their complement. In other words, the canonical semantic type of their complement is an event type, not an entity type. Although in the sentence “John began the book,” the complement “the book” is an entity type, American English native speakers generally accept this construction as both grammatically correct and semantically natural. Pustejovsky (1995) argues that this acceptance arises because speakers assume an activity related to the book. Formally, a main verb like “begin” or “enjoy” coerces the semantic type of its complement into an event type, aligning with the conventional interpretation of the sentence, thus rectifying any potential type error.

Aspectual Coercion specifically refers to Type Coercion by aspectual verbs such as “begin”, “continue”, “end”, or “finish”². The language’s conventional interpretation coerces the argument’s meaning into an appropriate interpretation while forcibly aligning the argument’s type with an event type (Pustejovsky and Bouillon, 1995)³.

One of the fundamental characteristics of language is the principle of linguistic economy, employing the

minimal expression required to convey their intended message (Culicover and Jackendoff, 1990). This principle often entails omitting linguistic expressions denoting information that can be inferred implicitly, relying on shared conventions, common/world knowledge, or situational context within conversation. Instances such as Aspectual Coercion exemplify common language phenomena where implicit meanings are interpreted based on linguistic conventions, common sense, or contextual cues, whether linguistic or non-linguistic in nature.

When considering the principle of linguistic economy from a Natural Language Processing (NLP) perspective, it presents a quite difficult challenge. Traditional machine learning-based NLP methodologies often entail enumerating various types of inferences, exemplified by research in Natural Language Inference (NLI), and constructing training datasets for these inferences (MacCartney et al., 2006; Im and Pustejovsky, 2009). However, with phenomena like Aspectual Coercion, the implicit meaning becomes inherently ambiguous, and the specific interpretation of a type-coerced sentence can fluctuate depending on diverse contextual factors. Furthermore, disparate interpretations may hold precedence in different contexts, without necessarily excluding alternative understandings. As a result, addressing challenges posed by Aspectual Coercion remains among the most arduous tasks within traditional machine learning-based NLP.

The emergence of powerful Natural Language Generation (NLG) models like OpenAI’s GPT-4 (Josh et al., 2023) signifies a remarkable transformation in

¹ Refer to [Microsoft Copilot for Microsoft 365 overview | Microsoft Learn](#) to learn about Copilot.

² Michaelis (2004, 2022) considers aspectual type shift coerced by certain expressions in a sentence as aspectual coercion (e.g., “I was outside twice”). In this paper, we adopt Aspectual Coercion as proposed by Pustejovsky and Bouillon (1995).

³ Im and Lee (2013) discuss the phenomenon of type coercion associated with the light verb “ha-” (‘do’) in Korean, drawing upon the explanation of aspectual coercion observed with the English verb “begin” within the framework of Generative Lexicon theory.

the landscape of NLP. This shift marks a notable turning point, presenting unprecedented opportunities.

Nevertheless, we question whether Pre-trained Large Language Models (PLLMs) like GPT-4 can offer a linguistic theoretical explanation of the Aspectual Coercion Phenomenon. This skepticism arises from the models' foundation on the Distributional Hypothesis (Harris, 1954), which posits that word meanings are described by their contextual usage. Distributional semantics solely reveals the distributional characteristics of words without delving into the cognitive or conceptual aspects of why these properties emerge within the lexicon of human language.

In this context, our aim is to investigate whether a PLLM such as GPT-4 can accurately and completely provide linguistic explanations for Aspectual Coercion. Additionally, we examine the intricacies of designing prompts that effectively enable the extraction of precise linguistic insights about Aspectual Coercion.

In sections 2.1 and 2.2, we discuss the semantic nature and co-occurrence constraints of the aspectual verb "begin" and its direct object "book". This analysis is grounded in the framework of the Generative Lexicon Theory and Type Composition Logic (Asher and Pustejovsky, 2013). In section 2.3, we investigate GPT-4's understanding of the semantic attributes of the verb "begin" and the noun "book" through prompting. More specifically, we employ Microsoft's Copilot, an AI-powered assistant which leverages GPT-4. Section 3 consolidates the previous discussions and scrutinizes the Aspectual Coercion phenomenon that emerges during the semantic composition of "John," "began," and "the book." We particularly explore Copilot's interpretations of Aspectual Coercion sentences in section 3.2. Lastly, Section 4 summarizes our research findings and presents conclusions.

2. The Aspectual Verb "Begin" and the Noun "Book"

2.1 The Aspectual Transitive Verb "Begin"

Aspectual verbs such as "begin", "continue", and "finish" play a crucial role in encoding distinctions related to the temporal aspect of actions or events. In particular, the English aspectual verb "begin" is frequently used to indicate the start or commencement of an action, process, or event. This verb, when used transitively, accepts various types of complements: A direct object noun (e.g., "She began her study an hour ago."), a "to"-infinitive (e.g., "He began to read the novel a week ago."), and a gerund (e.g., "He began writing an essay a month ago.").

In the examples provided, the direct object "her study" is an event type argument, as do "to read the novel" and "writing". Conversely, the sentence "She began

the rock" is semantically awkward because the direct object "the rock" represents an entity type rather than an event. American English native speakers typically do not perceive such a sentence as semantically natural.

The first constraint in complement selection of the aspectual verb "begin" is that:

- (1) **Complement Selection Constraint 1:** It typically requires an event or action-type argument as its canonical complement. It cannot accommodate other types of arguments. (Pustejovsky, 1995)

However, the verb cannot take all kinds of event-type argument. Given that "begin" refers to the initial phase of an event or action that involves a duration of time, the argument of the verb cannot depict an event that ends in a very short moment. For example, the sentence "She began to blink her eyes one time" is not grammatically valid. Similarly, the sentence "She began to arrive at school" is also considered ungrammatical. This leads to the second constraint of the verb's complement selection:

- (2) **Complement Selection Constraint 2:** It can NOT take an achievement or punctual event-type complement. (Im and Lee, 2015)

To summarize, the aspectual verb "begin" should take an event-type argument as its complement. However, the event-type complement should not be an achievement or punctual event type.

