# Making Sense of Korean Sentences: A Comprehensive Evaluation of LLMs through KoSEnd Dataset

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## Abstract

Although LLMs have made significant progress in handling various languages, there are still concerns about their effectiveness with low-resource agglutinative languages compared to languages such as English. In this study, we focused on Korean, a language known for its complex sentence endings, and evaluated LLMs on this challenging aspect. We introduce the Korean Sentence Endings (**KoSEnd**) dataset, which includes 3,000 sentences and 45,000 sentence ending labels. These were collected from diverse sources to cover a wide range of contexts. We evaluated 11 models to assess their understanding of Korean sentence endings, analyzing them based on parameter count and prediction consistency. Notably, we observed that informing models about the possibility of missing sentence endings led to improved performance, demonstrating the influence of explicitly considering certain linguistic features.

## 1 Introduction

With the continuous advancement of large language models (LLMs), they have become capable of understanding multiple languages and performing tasks based on user intent, irrespective of the input language (Zhang et al., 2023; Huang et al., 2023). However, the data used to train these models are heavily skewed toward English, rather than being evenly distributed across various languages (Liu et al., 2024; Li et al., 2024). Consequently, LLMs may exhibit varying levels of comprehension depending on the language used, raising concerns regarding their effectiveness in understanding low-resource languages (Cahyawijaya et al., 2024; Asai et al., 2024; Cahyawijaya et al., 2023).

Moreover, languages with alphabetic scripts often have advantages in multilingual tokenization because they can share some of the limited token capacity within a model (Petrov et al., 2024; Limisiewicz et al., 2023). By contrast, agglutinative languages, which form words through different morpheme combinations, have challenges due to their complex morphological structures (Song et al., 2024; Kaya and Tantuğ, 2024). Consequently, LLMs tend to have disproportionate advantages in alphabetic languages, as opposed to low-resource agglutinative languages.

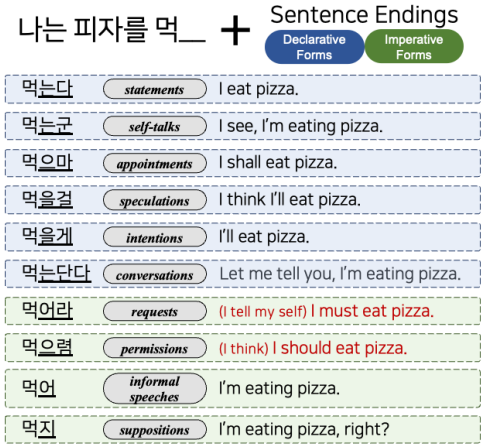


Figure 1: Impact of the Korean sentence endings on the meaning of sentences. The translated texts showed that even small differences in sentence endings can lead to significant changes in meaning.

In this case, we focus on the Korean language with agglutinative characteristics (Sohn, 2001). In Korean, a single verb stem can be combined with various sentence endings to express different meanings such as *statements*, *perceptions*, and *exclamations* (Lee, 2005). As illustrated in Figure 1, minor changes in sentence endings can significantly affect a sentence's meaning and interpretation[1]. For example, while the blue expressions with `Declarative` endings generally convey the intended meanings, the green expressions with `Imperative` endings

[1]When using translation tools such as Google Translate or DeepL, we found that they fail to capture the nuances of Korean sentence endings accurately. To address this, we instructed the latest `gpt-4o` model to perform zero-shot translation with careful attention to the use of sentence endings.

