VAI TRÒ CỦA NGÔN ĐIỆU TRONG QUÁ TRÌNH XỬ LÍ CÂU TIẾNG ANH

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Ngôn điệu (prosody) bao gồm các đặc điểm âm học siêu đoạn tính (độ dài âm tiết, cao độ, ngữ điệu, độ dài quãng nghỉ, v.v.) xuất hiện trong giao tiếp. Ngoài giao tiếp trực tiếp và đọc thành tiếng, ngôn điệu cũng xuất hiện trong đọc thầm dưới dạng ngôn điệu ngầm (implicit prosody). Một số nghiên cứu trước đây cho rằng ngôn điệu có thể ảnh hưởng đáng kể đến quá trình truyền đạt thông tin trong giao tiếp trực tiếp cũng như trong đọc hiểu. Thay đổi ngôn điệu có thể làm quá trình tiếp nhận thông tin trở nên khó khăn, và trong một số trường hợp có thể dẫn tới hiểu lầm hoặc hiểu sai thông điệp. Sử dụng ngôn điệu không phù hợp hoặc không nhất quán có thể tạo ra những rào cản trong giao tiếp và trong quá trình đọc hiểu. Bài báo này trình bày kết quả phân tích các nghiên cứu liên quan tới ngôn điệu nhằm nâng cao hiểu biết về vai trò của ngôn điệu trong quá trình xử lí câu, trong đọc thành tiếng cũng như trong đọc thầm. Kết quả phân tích tập trung vào tương tác giữa ngôn điệu và cú pháp, mối quan hệ giữa ngôn điệu và trí nhớ, và ảnh hưởng của ngôn điệu đến quá trình xử lí và đọc hiểu câu.

Từ khóa: *ngôn điệu, ngôn điệu trong đọc thầm, xử lí câu trong đọc hiểu.*

Prosody refers to the suprasegmental features observed in speech, including syllable length, pitch, intonation, break durations, etc. Apart from verbal communication and reading aloud, prosody is also exhibited in silent reading as implicit prosody. Research has demonstrated that prosody has a significant impact on the processing of information during verbal communication and reading comprehension. Altered or manipulated prosody is expected to hinder sentence processing and, in some cases, could lead to misinterpretation of the intended message. Improper or inconsistent projection of prosody onto sentences could place barriers in communication and disrupt comprehension. This study looks into existing research, aiming to provide insights into the role of prosody in sentence processing, both in oral and silent reading. The focus of the study is on the interaction between prosody and syntax, its relationship with memory, and its influence on sentence processing and comprehension.

Keywords: *prosody, implicit prosody, sentence processing, reading comprehension.*

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PROSODY IN THE PROCESSING OF ENGLISH SENTENCES

1. Introduction

Human speech entails prosodic patterns that facilitate mutual understanding and, thus, communication. These patterns occur in verbal communication through the use of stress, pitch, intonation, and timing variations. In silent reading, prosody is exhibited in the form of implicit prosody that is often aligned with the syntactic structure of the sentence. Research has suggested that prosody in both verbal communication and silent reading plays a key role in cognitive processing (Fodor, 2002). Alteration or disruption of prosody, consequently, would tax comprehension (Miller & Schwanenflugel, 2006).

Through the synthesis of existing research, this study aims to provide insights into the role of prosody in sentence processing, both in oral and silent reading. The focus is on the interplay between prosody and syntax, its relationship with memory, and its impact on sentence processing and comprehension.

2. Results and discussion

2.1. Interaction between prosody and syntax

The natural prosodic pattern projected onto a sentence is suggested to correspond with its syntactic structure (Ferreira, 2002; Watson & Gibson, 2004). In cases of syntactic ambiguities, such alignment is particularly essential in resolving the ambiguity. This section examines how prosody interacts with syntax in the four common types of syntactic ambiguity: noun phrase (NP) ambiguity, prepositional phrase (PP) ambiguity, ambiguities in relative clauses (RCs), and garden path sentences.

Studies that examined prosodic contours and syntactic boundaries in the production and comprehension of constructions with NP ambiguity have yielded consistent findings. In research on sentence production (Allbritton et al., 1996), participants were observed altering prosodic breaks to reflect their preferences for NP attachments, as shown in Example 1.

Example 1:

(a) They will use [either television or radio] and [newspapers] to announce the sale.

(b) They will use [either television] or [radio and newspapers] to announce the sale.