2.2 The Dot Object Noun "Book"

In this section, we propose a slight adjustment to the semantic type of the English noun "book" as proposed in Im and Lee (2015). Specifically:

- (3) **The semantic type of "book"**
`text_info·bound_paper·goods`

This semantic type represents "book" as a Dot Object comprising the subtypes `text_info`, `bound_paper`, and `goods`⁴. Dot objects, introduced by Pustejovsky (1994), refers to objects characterized by a complex type, exemplified by the semantic type of "book" outlined in (3) above.

Such a complex type of a noun facilitates predications that are licensed over one of the three dot element types (Asher and Pustejovsky, 2013). Consequently, each subtype in (3) implies a set of predicates that can co-occur with the noun "book" as detailed below.

- **text_info** → {read, write, translate, publish, digitize, evaluate, underestimate, criticize, create, ...}
- **bound_paper** → {take, carry, put, place, position, pack, tear, burn, weight, borrow, own, have, lend, ...}

⁴ We consider that the semantic type of "book" presupposes a paper book in this paper. However, we notice that a book can represent special types of books such as an audiobook or a picture book. In

future work, we need to update the semantic type of "book" based on corpus analysis. Language Models like GPT-4 can be helpful for this task.

- **goods** → {buy, sell, promote, market, advertise, ...}

Even more intriguingly, the semantic type of “book” implies a set of predicates that cannot co-occur with the noun. For instance, the noun “book” cannot be a direct object of the verbs presented in (4).

(4) Verbs that cannot co-occur with “book”
{eat, drink, wear, sing, mow, bake, ...}

To sum up, the complex type of “book” dictates which predicates can co-occur with the word and which cannot.

2.3 Copilot’s Understanding of the words “Begin” and “Book”

In this section, we pose inquiries to Copilot regarding the lexical semantics and co-occurrence constraints of the aspectual verb “begin” and the complex-type noun “book”⁵. The first question in Prompt 1 pertained to the direct object selection constraints of the aspectual verb “begin”.

Question: What are the lexical semantic constraints for a complement of the transitive verb ‘begin’?
Answer: ... Aspectual verbs like ‘begin’ have been assumed to select exclusively for eventive complements, such as in the sentence ‘John began reading the book’. ...

Prompt 1 Complement selection constraints of the aspectual verb ‘begin’

Prompt 1 demonstrates that Copilot recognizes that aspectual verbs like “begin” typically require event-type complements. However, it does not demonstrate knowledge of the more specific constraint that the verb “begin” does not accept achievement or punctual event-type arguments as its complement.

To compile a list of the most common verbs that can be inserted into the structure “John began to _____ the book,” we employed Prompt 2 as follows:

Question: Please list the most common verbs that can be inserted into “John began to _____ the book.” in order of frequency.
Answer: ... 1. Read, 2. Write, 3. Study, 4. Open, 5. Close, 6. Finish, 7. Review, 8. Mark, 9. Cover, 10. Illustrate, 11. Edit, 12. Publish, 13. Sell, 14. Buy, 15. Bind, 16. Sign, 17. Dedicate, 18. Translate, 19. Print, 20. Annotate.

Prompt 2 The most common twenty transitive verbs that co-occur with ‘begin’ and ‘the book’

We tasked Copilot with listing verbs in order of frequency. From Copilot’s output, we found that the verb “read” is the most common verb between the

aspectual verb “begin” and the noun “book”. The second most common candidate is “write.” This highlights the advantage of Language Models in situations where we cannot determine, based solely on linguistic knowledge, which of the verbs is the most common verb to co-occur with “book”.

In addition, Copilot noted that these twenty verbs represent the most common activities or events of duration that individuals typically undertake with a book. This suggests that Copilot emphasized the co-occurrence of the verbs with the noun “book” rather than with the aspectual verb “begin”. In essence, Copilot does not consider the constraints of semantic type composition when words are combined to form a sentence.

The sixth verb, “finish,” in the list is not directly related to any subtype of the noun “book.” It also requires a form of aspectual coercion to co-occur with the noun “book.” However, GPT-4, relying on word distribution, simply lists the most frequent verbs that take “book” as their direct object, regardless of the type composition constraints of the noun “book” and its governing verbs.

Next, we employed another prompt to inquire about verbs that are not suitable for insertion into the sentence. In Prompt 3, Copilot presented the twenty verbs as the least likely options to co-occur with “begin” and “the book”. Furthermore, it provided an explanation for selecting this list of verbs: These verbs denote actions that are not commonly linked with a book or reading.

Question: Please list the 20 transitive verbs that cannot be inserted into ‘John began to _____ the book.’ with the reason.
Answer: 1. Swim, 2. Jump, 3. Run, 4. Fly, 5. Breathe, 6. Eat, 7. Drink, 8. Sleep, 9. Dance, 10. Sing, 11. Laugh, 12. Cry, 13. Sneeze, 14. Walk, 15. Drive, 16. Climb, 17. Smile, 18. Frown, 19. Blink, 20. Sweat
 These verbs are awkward in this context because they denote actions that are not typically associated with a book or reading. ...

Prompt 3 The most improbable transitive verbs that co-occur with “begin and “the book”

Copilot solely concentrated on actions that are not typically associated with a book, disregarding verbs that cannot co-occur with the aspectual verb “begin” even though they can take “the book” as their complement. For example, the verb “obtain” is an achievement verb and cannot be combined with “begin”, despite its compatibility with “the book” as a complement. However, Copilot incorrectly indicated that the sentence “John began to obtain the book.” is semantically acceptable as shown in Prompt 4.