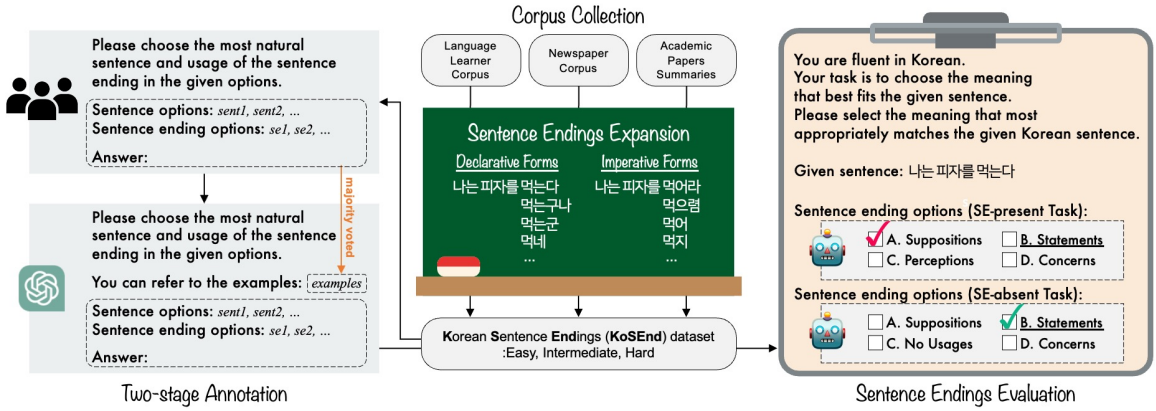


Figure 2: Process of constructing the Korean Sentence Endings (KoSEnd) dataset and evaluating LLMs' understanding of Korean sentence endings. Sections §3.1 and §3.2 cover the *Corpus Collection* and *Sentence Endings Expansion*, respectively. Section §3.3 describes the *Two-stage Annotation*, and these three sections constitute the process of constructing the dataset. Section §4 presents the *Sentence Endings Evaluation*, where we evaluated the LLMs understanding in Korean sentence endings through the designed tasks.

can feel awkward in certain contexts[2]. This demonstrates that sentence endings significantly impact the meaning and interpretation of a sentence, depending on the context.

Considering these perspectives, we recognized that the Korean language may face certain disadvantages in LLMs. To explore this, we examined the diverse usages of sentence endings and evaluated LLMs in this area. The construction of the proposed dataset and evaluation process we conducted are illustrated in Figure 2. We propose the Korean Sentence Endings (**KoSEnd**) dataset, which explores the use of sentence endings in various contexts[3]. Each sentence was expanded to include all theoretically possible sentence endings applicable to both `Declarative` and `Imperative` forms (Lee, 2005), ensuring that the dataset captures a wide range of contextual variations. Subsequently, we conducted a two-stage annotation process to reflect the natural usage of these endings based on context.

Using the proposed dataset, we evaluated the understanding of Korean sentence endings across various LLMs. We designed specific tasks to assess the models in relation to Korean linguistic features. We then quantified each model's ability to interpret sentence endings naturally and analyzed the results by considering factors such as the number of model parameters and the robustness of their predictions.

The contributions of our study are as follows:

- We propose the Korean Sentence Endings (**KoSEnd**) dataset, a collection of corpora categorized by the contextual difficulty. This process include sentence ending expansions and two-stage annotation that capture the natural usages of Korean sentence endings.
- We evaluated 11 LLMs to assess their understanding of Korean sentence endings. We compared performance by parameter count and analyzed prediction consistency across option orders, identifying models with robust comprehension of Korean sentence endings.
- We further explored how informing models about the potential absence of sentence endings affected their performance. Across all models, performance improved with this consideration, suggesting that LLMs better grasp Korean sentence endings when considering this linguistic feature.

## 2 Related Work

### 2.1 NLP Benchmarks

Numerous benchmarks have been developed to evaluate the reasoning abilities of language models. A notable research is SQuAD, which involves collecting question pairs for reading comprehension, along with its adaptations (Rajpurkar et al., 2018, 2016). Afterward, GLUE emerged with a broad set of language understanding tasks such as QA and NLI. (Wang et al., 2018). Subsequently, a method for evaluating the multitask performance of language models has been introduced, reflecting the

[2]In Figure 1, some sentences may sound awkward as certain `Imperative` endings were used with the subject '*I*.' These sentences are highlighted in red within the figure.