Allbritton et al. (1996) observed that there was a longer reading time at the critical NP *radio* in (1a) compared to *radio* in (1b). Though both trained and untrained participants in their study showed inconsistencies in their prosodic parsing of the experimental sentences, the prosodic cues employed by the participants effectively facilitated their interpretation and resolution of the ambiguous sentences.

As for reading comprehension, readers also used prosodic groupings to guide their

interpretation during processing. Beach et al. (1996) found that participants in their study were able to use prosodic cues to interpret the experimental sentences that contained phrases such as *pink and* [*green and white*], [*pink and green*] *and white*. Both adults and children aged five to seven participated in Beach et al.'s study. Results showed that, like adults, children adjusted pitch and pauses to resolve ambiguities. However, children were generally less successful than adults in the use of prosodic cues.

For PP ambiguity, Watson and Gibson (2004) proposed the Anti-attachment Hypothesis. The Hypothesis aims to reduce the negative effects of misaligned prosodic boundaries on sentence processing. It suggests that placing a prosodic boundary immediately after the critical phrase in a sentence would prevent additional attachments to the PP segment.

Example 2:

(a) [An artist arranged a donation of the paintings] [of the landscape] [to the museum].

(b) [An artist arranged a donation of the paintings of the landscape] [to the museum].

Watson and Gibson (2004) noted that comprehenders benefited from the inclusion of a prosodic break between the two prepositional phrases (e.g., *of the landscape* and *to the museum*) during sentence processing. Participants found sentences with inserted prosodic breaks more comprehensible than those without such breaks.

Although prosodic boundaries are expected to aid comprehenders in sentence processing, questions remain about the extent to which they rely on prosodic information to resolve syntactic ambiguities. While the Anti-attachment Hypothesis (Watson & Gibson, 2004) supports the immediate use of prosodic cues in processing, the Informative Boundary Hypothesis (Clifton et al., 2002) argues that other prosodic boundaries influence the interpretation of a prosodic break within the same sentence rather than its absolute position. Beyond studies on NP and PP attachments, research on RC attachments has provided further insights into how prosody and syntax interact during the resolution of syntactic ambiguities.

Example 3: The police questioned [the driver]$_{NP1}$ of [the politician]$_{NP2}$ [that attended the rally].

Example 3 illustrates two potential interpretations based on whether the relative clause is attached to the first noun phrase [the driver] – referred to as high attachment – or the second noun phrase [the politician], known as low attachment. Studies that incorporated cross-linguistic experimental stimuli revealed that participants differing in their mother tongues also differed in their preferences for high or low attachment, as explained by

Frazier's (1979) Late Closure Principle. While English natives favored low attachment, Spanish participants geared towards high attachment, a pattern reflected in longer reading times when they were forced to interpret sentences with low attachment.

Comprehenders were observed to also rely on linguistic cues beyond attachment preferences, such as lexical-semantic and pragmatic cues, during the resolution of RC ambiguities (Fernández & Sekerina, 2015). In Example 3, the answers to the question *Who attended the rally?* were influenced by participants' preferences for the semantic relationship between the two noun phrases, *the driver* and *the politician. These preferences* potentially guided participants' interpretation of who was more likely to attend the rally. Additionally, when prosodic parsing was controlled across stimuli, the length of the RC was observed to affect attachment preferences: participants tended to favor high attachment for longer RCs and low attachment for shorter ones.

Fodor (2002) viewed a classic example of garden path sentences, as illustrated in Example 4, a locally ambiguous structure.

Example 4: The horse raced past the barn fell.

The interpretation of garden path sentences typically aligns with the Minimal Attachment and Late Closure Principles (Frazier, 1979). These principles propose that comprehenders tend to attach incoming information to the syntactic constituents currently being processed. This attachment often results in an inaccurate interpretation of the sentence. When processing difficulties arise, comprehenders reanalyze the sentence to finally achieve the correct interpretation, as shown in Example 5.

Example 5: While Anna dressed the baby spit up on the bed.

According to the Late Closure Principle, processors are likely to attach the noun phrase *the baby* in Example 5 to the most recent constituent, *dressed*, rather than interpret it as the beginning of a new constituent. In this example, *the baby* is initially misinterpreted as part of the verb phrase headed by *dressed*. However, the presence of the phrasal verb *spit up* necessitates the reattachment to the preceding subject, making the initial interpretation illogical. Reanalysis of the sentence occurs when processing difficulties arise.