⁵ Microsoft Bing AI Copilot has three modes of chatting: more balanced, more precise, and more creative. In this section, we utilized the more balanced mode for our interactions.

⁶ For now, we include only essential content in prompting example boxes due to space limitations. All prompts containing full content will be provided in the Appendix when we have the opportunity to publish a camera-ready version of our paper.

Sentence: John began to obtain the book.
Question: Is the sentence semantically acceptable?
Answer: Yes, the sentence “John began to obtain the book.” is semantically acceptable. The verb “obtain” means to come into possession of something, so this sentence suggests that John started the process of getting the book. ...

Prompt 4 Question regarding the possibility of co-occurrence of 'obtain' and 'begin'

From the prompts used, it seems that Copilot may not possess the understanding that the aspectual verb “begin” cannot be combined with achievement or punctual event-denoting verbs. To verify Copilot’s comprehension of the properties of achievement verbs, we posed a question using an alternative prompt.

Sentence: John obtained the book for three hours.
Question: Is the sentence semantically acceptable?
Answer: No, the sentence “John obtained the book for 3 hours” is not semantically acceptable. The verb “obtain” implies a change of possession, which is typically an instantaneous action rather than one that extends over a period of time. Therefore, it’s unusual to use “for three hours” with “obtain”. ...

Prompt 5 Is Copilot knowledgeable about the lexical semantic properties of achievement verbs?

Copilot’s response indicates its awareness that achievement verbs like “obtain” cannot co-occur with a prepositional phrase denoting time duration (e.g., “for three hours”). Therefore, we conclude that Copilot lacks the knowledge that the aspectual verb “begin” cannot accept achievement or punctual event-denoting verbs as its complement. Furthermore, Copilot’s listing of the verbs that can co-occur with “book” does not align with the semantic type of the noun. We used another prompt to confirm this discrepancy.

Question: What is the semantic type of the English noun “book”?
Answer: The semantic type of the English noun “book” is associated with the category of “things” or “objects” ...

Prompt 6 Semantic Type of the English Noun “book”

Based on Copilot’s answer in Prompt 6, we argue that it cannot provide deeper linguistic knowledge related to the complex type of “book” described in section 2.2. We asked Copilot more specifically using the question “What is the semantic type of “book” in Generative Lexicon Theory or Type Composition Logic?”. However, Copilot could not identify “book” as a complex type (dot object) noun. In conclusion, GPT-4 lacks deeper knowledge about linguistic constraints regarding composition of words.

3. Composition and Interpretation of the Sentence “John began the book”

3.1 Interpretation of the Sentence “John began the book”

Aspectual Coercion refers to the process in which an aspectual verb changes the semantic type of its direct object when the object does not meet the constraints imposed by the aspectual verb. Consequently, the complement undergoes Type Shifting to a suitable type. The aspectual verb “begin”, which requires an event type expression as its direct object, coerces the semantic type of “book” – originally a complex type `text_info-bound_paper-goods` – into an event type.

Im and Lee (2015) proposed constraints on the aspectual coercion of the verb “begin” in the sentence “John began the book,” drawing from the work of Pustejovsky and Bouillon (1995) and the constraints discussed in section 2:

- A. Only in the control construction of “begin”
- B. When the subject is animate
- C. Only when the missing predicate belongs to a process or an accomplishment type verb class (neither a punctual nor an achievement)
- D. And only when the missing predicate is a two-place verb which takes a subject and an object.

The examples provided in (5-8) show violations of the conditions of Aspectual Coercion.

- (5) The book begins with the word. → *The book begins the word. (constraint A)
- (6) *The rock began reading the book. → *The rock began the book. (constraint B)
- (7) *John began losing the book. → *John began the book. (constraint C)
- (8) John began giving me books. → *John began me books. (constraint D)

Inversely, the constraints of Aspectual Coercion suggest the limitations on candidates for the implicit predicate that is not explicitly encoded on the surface. This predicate should be inferred by native speakers of the language based on context, linguistic conventions, and common sense or world knowledge when interpreting the Aspectual Coercion construction.

Firstly, when the words “John,” “began,” and “book” come together to form a sentence, their semantic types also interact. In essence, the combination of “began” and “the book” necessitates an intersection of the verbs permitted by “began” and those governing “the book.” Subsequently, this intersection set intersects with the set of verbs permitted by “John.” For example, “began the book” can be interpreted as “began reading the book,” but it cannot be understood as “began losing the book” or “began swimming the book.” The subject “John”, which gives no specific information, imposes no limitation on the possible interpretations of the sentence. Therefore, the sentence can be interpreted as follows:

“John began to **read/write/publish/study/...** the book.”

The most common interpretation in this case depends on linguistic conventions and common knowledge in English. Prompt 2 showed that reading interpretation is most common.

Secondly, with a more specific linguistic context provided in the sentence, the preferences for interpretations change.

Sentence: The writer began the book.

Preferred interpretation: The writer began to write the book.

The preferred interpretation leans towards writing, given that the subject “the writer” provides more specific context indicating that the individual initiating the book is indeed a writer. It is important to note that all possible interpretations derived from “began the book,” including reading interpretation, are still considered, despite the changes in preferred ratings.

Thirdly, when a specific situational context is given, the preferred interpretation of the sentence also changes.

Sentence: John began the book.

Situational context: John went to the shop that sells chocolates. He bought a chocolate box with various shapes of chocolate including a book-shaped chocolate.

Preferred Interpretation: John began eating the book.

In this case, the preferred interpretation of the sentence is ‘John began eating the book’ as mentioned above. More accurately, it is interpreted as John began eating the book-shaped chocolate⁷. We mention that an interpretation like ‘John began reading the book’ is possible, but “the book” does not denote the book-shaped chocolate but a book the speaker or John considers in their mind.