[3]We will publicly release the proposed dataset to encourage further research. https://anonymous.4open.science/r/KoSEnd-7183/README.md

| Sentence Endings in `Declarative` Forms | Usages | Sentence Examples |
|---|---|---|
| (1) [다, 는다, ㄴ다] | *statements*, *exclamations*, *questions* | 보통 마음대로 좋은 선물을 가지고 간다<br>(They usually bring a good gift as they please.) |
| (2) [구나, 는구나] | *perceptions*, *suppositions* | 결말에 주인공이 국가를 위해 목숨을 바치는구나<br>(Ah, in the end, the main character sacrifices their life for the country.) |
| (3) [군, 는군] | *self-talks*, *perceptions* | 얘기를 많이 하니까 시간이 빨리 가는군<br>(Time sure flies when you talk a lot.) |
| (4) [네] | *perceptions*, *exclamations*, *self-talks*, *questions* | 그래서 우리는 학교 근처 편의점에 가네<br>(So, we ended up going to the convenience store near the school.) |
| (5) [으마, 마] | *appointments*, *intentions* | 학생들이 잘 공부하도록 언제나 최선을 다하마<br>(I will always do my best so that the students can study well.) |
| (6) [을걸, 걸] | *speculations* | 벌써 1년이나 지났는데 지금 그날을 생각하면 아직도 행복한 느낌이 들걸<br>(It's already been a year, but when I think about that day, I still feel happy.) |
| (7) [을게, ㄹ게, 을래, 래] | *(expressions of) intentions*, *questions* | 한국 문화에 관심이 있을래<br>(I think I might be interested in Korean culture.)<br>(Would you be interested in Korean culture?) |
| (8) [을라, ㄹ라] | *concerns* | 많은 사람들이 물가가 너무 올라가서 걱정을 할라<br>(Many people are worried because the cost of living has gone up too much.) |
| (9) [는단다, ㄴ단다, 단다, 란다] | *conversations* | 아주 힘들었지만 예쁜 경치를 봐서 기분이 좋단다<br>(It was really tough, but I feel good because I got to see the beautiful scenery.) |
| Sentence Endings in `Imperative` Forms | Usages | Sentence Examples |
| (10) [아라, 어라, 여라] | *commands*, *requests*, *permissions*, *exclamations* | 한국에서 간 장소에서 홍대를 소개하여라<br>(Introduce *Hongdae* among the places you visited in Korea.) |
| (11) [으려무나, 려무나, 으렴, 렴] | *permissions*, *commands* | 돈을 벌고 나서 같이 여행하렴<br>(After you earn some money, let's go on a trip together.) |
| (12) [소서] | *hopes* | 장애인에게 많은 관심을 가지소서<br>(Please show a lot of interest in people with disabilities.) |
| (13) [어] | *informal speeches* | 게다가 이 일을 하면 스트레스가 많어<br>(Besides, doing this job causes a lot of stress.) |
| (14) [아] | *informal speeches*, *surprises* | 명동은 사람이 많아<br>(*Myeongdong* is crowded with people.) |
| (15) [지] | *questions of confirmation*, *obvious statements*, *suppositions*, *gentleness*, *intentions*, *regrets* | 나는 인생에 대한 새로운 생각이 생기지<br>(I've come to have new thoughts about life.) |

Table 1: All forms of sentence endings (Lee, 2005) used in this study, along with their usages and examples[1]. The top nine sentence ending forms are categorized as `Declarative`, while the bottom six are `Imperative`. Each ending is further grouped by usage, with the underlined Korean expressions in the 'Sentence Examples' highlighting the specific endings used in each example.

ongoing research aimed at assessing model performance from multiple perspectives (Bai et al., 2024; Hendrycks et al., 2021).

Recently, several Korean NLI datasets have been developed using sources such as Wikipedia and news articles (Park et al., 2021; Ham et al., 2020). Research has progressed in utilizing linguistic features to understand sentence relationships (Jang et al., 2022; Lim et al., 2019) and measuring national alignment, particularly with the advent of advanced LLMs (Lee et al., 2024).