The Garden Path Theory (Frazier, 1979) posits that comprehenders analyze sentences incrementally rather than waiting until the end. This involves a serial, parallel approach to syntactic parsing, where comprehenders simultaneously analyze the current syntactic constituent while preparing for subsequent ones. Reanalysis occurs immediately when the comprehender encounters difficulties. This Theory suggests that readers concurrently use a broad range of information during the

processing of sentences. The interplay between prosodic grouping and the Late Closure Principle demonstrates that prosodic cues facilitate processing during early stages.

Although previous studies suggested that garden path sentences, like those in examples 4 and 5, cannot be resolved prosodically (Fodor, 2002), others offer contrasting views. Grillo et al. (2015) argued that garden path sentences can be prosodically disambiguated if embedded in a matrix clause, which sets a baseline pace for prosodic contour changes. Their experiments used two conditions: (a) main verb condition and (b) reduced relative clause condition. The key difference between these conditions was the inclusion of the coordinator *and*, which served as a disambiguating element.

Example 6:

(a) James believes that the driver stopped at the red light and avoided a collision.

(b) James believes that the driver stopped at the red light avoided a collision.

Participants in the experiments were asked to silently read the stimuli similar to Example 6 and then verbally produce the sentences at normal speed. The findings revealed that sentences in the main verb condition were read at a regular pace, while those in the embedded reduced relative clause condition were read more quickly. This demonstrated differences in prosodic contours between the two conditions, indicating that garden path sentences could potentially be resolved prosodically. The experiment also suggested that comprehenders process complex syntactic structures, like embedded reduced RCs, more quickly than simpler structures.

Additionally, studies have shown inconsistent results regarding the effects of intonational breaks on resolving syntactic ambiguities (Clipton et al., 2002; Cutler et al., 1997; Matsui et al., 2016). This inconsistency may stem from the varying syntactic structures of the experimental sentences. Different types of ambiguity, such as semantic ambiguity (e.g., "*Visiting relatives can be annoying.*"), require distinct strategies for disambiguation. In cases of semantic ambiguity, prosodic contours appear to provide little to no assistance in resolving ambiguities. Furthermore, real-time processing involves memory, which can sometimes act as a covariate alongside prosody in the resolution of syntactic ambiguities.

2.2. Prosody and working memory

Working memory capacity plays a critical role in sentence processing, particularly in retaining information and retrieving cues for interpretation (Grodner & Gibson, 2005; Swets et al., 2007). Memory constraints are evident in tasks that test the effects of memory capacity on comprehension and production. Difficulties arise when comprehenders fail to retain sufficient information about the

target dependencies in memory, such as *designer* and *buy(s)* in Example 7, which is discussed in Section 4.2.

Frazier's (1979) Minimal Attachment Principle links the preference for minimal syntactic attachments to limited memory capacity. Studies on garden path sentences associate the cognitive load of initial misinterpretations with the inability to process multiple syntactic structures simultaneously. Early-stage syntactic analysis demands storing unanalyzed syntactic constituents in memory, which can heavily tax cognitive resources (Gorgon et al., 2002; Swets et al., 2007).

Grodner and Gibson (2005) argued that sentence processing is restricted by the limited storage capacity of working memory. Lewis et al. (1996) proposed a processing model that ties sentence parsing to the connection between heads and dependencies in hierarchical structures, emphasizing working memory as a crucial factor in comprehension. Swets et al. (2007) suggested that individual differences in working memory capacity affect how comprehenders process and use information during sentence interpretation.

Conflicting theories exist regarding the type of information used in early sentence processing. Frazier (1979) proposed that comprehenders initially rely solely on grammatical information, with other types of information being considered in later stages. On the contrary, others, such as MacDonald et al. (1994) (i.e., Constraint-based Model) argued that working memory capacity dictates the amount and the type of information deployed during processing.

Modification of prosodic contours is suggested to tax memory, thus increasing cognitive load. Lengthy and syntactically complex sentences put further strain on memory retrieval, making comprehension more difficult. When the prosodic contour of a lengthy and complex sentence misaligns with its syntactic structure, the processing of the sentence becomes even more challenging. Pratt and Fernández (2016) introduced a model that incorporates prosody with cue-based memory retrieval. Their study recruited both English and Spanish participants and featured experimental stimuli in English. The findings of the study showed that manipulation of implicit prosody reflected in the change of text presentation formats (i.e., word-by-word, phrasal-segment, and whole-sentence) affects comprehension accuracy and grammaticality rating in both groups. These findings from Pratt and Fernández's (2016) study highlight the importance of implicit prosody in sentence processing among readers of different language groups.