In summary, we presented comprehensive constraints of Aspectual Coercion and demonstrated that the preferred interpretations of Aspectual Coercion sentences depend on contextual cues. We emphasize that although preferred interpretations change according to contextual information, all possible interpretations remain.

3.2 Copilot’s Interpretation of the Aspectual Coercion Sentence

To verify if Copilot possesses knowledge about aspectual coercion of the verb “begin” and the interpretation of the construction, we posed various questions through prompting. Initially, we simply asked the meaning of the sentence “John began the book.”

Copilot offers three sessions: the more balanced session for casual, informed chat; the more precise session for concise chat aimed at helping you discover facts; and the more creative session for original and imaginative chat. We compared

interpretations of the Aspectual Coercion sentence across the three modes of Copilot. As observed in Prompt 7, all three modes showed no difference in their answers, providing interpretations such as reading or writing the book. The more creative session added another interpretation, such as “John opened the book,” which could be considered an overgeneration.

Sentence: John began the book.

Question: What is the meaning of the sentence?

More balanced mode answer: The sentence “John began the book” typically means that John started reading a book or started writing a book. The exact meaning depends on the context....

More precise mode answer: ... when no specific context is provided, the most common understanding is that John started reading or writing the book. ...

More creative mode answer: The sentence ‘John began the book’ conveys the idea that John initiated the act of starting to read or write the book.

Prompt 7 Interpretation in the More Balanced session

When we inquired about the most common interpretation of the sentence with no specific context, Copilot gave the exact answer we intended, “John started reading a book,” only in the more precise session. However, it also mentioned the possibility of a writing interpretation and emphasized the importance of context (Prompt 8).

Sentence: John began the book. **Question:** What is the most common interpretation of the sentence when no specific context is given in English?

Answer: The most common interpretation of the sentence “John began the book” when no specific context is given in English is that John started reading a book. ...

Prompt 8 The most common interpretation of the Aspectual Coercion sentence when no specific context is provided

As discussed in section 3.1, the Aspectual Coercion sentence remains ambiguous even though the most preferred interpretation is “John began to read the book.” Therefore, we requested Copilot to provide a list of twenty possible interpretations of the sentence when no specific context is given. For this question, we selected the more precise session. We only display answers from the more precise session from now on.

Sentence: John began the book.

Question: Please list the 20 possible interpretations of the sentence.

Answer: Sure, here are 20 possible interpretations of the sentence “John began the book”: 1. John

⁷ Even without this specific context, the change of the subject to “the goat (non-human animate agent)” triggers an eating interpretation as the preferred⁶⁰

interpretation of the sentence “The goat began the book.”

started reading a book. 2. John started writing a book. 3. John opened the book to start reading. 4. John started studying the book for academic purposes. 5. John began narrating the book to someone else. 6. John started translating the book into another language. 7. John started illustrating a book. 8. John began binding the book. 9. John started selling the book. 10. John began a book club focused on the book. 11. John started a journey that the book is about. 12. John began to critique the book. 13. John started to adapt the book into a movie or play. 14. John began to memorize the content of the book. 15. John started to audio-record the book. 16. John began to teach the content of the book. 17. John started to convert the book into braille. 18. John began to digitize the book. 19. John started to restore the old book. 20. John began to research about the book's background. ...

Prompt 9 Twenty possible interpretations of the sentence

Prompt 9 suggested verbs denoting common activities that people engage in with a book, including reading and writing. Interestingly, it provided various types of interpretations beyond just recovering the implicit verb that governs “the book” as its direct object. For instance, Prompt 9 suggested “began a book club focused on the book.” This finding raises questions about previous linguistic research on Aspectual Coercion phenomena and the interpretations of the construction. Perhaps we should develop more elaborate linguistic explanations that encompass various types of interpretations, rather than solely focusing on recovering implicit verbs.

To examine whether Copilot is aware of the linguistic theoretical constraints for interpreting the Aspectual Coercion sentence, we inquired about the criteria it used to select the interpretations it showed.

Question: What were the criteria for selecting the 20 interpretations?
Answer: Here are the criteria I used:
 1. Different Actions: ...
 2. Different Roles: ...
 3. Different Contexts: ...
 4. Feasibility: ...
 5. Variety: ...
 Remember, the exact interpretation of a sentence often depends on the context in which it's used. Without additional context, multiple interpretations could be valid.

Prompt 10 Copilot's criteria for selecting twenty possible interpretations

In Prompt 10, regarding different actions, Copilot suggests that the verb “began” can imply various actions such as reading, writing, translating, selling, etc. Each action provides a different interpretation of the sentence. Copilot also considered different roles the subject “John” can take in relation to the book – reader, writer, seller, teacher, etc. Third, the Copilot considered that the context in which the sentence is used can drastically change its meaning. For example, in a publishing context, “John began the book” could

mean he started writing it. In a bookstore, it could mean he started selling it. Copilot mentioned feasibility. The interpretations should be plausible scenarios that could realistically occur in everyday life. Finally, Copilot considered as many different actions and roles as possible to provide a wide range of interpretations. Again, the criteria suggested by Copilot do not encompass the constraints provided by the verb “begin”, instead focusing solely on the meaning of “book”.

When a specific context is provided, the most appropriate interpretation of the sentence depends on the context. We wrote a specific context together with the aspectual coercion sentence and a question about its meaning in Prompt 11.

Context: John is an editor who works for a publishing company. **Sentence:** John began the book. **Question:** What is the most appropriate interpretation of the sentence when the context is given ?
Answer: Given the context that John is an editor working for a publishing company, the most appropriate interpretation of the sentence “John began the book” would be that John started editing the book. This interpretation assumes that “the book” refers to a manuscript or a draft that John is working on as part of his job as an editor. ...