## 2.2 Commonsense Knowledge Evaluation

Research on analytic languages, such as English, often struggles when applied to agglutinative languages with complex word formation. Recent studies reveal that LLMs face these challenges, highlighting the need for models that effectively address linguistic diversity (Maxutov et al., 2024; Weissweiler et al., 2023). In response, benchmarks have been introduced for NLU tasks in agglutinative languages, including Japanese, Indonesian, and Kazakh (Kurihara et al., 2022; Wilie et al., 2020).

Specifically, several datasets have been designed to evaluate the bias and dialogue comprehension of LLMs to assess their ability to understand nuanced semantic information in Korean (Jang et al., 2024; Jin et al., 2024). Nevertheless, performance comparisons from cultural and regional sources have noticed that LLMs encounter challenges in commonsense reasoning within a Korean-specific context (Son et al., 2024a,b; Kim et al., 2024a).

## 2.3 Linguistic Knowledge Evaluation

Recent works have evaluated LLMs handling of morphological complexities and structural challenges in low-resource and agglutinative languages (Nasution and Onan, 2024; Leong et al., 2023). In Korean, studies have specifically examined the linguistic knowledge, including their understanding of grammatical structures and language proficiency (Seo et al., 2024). For instance, studies analyzing linguistic factors, such as case markers and pragmatic competence, offer deeper insights

| Difficulty | Declarative | | Imperative | |
|---|---|---|---|---|
| | Sentences | Usages | Sentences | Usages |
| Easy | 0.748 | **0.634** | 0.733 | **0.644** |
| Intermediate | **0.755** | 0.453 | **0.857** | 0.544 |
| Hard | 0.556 | 0.300 | 0.594 | 0.417 |

Table 2: Krippendorff's $\alpha$ (Hayes and Krippendorff, 2007) based on the human annotation results for each difficulty level. We found that easier levels resulted in higher scores and greater consistency among annotators, while scores decreased as difficulty increased, indicating more variation in the annotations.

| Difficulty | Declarative | | Imperative | |
|---|---|---|---|---|
| | Sentences | Usages | Sentences | Usages |
| Easy | 53.69 | 64.62 | 54.99 | 54.99 |
| Easy (w/o *None*) | 79.51 | 97.81 | 79.99 | 72.21 |
| Intermediate | 77.58 | 91.10 | 50.55 | 53.60 |
| Intermediate (w/o *None*) | 81.41 | 95.94 | 72.77 | 72.91 |
| Hard | 74.44 | 82.77 | 48.88 | 47.49 |
| Hard (w/o *None*) | **87.58** | **96.06** | **80.41** | **74.44** |

Table 3: Accuracy on the model's classification with samples used for annotation. The gold labels were majority voted by the results among the annotators. The difficulty with (w/o *None*) excludes samples where the gold label was labeled as '*None*'.

into LLM performance in Korean (Hwang et al., 2024; Kim et al., 2024b; Park et al., 2024b).

## 3 UniGEC: Dataset Construction

### 3.1 Corpus Collection

Recognizing that Korean sentence endings can vary depending on the context, we collected three corpora, each categorized by the difficulty level: `Easy` from the language learner corpus, `Intermediate` from the newspaper corpus, and `Hard` from the academic papers summaries. The details regarding each corpus are provided in Appendix A.1.

### 3.2 Sentence Endings Expansion

We expanded the original sentences from the corpora collected at each difficulty level with diverse sentence endings. We focused on the `Declarative` and `Imperative` forms, which were categorized into nine and six types, as shown in Table 1. The details in the sentence endings expansion and the explanations of some examples in Table 1 are explained in Appendix A.2.

In Korean, the choice of appropriate sentence ending can be subjective, varying among readers based on their interpretation of context and communicative intent. Therefore, we conducted an annotation process to ensure the natural usages of sentence endings after expanding all sentences using a total of fifteen different sentence endings for `Declarative` and `Imperative` forms.