2.3. Prosody in reading

The relationship between prosody and reading skills has been researched quite extensively for the past few decades (Dowhower, 1991). This section discusses the role of prosody in reading comprehension, particularly looking at

how prosody affects processing during oral and silent reading.

2.3.1. Prosody in oral reading

To achieve fluency while reading, readers need to progress through word decoding and recognition, lexical stress production, and application of prosodic parsing. The ability to project appropriate prosodic contours onto sentences serves as a strong indicator of advanced reading proficiency (Dowhower, 1991).

The Automaticity Theory (LaBerge & Samuels, 1974) and the Verbal Efficiency Theory (Dowhower, 1991) are among the theories that look into the role of prosody and reading fluency development. The former theory suggests that once readers are automatic in the low-level processes (i.e., word decoding and recognition), reading becomes less demanding. The automaticity of these earlier stages allows readers to save cognitive resources for higher-level tasks such as processing and comprehension. The Verbal Efficiency Theory, on the contrary, does not view word decoding and recognition as a prerequisite for reading comprehension. Instead, it places emphasis on the ability to segment texts into meaningful chunks, indicating that this skill plays a more important role in the development of reading fluency and comprehension.

Variations in the use of prosody during reading are evident among fluent and non-fluent readers. While fluent readers are able to insert prosodic breaks corresponding to the syntactic structure of the sentence, allowing them to process the text with minimal effort, non-fluent readers tend to follow word-by-word patterns, which requires more reading time and, thus, increases cognitive load (Kuhn & Stahl, 2003). Even when non-fluent readers attempt to experiment with prosodic groupings, these groupings do not often correspond with the syntactic structure of the text, limiting the potential for comprehension to occur (Miller & Schwanenflugel, 2006). The use of prosody in oral reading through word stress, intonation, and prosodic breaks aids comprehension. As a result, failure to apply these acoustic elements during oral reading could lead to processing difficulty and sometimes misinterpretation of the text.

2.3.2. Prosody in silent reading

Recognizing the role of prosody in sentence processing, researchers (e.g., Pratt & Fernández, 2016) have extended the exploration to silent reading. Studies have suggested that when the implicit prosody of a sentence (in the form of text presentation format) aligns with its syntactic structure, cognitive load is reduced, making processing easier. In contrast, if the segmentation of text contradicts its syntactic boundaries, readers may experience difficulties during processing and, thus, comprehension could be impeded.

Gerber-Moron et al. (2018) explored the effects of text segmentation on the processing of video subtitles. The subtitles

were intentionally designed to either follow or violate syntactic boundaries. Findings, including those from audio-impaired participants, supported previous research by demonstrating that segmentation formats either ease or increase cognitive load, particularly in tasks requiring detailed syntactic analysis of the text.

Earlier studies on reading comprehension focused on the role of text segmentation in developing fluency among children and adults (Miller & Schwanenflugel, 2006; O'Shea & Sindelar, 1983; Rasinski, 1990). These studies revealed that breaking text into smaller units improved reading performance among individuals with poor to average skills. However, highly proficient readers were less affected by segmentation changes. These readers relied on their syntactic knowledge to identify natural prosodic breaks. These findings indicated that the effects of segmentation could vary based on the proficiency of the readers.

Pratt and Fernández (2016) demonstrated that first-language (L1) and second-language (L2) speakers of English responded differently to changes in text segmentation. In their study, sentences were presented in one of the three formats: word-by-word, phrase segments, or whole-sentence, as illustrated in Example 7.

Example 7: The designer | who called the retailers several times a week | buy(s) expensive silks for her customers.

While phrase-by-phrase text presentation was shown to benefit L1 participants across experimental tasks, it did not have the same effect on L2 participants. This suggested that prosodic manipulations through text segmentation formats influenced L1 and L2 speakers differently. These findings offer direct evidence that segmentation cues may influence sentence processing differently depending on the linguistic backgrounds of the participants.