Prompt 11 Interpretation of the sentence when a specific context is provided

Because the context gave a specific information about “John,” Copilot suggested the most appropriate interpretation of the sentence as “John started editing the book”. However, the interpretation cannot exclude the reading or writing or even other possible interpretations of the sentence. We check if Copilot knows about the fact by using another prompt.

Question: Under the context, is the only interpretation you gave possible? Please give me other possible 10 interpretations of the sentence when the context is given.
Answer: Given the context that John is an editor working for a publishing company, here are 10 other possible interpretations of the sentence “John began the book”:
 1. John started to review the book for potential publication. 2. John began to format the book for printing. 3. John started to plan the layout of the book. 4. John began to proofread the book. 5. John started to assign the book to a specific genre or category. 6. John began to write a summary or blurb for the book. 7. John started to coordinate with the author about revisions for the book. 8. John began to plan the marketing strategy for the book. 9. John started to discuss the book with other editors or staff. 10. John began to prepare the book for digital publication.

Prompt 12 Ten other possible interpretations

In the given context, when asked for ten additional interpretations other than the translation provided by the Copilot, it suggested the interpretations in Prompt 12. Most of these interpretations were related to tasks

associated with editors working for publishing companies. The Prompt provided interpretations with various types of structure, rather than simply recovering elided predicates. This fact hints to us that we need to generalize and explain the kinds of interpretations in terms of linguistic theory.

We were curious if Copilot knew, even in the context of John being an editor, that the sentence can still be “John began reading the book.” Therefore, we asked about it with another prompt.

Question: Is it impossible to interpret the sentence as ‘John began reading the book’ under the context?

Answer: No, it's not impossible. ... it's still plausible that “John began the book” could mean “John began reading the book”. ... Context is key, and without more specific information, multiple interpretations can still be valid. ... Without additional context, multiple interpretations could be valid.

Prompt 13 Is reading interpretation possible under the context in Prompt 12?

The response from Copilot to the question in the above prompt reflects that it recognizes that while the interpretation contextualized in the given context is the most likely interpretation, there is openness to the possibility of other interpretations.

Another question we asked is about impossible interpretations of the Aspectual Coercion sentence when no specific context is given. We show only five interpretations in Prompt 14. The Prompt explains the reason that these examples are impossible interpretations as follows: These interpretations are impossible because they involve using a book in ways that defy the laws of physics or the nature of a book.

Sentence: John began the book. **Question:** Please list the 20 impossible interpretations of the sentence.

Answer: 1. John started to eat the book. 2. John began to use the book as a spaceship. 3. John started to wear the book as a hat. 4. John began to play the book like a guitar. 5. John started to drink the book. ...

Prompt 14 Impossible interpretations

Now, we asked a question about the same aspectual coercion sentence with a specific context in the following prompt.

Context: John's father gave a chocolate box in which there are various shapes of chocolates. One of them is a book-shape. **Sentence:** John began the book. **Question:** What is a common

interpretation of the sentence when the context is given?

Answer: Given the context, a common interpretation of the sentence could be that John started eating the chocolate that is shaped like a book. This interpretation assumes that “the book” refers to the book-shaped chocolate in the context provided. Remember, the exact interpretation of a sentence often depends on the context in which it's used. Without additional context, multiple interpretations could be valid.

Prompt 15 Common interpretation of the sentence under a specific situational context

In the more precise Copilot mode, it gave the exact answer that we wanted when we gave a specific context. A common interpretation of the sentence is that John started eating the chocolate that is shaped like a book, assuming “the book” refers to the book-shaped chocolate. It is very interesting compared to Copilot's answer to the question regarding the impossible interpretations of the sentence when no specific context is given. In the case, Copilot suggested John started to eat the book as one of the impossible interpretations. On the contrary, Copilot showed that the sentence is interpreted as “John began eating the book” when the appropriate specific context is provided⁸.

Finally, we propose the possibility of building a lexical resource that systematically organizes information about Aspectual Coercion and the interpretation of Aspectual Coercion sentences through prompting. In the following prompt, we listed aspectual verbs and then described the task Copilot should perform as kind of pseudo code. Copilot performed well as we intended. It created Aspectual Coercion sentences with each of the verbs in the list, “Words.” And then it provided five possible interpretations for each aspectual coercion sentence.

Words = ['begin', 'finish'] **Sentence:** John _____ the book. **Question:** For each word in words, please make a sentence by inserting each word into _____. And then please list 5 possible interpretations of each sentence in order of frequency.

Answer: Here are the possible interpretations for each word:

1. John began the book.

- John started writing a novel, perhaps sitting at his desk with a blank page before him.
- John initiated the process of creating a literary work, whether fiction or non-fiction.
- John embarked on the journey of authorship, with ideas swirling in his mind.
- John opened a new chapter in his creative endeavors.

2. John finished the book.

⁸ In an imagined or fictional contextual scenario, a more intriguing issue of interpretation arises. For instance, when we present the sentence “The lady in the picture began a song” and inquired about its meaning to Copilot, it did not provide the intended

answer but instead suggested longer sentences with more specific contextual details, indicating that the context is fictional or imagined. Copilot's response to the question implies that it cannot interpret the sentence as we, human being, can.

- John completed reading a captivating novel, turning the final page with satisfaction.
 - John concluded writing a manuscript, typing the last sentence and feeling a sense of accomplishment.
 - John reached the end of a literary work, whether it was a short story or an epic saga.
 - John wrapped up the book project, editing and revising until it was polished.
 - John closed the cover of a well-loved book, reflecting on the journey it took him on.
- Remember, context matters, and the intended meaning depends on the surrounding information!