### 3.3 Two-stage Annotation

To establish standards for determining the natural use of sentence endings, we conducted a two-stage annotation process after expanding all the sentences. We began by performing human annotation on a subset of 20 sentences, covering 300 sentence ending instances from each difficulty level of the corpus. We found that even annotations from native Korean speakers can be inconsistent, as shown in Table 2. Given this situation, manually annotating the remaining sentences per difficulty level would be highly inefficient[4]. Therefore, for the cases not human-annotated, we utilized an LLM-based annotation (He et al., 2024; Ding et al., 2023).

To evaluate whether the selected model efficiently understands Korean sentence endings, we provided it with the same samples used for human annotation[5]. We then compared the model's predictions to the majority voted human annotations and the accuracy results are shown in Table 3. The model achieved high accuracy in nearly all cases, aligning with the human annotation results.

Although the model demonstrated reliable predictive performance, reaching a certain level of accuracy, we remained cautious about the potential for misclassifying sentence endings when annotating the remaining sentences. To address this, we employed two strategies to enhance the model's ability to predict the usage of sentence endings accurately. The details about these strategies, including few-shot learning and cyclic permutation, are provided in Appendix A.3. Finally, we constructed a dataset that includes 1,000 sentences for each difficulty level with 15 different sentence endings applied to each sentence. This resulted in 45,000 distinct Korean sentence ending cases.

## 4 Experiment

We defined specific tasks to evaluate LLMs' understanding of sentence endings by selecting the most contextually natural option from the provided choices for each sentence ending. As mentioned earlier, the appropriate usage of sentence endings

[4]It will require a total of $980 \times 15 \times 3$ sentence ending cases for each, in terms of both time and cost.

[5]In this case, we instructed the latest `gpt-4-turbo` model to perform zero-shot classification with careful attention to the use of sentence endings.

| | Llama3.1 | Llama3 | Llama3-ko | KULLM | EXAONE | Qwen2 | | Gemma2 | | Openchat | Synatra |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 8B | | 10.7B | 7.8B | 1.5B | 7B | 2B | 9B | 8B | 7B |
| Declarative Forms | 13.06 | 15.09 | 17.33 | 14.98 | 15.41 | 13.83 | 13.23 | 16.33 | 14.44 | 13.49 | 16.64 |
| | 13.47 | 17.23 | 20.14 | 17.07 | 14.40 | 15.14 | 13.54 | 16.85 | 13.83 | 14.18 | 16.84 |
| | 12.33 | 15.77 | 18.31 | 16.82 | 13.85 | 14.25 | 12.54 | 15.78 | 13.05 | 13.35 | 15.46 |
| Average | 12.95 | 16.03 | **18.59** | 16.29 | 14.55 | 14.40 | 13.10 | 16.32 | 13.77 | 13.67 | 16.31 |
| Imperative Forms | 8.71 | 10.32 | 10.67 | 10.28 | 9.49 | 10.47 | 8.79 | 9.68 | 9.66 | 9.31 | 10.97 |
| | 8.67 | 12.40 | 12.26 | 11.75 | 9.91 | 11.23 | 10.23 | 9.92 | 10.66 | 10.65 | 12.16 |
| | 8.43 | 11.02 | 11.33 | 11.40 | 10.81 | 10.97 | 10.53 | 10.78 | 11.35 | 10.39 | 11.70 |
| Average | 8.60 | 11.24 | 11.42 | 11.14 | 10.07 | 10.89 | 9.85 | 10.12 | 10.55 | 10.11 | **11.61** |

Table 4: Accuracy of understanding Korean sentence endings across LLMs for the SE-*always* task. We determined each model's final accuracy using cyclic permutation, following the approach used in previous work (Kim et al., 2024a). For both Declarative and Imperative forms, the three reported values from the top represent results for Easy, Intermediate, and Hard, respectively. The model with the highest average score across all models is highlighted in bold, whereas the second-best model is underlined.

depends on the context, and their natural application may be absent in some cases.