In silent reading, the incorporation of prosody enhances comprehension, while disruptions to prosody or monotonous text presentation increase cognitive load, potentially leading to sentence misinterpretation (Miller & Schwanenflugel, 2006). Extensive research has examined the impact of prosody on children's reading skills and comprehension. Young children initially use prosody during oral reading and later apply it in silent reading. They also demonstrate sensitivity to linguistic focus in oral reading, adjusting pitch and acoustic intensity to match syntactic parsing.

Several hypotheses also address the role of prosody in reading. The Structural Precedence Hypothesis (Koriat et al., 2002) posits that readers rely primarily on lexical and morphosyntactic cues during early sentence processing. According to this hypothesis, syntactic analysis occurs independently of semantic and prosodic information and without prior preparation.

Contrasting theories emphasize the role of prosody during both the initial and re-analysis stages of syntactic processing. Fodor (2002) argued that projecting implicit prosody onto written texts aids syntactic parsing, including during re-analysis. Evidence supporting these claims comes primarily from studies on ambiguous or garden path sentences, where prosodic parsing resolves syntactic ambiguities. For instance, in sentences like Example 8, prosodic breaks align with syntactic structures, influencing attachment preferences (high or low) for prepositional phrases.

Example 8: I saw the man on the hill with a telescope.

Observations on the processing of syntactic ambiguities and garden path sentences have led to the Implicit Prosody Hypothesis (Fodor, 2002), which highlights that the projection of prosody in silent reading influences the interpretation of syntactically ambiguous sentences.

Implicit prosody is conceptualized as an internalized "voice" that readers engage with during silent reading. Empirical studies have supported the link between prosodic reading and fluency (Breen et al., 2016; Drury et al., 2016). However, further research is needed to understand how implicit prosody operates in silent reading and transitions from spoken to written text. The influence of syntax and punctuation on prosodic segmentation remains underexplored, although punctuation has been shown to guide comprehension in both oral and silent reading. Steinhauer (2003) observed that commas correspond with inner prosodic boundaries, facilitating phonological parsing. Punctuation, alongside semantic and syntactic cues, plays a vital role in prosodic grouping.

The use of implicit prosody varies among readers with different skill levels. Phonological processing occurs early in lexical access, with readers associating phonological features with written words immediately upon visual recognition. Skilled readers rely on prosodic parsing, punctuation, and other linguistic features to connect sentence reading with the writer's intent. Evidence suggests that skilled readers use prosodic patterns to differentiate contrastive information in text and extract speaker intentions from prosodic contours (Hellbernd & Sammler, 2016). Poor readers, however, often struggle with both the perception and production of prosody. These findings underscore the importance of prosody in constructing structural representations of written texts.

In the context of syntactic dependencies, studies have focused on subject-verb agreement. Koriat et al. (2002) found that sensitivity to agreement violations depends on prosodic phrasing, with natural prosody aiding error detection and disrupted prosody hindering processing. Rapid serial visual presentation (RSVP), such as word-by-word presentation, has also been shown to impede general reading comprehension (Pratt & Fernández, 2016).

The role of prosody in resolving anaphor-antecedent relationships, such as Example 9, remains under-researched.

Example 9: The writer that [Emily/Liam] collaborated with on the novel mentioned [herself/himself] as a creative thinker.

Klassen and Wagner (2017) reported that prosodic marking has limited predictive power for interpreting anaphors. Variations in prosodic prominence often serve to indicate anaphoric links to antecedents, conveying speakers' intentions through the nuanced application of anaphors. However, the impact of prosody on the real-time processing of reflexive anaphors still calls for further research.

3. Conclusion

This study explores the role of prosody in sentence processing, focusing on how it influences both oral and silent reading. Prosody, which includes elements such as syllable length, pitch, intonation, and pauses, is crucial for understanding sentence structure and improving reading comprehension. Research in linguistics and psycholinguistics has shown that prosody helps resolve syntactic ambiguities, interacts with working memory in the retrieval of information, and enhances reading fluency and comprehension.

In oral reading, prosodic patterns that align with syntactic structures make reading smoother and easier to understand. In silent reading, implicit prosody plays an equivalent role in helping readers process and interpret text. Factors such as language skills and cognitive load influence how effectively prosody is used during reading.

While there has been significant progress in research on the relationship between prosody, memory, and syntax, some areas still remain underexplored. These include the subtle effects of implicit prosody in silent reading across languages, how it helps resolve anaphoric references and its impact across different reading contexts. Future research could fill these gaps, deepening our understanding of how prosody contributes to communication and comprehension, and solidifying its importance in the reading process.

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