Prompt 16 Building a lexical resource about Aspectual Coercion

4. Related Work

The coercion phenomenon has been widely studied in theoretical, psychological, and computation linguistics. From the perspective of theoretical linguistics, coercion challenges to traditional semantic compositionality theory (Asher, 2015; Pustejovsky & Batiukova, 2019, Rambelli et al., 2020). Pustejovsky (1995) suggested that the superficial violation of compositionality can be resolved by recovering an implicit event-denoting verb based on the qualia of the noun in the complement NP (e.g., qualia of “book” in “begin the book”). Therefore, the source of interpretation of the coercion construction lies within our lexicon.

Alternatively, Zarccone et al. (2011, 2012, 2013, 2017) proposed, based on several experimental and computational linguistic studies, that the source of interpretation is generalized event knowledge, that is, pragmatic and world knowledge. In particular, Zarccone et al. (2017) explored the interaction between the semantic type of the object (event vs. entity) and the typicality of the covert event (“the author began a book” → “writing”) during the processing of coercion construction by employing a self-paced reading study. This interaction demonstrates the combined influences of verb-driven type preferences and generalized real-world event knowledge during language comprehension.

Psycholinguists and cognitive scientists are interested in determining whether there are indicators that could demonstrate the presence of coercion and implicit eventive expression by revealing extra processing costs during online sentence comprehension in cognitive research on human sentence processing (McElree et al., 2001; Traxler et al., 2002). Another intriguing question concerns the origins of the extra processing costs. One possible explanation is the retrieval of an event sense of the complement (e.g., “began **reading** the book”), while another is the relative unpredictability of the complement noun. Delogu et al. (2017) argue that the cost largely corresponds to the surprisal associated with the complement noun. Gu (2022) utilized surprisal estimates at critical sentence positions to investigate how Large Language Models (LLMs) respond to implicit meaning such as type coercion

They demonstrated that surprisal estimates in Language Models (LMs) reflect the difficulty involved in recovering the covert meaning.

Computational studies on type coercion focus on interpreting coerced sentences, aiming to identify potential covert event candidates for the complement argument in aspectual coercion sentences. Representative computational models for interpreting type coercion sentences include probabilistic, distributional, and Large Language Model (LLM)-based models. First, the probabilistic model, as proposed by Lapata and Lascarides (2003), considers the interpretation of a coercion sentence as a joint distribution $P(\text{subject } (s), \text{ coercion verb } (v), \text{ the object } (o), \text{ covert event } (e))$. The preferred interpretation of the coercion sentence is then the event that maximizes $P(s, v, o, e)$. Second, Zarccone et al. (2012, 2013) introduced a distributional semantic model that identifies the covert event as the one with the highest thematic fit with the complement in the coercion sentence. Additionally, Chersoni et al. (2019) proposed the Structured Distributional Model (SDM) that integrates word embeddings with formal semantics. This model incorporates the psycholinguistic research findings that generalized knowledge about events stored in semantic memory plays a crucial role in sentence comprehension.

Recent studies have employed LLMs to address the challenge of interpreting coercion constructions. Ye et al. (2022) introduced a BERT-based dense paraphrasing model, which combines paraphrasing and decontextualization (Choi et al., 2021). Their results surpassed those of previous statistical and distributional models, suggesting that while coercion construction interpretation remains challenging even for LLMs, model performance can be enhanced by fine-tuning LLMs through dense paraphrasing. In a study by Rambelli et al. (2020), various models, including probabilistic, distributional, and LLM-based ones, were compared in terms of their effectiveness in interpreting coercion sentences. The findings indicate that the top-performing LLM-based models and some traditional distributional models exhibit comparable performance. Despite the diverse computational approaches to modeling the interpretation of type coercion constructions, experimental results suggest that type coercion remains a challenging phenomenon for computational modeling.

5. Conclusion

In this paper, we aimed to investigate the understanding of phenomena such as Aspectual Coercion by Pre-trained Large Language Models (PLLMs) like GPT-4 and their ability to accurately interpret Aspectual Coercion sentences. To achieve this, we prompted Microsoft’s Copilot, which incorporates GPT-4, with various questions.

In section 2.1, we presented the lexical meaning and compositional constraints of the aspectual verb “begin” and the complex noun “book.” Our interaction with Copilot in section 2.2 revealed its limitations in

providing deeper linguistic insights about the lexical semantic properties of the aspectual verb “begin” and the noun “book.” Specifically, while it could generate a list of verbs that can co-occur with “begin” and “book” based on its ability of extracting distributional properties of words, it struggled to explain the underlying rationale behind its suggestions with deeper linguistic knowledge.

Section 3 explores the interpretation of Aspectual Coercion sentences containing “began the book.” When interpreting the Aspectual Coercion construction, the retrieval of missing information is deduced from the intersection set of candidates that each word allows for in the sentence when forming the Aspectual Coercion sentence. Copilot generally provided accurate interpretations of Aspectual Coercion sentences and demonstrated an understanding that such sentences are ambiguous and can be interpreted in various ways. Additionally, it offered interpretations beyond merely recovering omitted verbs, presenting a range of interpretations. This suggests that linguistic theoretical research on Aspectual Coercion should offer more sophisticated explanations that encompass such diverse interpretations.

Next, we posed several questions to determine whether Copilot recognizes that the preferred interpretation of the Aspectual Coercion construction changes when specific contexts are provided and whether it remains ambiguous. As a result, Copilot demonstrated its awareness that the preferred interpretation changes depending on the context and offered interpretations that are suitable for the context. Additionally, we confirmed that Copilot understands that while the preferred interpretation may change, the sentence remains ambiguous. Furthermore, Copilot indicated impossible interpretations when no context was provided but also demonstrated an understanding that these interpretations can change to possible ones when specific contexts are given. Finally, we discussed the potential for creating a lexical resource that offers insights into Aspectual Coercion through prompts using pseudo-code.

Through our research, we have affirmed that Language Models such as GPT-4 offer advantages in extracting preferred interpretations of aspectual coercion sentences. This is because the LLMs are fundamentally data-driven and capture the distributional patterns of a language, enabling them to effectively discern and generate contextually appropriate interpretations. However, they face difficulties in capturing more profound linguistic or conceptual knowledge about aspectual coercion.