In this scenario, we evaluated model performance in two cases: one where a natural ending is always expected (SE-*always*) and one where it may sometimes be absent (SE-*absent*)[6]. In the SE-*always* task, we excluded samples labeled '*no usages*' for each sentence ending and only included samples with labeled usages. In contrast, the SE-*absent* task allowed '*no usages*' as an option among the choices. This setup enabled us to compare model performance while considering the possibility of a missing natural sentence ending. The details of these tasks are provided in Appendix B.1.

We experimented with a diverse set of LLMs to assess their understanding of sentence endings, containing Llama-familes, Qwen2, and Gemma2 with parameter variations. We also selected Korean instruction-tuned models, including KULLM and EXAONE. The details regarding the models and metric are provided in Appendix B.2.

## 5 Discussion

### 5.1 Experimental Results

**Which type of sentence ending form is more challenging?** The results of the sentence ending comprehension evaluation using the proposed dataset with the SE-*always* task are presented in Table 4. The accuracy for the Imperative forms was lower than that for the Declarative forms, indicating the greater difficulty in understanding sentence endings. This discrepancy likely arose because

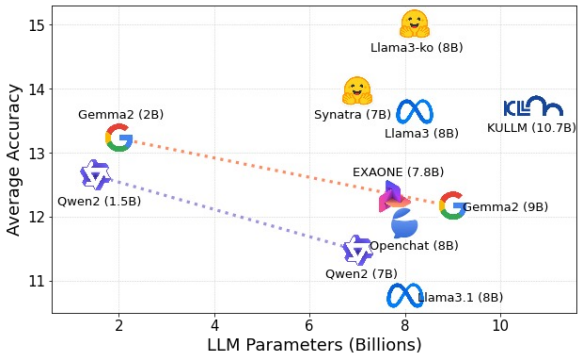


Figure 3: Comparison across LLMs based on parameter count, with scores averaged over all six difficulty levels for both Declarative and Imperative forms.

Imperative endings have more overlapping usage options than Declarative endings, making it more challenging for models to select contextually appropriate sentence endings.

**Does the contextual difficulty affect understanding of sentence endings?** We assumed that as the difficulty of the corpus increases, the models would struggle more to select the appropriate sentence endings. However, the results showed that corpus difficulty had a minimal effect on the accuracy of most models, except for Gemma2 when predicting the usages of Declarative endings. This contrasts with the results in Table 2, which indicate that human annotation consistency decreased as corpus difficulty increased. It suggests that models faced more challenges in selecting the most natural sentence ending from the given options, regardless of the sentence's contextual complexity[7].

[6] In the following discussion of experimental results, we referred to the tasks as either SE-*always* or SE-*absent*, depending on which task was applied to evaluate the models.

[7] Unlike in human annotation, the models were evaluated assuming no prior knowledge of specific usages, so we presented a broader range of options. While this may have influ-

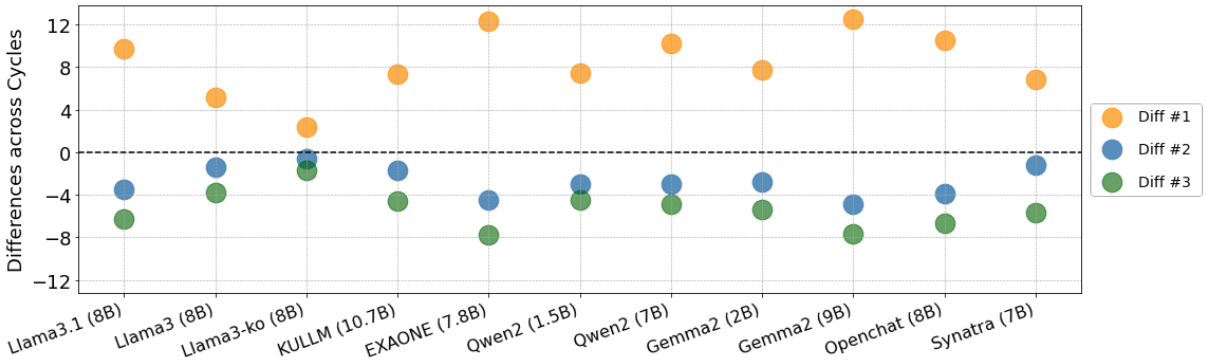


Figure 4: Difference between the accuracy of each cycle and the average accuracy across all cycles after applying three rounds of cyclic permutation to the models. The further a circle is from the dashed line, the greater the deviation from the average, indicating greater inconsistency in the model's predictions.

**How does model parameter size affect understanding of sentence endings?** We compared the average accuracy based on the parameter count, in Figure 3. Although larger parameter counts in LLMs enhance performance in general tasks (Wu and Tang, 2024; Chowdhery et al., 2023), our results showed that the parameter size had minimal impact. For instance, of the 11 models, KULLM with the largest parameters ranked in the top 4 for both Declarative and Impertive ending predictions. Its performance was not significantly better than that of Qwen2, which had only 1.5B parameters. Similarly, Gemma2, with only 2B parameters, ranked in the top 2 in predicting Declarative endings. These relations suggest that all the models, regardless of the parameter count, face challenges in understanding Korean sentence endings.

### 5.2 How does the option order of sentence endings affect the model's understanding?

In our evaluation of sentence ending comprehension, we applied cyclic permutation to assess the impact of the order options on model predictions. While some models consistently predicted sentence endings accurately, regardless of the option order, most struggled to maintain robust performance despite minor changes due to cyclic permutation. The performance shift for each model as cycle permutation was applied is illustrated in Figure 4.

The results showed that almost all models exhibited inconsistencies with cyclic permutation, regardless of the model type or parameter count. Notably, EXAONE showed significant deviations, indicating poor robustness to changes in option order despite being additionally trained on a Korean dataset. Even larger models such as KULLM and Gemma2 (9B) were vulnerable to these shifts, indicating that even increased parameter sizes do not guarantee stability against changes in option order.

Conversely, Llama3-ko showed the smallest accuracy differences across cycles compared with that of the other models. It exhibited relatively greater consistency when compared with other models in the Llama-families and those with the same 8B parameters. Table 5 provides a clear view of these differences, demonstrating that Llama3-ko had a significantly lower variability across cycles. It is likely due to the base model choice or the particular instruction-tuning approach, as opposed to other models trained on Korean datasets.

| Model (Parameters) | Diff #1 | Diff #2 | Diff #3 |
|---|---|---|---|
| Llama3.1 (8B) | +9.69 | -3.47 | -6.22 |
| Llama3 (8B) | <u>+5.15</u> | -1.39 | <u>-3.75</u> |
| Llama3-ko (8B) | **+2.35** | **-0.60** | **-1.74** |
| KULLM (10.7B) | +7.39 | -1.67 | -4.54 |
| EXAONE (7.8B) | +12.27 | -4.48 | -7.79 |
| Qwen2 (1.5B) | +7.46 | -2.99 | -4.47 |
| Qwen2 (7B) | +10.20 | -2.95 | -4.91 |
| Gemma2 (2B) | +7.78 | -2.76 | -5.40 |
| Gemma2 (9B) | +12.56 | -4.88 | -7.67 |
| Openchat (8B) | +10.53 | -3.88 | -6.64 |
| Synatra (7B) | +6.90 | <u>-1.24</u> | -5.66 |

Table 5: Numeral differences between the accuracy of each cycle and the average accuracy of cyclic permutations. The top-2 smallest absolute differences in each cycle are highlighted in bold or underlined.