Copilot provides slightly different answers each time it is asked the same question. Therefore, it is somewhat risky to determine Copilot’s understanding of deeper linguistic knowledge based on a single inquiry. Additionally, there are various modes, and there is also an option in the personal settings to decide whether Copilot will remember the queries and responses exchanged. Therefore, to accurately assess Copilot’s linguistic knowledge, it is necessary to make diverse and repeated attempts. These issues

will be addressed in future research, and efforts will be made to use the GPT-4 API provided by OpenAI to attempt more comprehensive prompt-based learning. Furthermore, comparing it with Chat-GPT would be interesting.

We are planning to expand our research to include other LLMs. Additionally, we are considering the integration of linguistic knowledge into LLMs as a means to enhance the explainability of LLMs concerning Aspectual Coercion. It is hoped that this study will contribute to research on the interaction between Pre-trained Large Language models and linguistic theories. This interdisciplinary approach has the potential to enrich both fields and pave the way for further advancements in natural language understanding and modeling.

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Appendix: Fully Described Prompts

Question: What are the lexical semantic constraints for a complement of the transitive verb 'begin'?

Answer: The lexical semantic constraints for a complement of the transitive verb 'begin' are related to the nature of the verb itself. 'Begin' is an aspectual verb, which forms a subset of the class

of 'coercion verbs' implicated in the phenomenon of complement coercion. Aspectual verbs like 'begin' have been assumed to select exclusively for eventive complements, such as in the sentence 'John began reading the book'.

Prompt 1 Complement selection constraints of the aspectual verb 'begin'

Question: Please list the most common verbs that can be inserted into "John began to ____ the book." in order of frequency.

Answer: ... 1. Read, 2. Write, 3. Study, 4. Open, 5. Close, 6. Finish, 7. Review, 8. Mark, 9. Cover, 10. Illustrate, 11. Edit, 12. Publish, 13. Sell, 14. Buy, 15. Bind, 16. Sign, 17. Dedicate, 18. Translate, 19. Print, 20. Annotate.

Prompt 2 The most common twenty transitive verbs that co-occur with 'begin' and 'the book'

Question: Please list the 20 transitive verbs that cannot be inserted into 'John began to ____ the book.' with the reason.

Answer: 1. Swim, 2. Jump, 3. Run, 4. Fly, 5. Breathe, 6. Eat, 7. Drink, 8. Sleep, 9. Dance, 10. Sing, 11. Laugh, 12. Cry, 13. Sneeze, 14. Walk, 15. Drive, 16. Climb, 17. Smile, 18. Frown, 19. Blink, 20. Sweat

These verbs are awkward in this context because they denote actions that are not typically associated with a book or reading. Remember, language use can vary greatly depending on context, and what seems awkward in one situation might be perfectly natural in another.

Prompt 3 The most improbable transitive verbs that co-occur with "begin and "the book"

Sentence: John began to obtain the book.

Question: Is the sentence semantically acceptable?

Answer: Yes, the sentence "John began to obtain the book." is semantically acceptable. The verb "obtain" means to come into possession of something, so this sentence suggests that John started the process of getting the book. This could be through buying, borrowing, or receiving it as a gift, among other possibilities. The sentence does not specify whether John completed the action of obtaining the book, only that he started it. The appropriateness of its use would depend on the specific context.

Prompt 4 Question regarding the possibility of co-occurrence of 'obtain' and 'begin'

Sentence: John obtained the book for three hours.

Question: Is the sentence semantically acceptable?

Answer: No, the sentence "John obtained the book for 3 hours" is not semantically acceptable. The verb "obtain" implies a change of possession, which is typically an instantaneous action rather than one that extends over a period of time. Therefore, it's unusual to use "for three hours" with "obtain". A more appropriate sentence might be

“John read the book for 3 hours.” or “John searched for the book for 3 hours.”, depending on the intended meaning. Remember, the appropriateness of a verb can depend on the specific context.

Prompt 5 Is Copilot knowledgeable about the lexical semantic properties of achievement verbs?

Question: What is the semantic type of the English noun “book”?

Answer: The semantic type of the English noun “book” is associated with the category of “things” or “objects”.

Prompt 6 Semantic Type of the English Noun “book”

Sentence: John began the book.

Question: What is the meaning of the sentence?

More balanced mode answer: The sentence “John began the book” typically means that John started reading a book or started writing a book. The word “began” implies the initiation of an action, and in this context, it refers to the start of John’s engagement with the book.

More precise mode answer: ... when no specific context is provided, the most common understanding is that John started reading or writing the book. The exact meaning depends on the context.

More creative mode answer: The sentence ‘John began the book’ conveys the idea that John initiated the act of starting to read or write the book. The exact interpretation depends on the context.

Prompt 17 Interpretation in the More Balanced session

Sentence: John began the book. **Question:** What is the most common interpretation of the sentence when no specific context is given in English?

Answer: The most common interpretation of the sentence “John began the book” when no specific context is given in English is that John started reading a book. However, it could also mean that John started writing a book, depending on the context. Without additional information, it’s difficult to determine the exact meaning. The verb “began” is quite versatile and can be used in various contexts. It’s always best to consider additional context when interpreting sentences.

Prompt 8 The most common interpretation of the Aspectual Coercion sentence when no specific context is provided

Sentence: John began the book.

Question: Please list the 20 possible interpretations of the sentence.

Answer: Sure, here are 20 possible interpretations of the sentence “John began the book”: 1. John started reading a book. 2. John started writing a book. 3. John opened the book to start reading. 4. John started studying the book for academic

purposes. 5. John began narrating the book to someone else. 6. John started translating the book into another language. 7. John started illustrating a book. 8. John began binding the book. 9. John started selling the book. 10. John began a book club focused on the book. 11. John started a journey that the book is about. 12. John began to critique the book. 13. John started to adapt the book into a movie or play. 14. John began to memorize the content of the book. 15. John started to audio-record the book. 16. John began to teach the content of the book. 17. John started to convert the book into braille. 18. John began to digitize the book. 19. John started to restore the old book. 20. John began to research about the book’s background. Please note that the exact interpretation would depend on the context in which the sentence is used.

Prompt 9 Twenty possible interpretations of the sentence

Question: What were the criteria for selecting the 20 interpretations?

Answer: Here are the criteria I used:

1. **Different Actions:** The verb “began” can imply various actions such as reading, writing, translating, selling, etc. Each action provides a different interpretation of the sentence.
2. **Different Roles:** The subject “John” can take on different roles in relation to the book – reader, writer, seller, teacher, etc. Each role provides a different interpretation.
3. **Different Contexts:** The context in which the sentence is used can drastically change its meaning. For example, in a publishing context, “John began the book” could mean he started writing it. In a bookstore, it could mean he started selling it.
4. **Feasibility:** The interpretations are plausible scenarios that could realistically occur in everyday life.
5. **Variety:** To provide a wide range of interpretations, I considered as many different actions and roles as possible.

Remember, the exact interpretation of a sentence often depends on the context in which it’s used. Without additional context, multiple interpretations could be valid.

Prompt 10 Copilot’s criteria for selecting twenty possible interpretations

Context: John is an editor who works for a publishing company. **Sentence:** John began the book. **Question:** What is the most appropriate interpretation of the sentence when the context is given?

Answer: Given the context that John is an editor working for a publishing company, the most appropriate interpretation of the sentence “John began the book” would be that John started editing the book. This interpretation assumes that “the book” refers to a manuscript or a draft that John is

working on as part of his job as an editor. Remember, the exact interpretation of a sentence often depends on the context in which it's used. Without additional context, multiple interpretations could be valid.

Prompt 11 Interpretation of the sentence when a specific context is provided

Question: Under the context, is the only interpretation you gave possible? Please give me other possible 10 interpretations of the sentence when the context is given.

Answer: Given the context that John is an editor working for a publishing company, here are 10 other possible interpretations of the sentence "John began the book":

1. John started to review the book for potential publication. 2. John began to format the book for printing. 3. John started to plan the layout of the book. 4. John began to proofread the book. 5. John started to assign the book to a specific genre or category. 6. John began to write a summary or blurb for the book. 7. John started to coordinate with the author about revisions for the book. 8. John began to plan the marketing strategy for the book. 9. John started to discuss the book with other editors or staff. 10. John began to prepare the book for digital publication.

Prompt 12 Ten other possible interpretations

Question: Is it impossible to interpret the sentence as 'John began reading the book' under the context?

Answer: No, it's not impossible. Even though John is an editor and his job involves tasks like reviewing, proofreading, and formatting, it's still plausible that "John began the book" could mean "John began reading the book". Perhaps he's reading it as part of his editing process, or maybe he's reading it for pleasure. Context is key, and without more specific information, multiple interpretations can still be valid. Remember, the exact interpretation of a sentence often depends on the context in which it's used. Without additional context, multiple interpretations could be valid.

Prompt 13 Is reading interpretation possible under the context in Prompt 12?

Sentence: John began the book. **Question:** Please list the 20 impossible interpretations of the sentence.

Answer: 1. John started to eat the book. 2. John began to use the book as a spaceship. 3. John started to wear the book as a hat. 4. John began to play the book like a guitar. 5. John started to drink the book. 6. John began to use the book as a time machine. 7. John started to fly using the book. 8. John began to use the book as a telescope. 9. John started to use the book as a pair of shoes. 10. John began to use the book as a magic wand. 11. John started to use the book as a football. 12. John began to use the book as a swimming pool. 13. John started to use the book as a parachute. 14. 67

John began to use the book as a cooking plan. 15. John started to use the book as a pillow. 16. John began to use the book as a car. 17. John started to use the book as a boat. 18. John began to use the book as a paintbrush. 19. John started to use the book as a basketball hoop. 20. John began to use the book as a refrigerator.

Prompt 18 Impossible interpretations

Context: John's father gave a chocolate box in which there are various shapes of chocolates. One of them is a book-shape. **Sentence:** John began the book. **Question:** What is a common interpretation of the sentence when the context is given?

Answer: Given the context, a common interpretation of the sentence could be that John started eating the chocolate that is shaped like a book. This interpretation assumes that "the book" refers to the book-shaped chocolate in the context provided. Remember, the exact interpretation of a sentence often depends on the context in which it's used. Without additional context, multiple interpretations could be valid.

Prompt 15 Common interpretation of the sentence under a specific situational context

Words = ['begin', 'finish'] **Sentence:** John ____ the book. **Question:** For each word in words, please make a sentence by inserting each word into _____. And then please list 5 possible interpretations of each sentence in order of frequency.

Answer: Here are the possible interpretations for each word:

1. John began the book.

- John started writing a novel, perhaps sitting at his desk with a blank page before him.
- John initiated the process of creating a literary work, whether fiction or non-fiction.
- John embarked on the journey of authorship, with ideas swirling in his mind.
- John opened a new chapter in his creative endeavors.

2. John finished the book.

- John completed reading a captivating novel, turning the final page with satisfaction.
 - John concluded writing a manuscript, typing the last sentence and feeling a sense of accomplishment.
 - John reached the end of a literary work, whether it was a short story or an epic saga.
 - John wrapped up the book project, editing and revising until it was polished.
 - John closed the cover of a well-loved book, reflecting on the journey it took him on.
- Remember, context matters, and the intended meaning depends on the surrounding information!

Prompt 16 Building a lexical resource about Aspectual Coercion