### 5.3 How does the possibility of no sentence ending affect the model's comprehension?

The results from the SE-*absent* task, in which the models were also given the '*no usages*' option

enced the results, the impact of difficulty on model accuracy during evaluation remained minimal.

| | Llama3.1 | Llama3 | Llama3-ko | KULLM | EXAONE | Qwen2 | | Gemma2 | | Openchat | Synatra |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 8B | | 10.7B | 7.8B | 1.5B | 7B | 2B | 9B | 8B | 7B |
| Declarative Forms | 16.58 | 17.70 | 22.58 | 20.89 | 20.08 | 18.50 | 16.98 | 19.62 | 16.85 | 16.94 | 18.39 |
| | 14.39 | 18.63 | 23.27 | 21.02 | 16.37 | 19.32 | 15.46 | 19.16 | 16.30 | 14.81 | 18.45 |
| | 14.70 | 17.90 | 21.94 | 21.32 | 16.70 | 18.35 | 15.46 | 18.91 | 14.94 | 14.62 | 17.36 |
| Average | 15.22 | 18.07 | **22.59** | 21.07 | 17.71 | 18.72 | 15.96 | 19.23 | 16.03 | 15.45 | 18.06 |
| Imperative Forms | 14.47 | 14.51 | 20.63 | 18.45 | 20.96 | 14.63 | 16.52 | 17.30 | 13.96 | 20.29 | 15.84 |
| | 15.37 | 16.17 | 19.25 | 20.98 | 19.43 | 16.06 | 17.84 | 16.91 | 16.44 | 20.09 | 17.31 |
| | 17.71 | 16.81 | 16.79 | 23.65 | 21.86 | 17.22 | 20.08 | 19.60 | 19.00 | 21.20 | 19.39 |
| Average | 15.85 | 15.82 | 18.88 | **21.02** | 20.75 | 15.96 | 18.14 | 17.93 | 16.46 | 20.52 | 17.51 |

Table 6: Accuracy of understanding Korean sentence endings across LLMs for the SE-*absent* task. The method for determining final accuracy and the order of reported values by difficulty level match those presented in Table 4. The model with the highest average score across all models is highlighted in bold, whereas the second-best model is underlined.

when evaluating sentence ending comprehension, are presented in Table 6. All models exhibited a consistent performance improvement compared with that listed in Table 4, despite the increased number of samples used in the metric owing to the inclusion of the '*no usages*' option. This suggests that all the models in our experiments, regardless of their model type, better understood sentence ending usage when accounting for the possibility that no valid usage exists.

Similar to the SE-*always* task, we found that contextual difficulty had no significant impact on accuracy when predicting the usage of sentence endings in this task. This suggests that, regardless of the model's awareness of an absent sentence ending, the selection of the most natural usage is influenced more by the available options than by the context of the sentence.

In addition, when comparing model performance by parameter size, the largest model KULLM ranked among the top 2 for both Declarative and Imperative forms. However, Gemma2 (2B) outperformed the 9B models in all cases, suggesting that even with the awareness of missing sentence endings, the parameter size did not consistently improve the understanding of sentence endings.

We presented the average scores for both SE-*always* and SE-*absent* tasks, highlighting the improvements in the SE-*absent* task in Table 7. In general, the models performed better when informed of the possibility that no appropriate sentence ending might exist. Notably, models such as KULLM, Llama3-ko, and EXAONE, instruction-tuned with the Korean dataset exhibited a more significant performance boost, indicating that instruction tuning in Korean helps LLMs better grasp the nuances of sentence ending usage.

| Model (Parameters) | SE-*always* Task | SE-*absent* Task | Increased Accuracy |
|---|---|---|---|
| Llama3.1 (8B) | 10.77 | 15.53 | +4.76 |
| Llama3 (8B) | 13.63 | 16.94 | +3.30 |
| Llama3-ko (8B) | **15.00** | 20.73 | +5.73 |
| KULLM (10.7B) | 13.71 | **21.04** | **+7.33** |
| EXAONE (7.8B) | 12.31 | 19.23 | +6.92 |
| Qwen2 (1.5B) | 12.64 | 17.34 | +4.69 |
| Qwen2 (7B) | 11.47 | 17.05 | +5.57 |
| Gemma2 (2B) | 13.21 | 18.58 | +5.35 |
| Gemma2 (9B) | 12.16 | 16.24 | +4.08 |
| Openchat (8B) | 11.89 | 17.98 | +6.09 |
| Synatra (7B) | 13.95 | 17.78 | +3.82 |

Table 7: Accuracy for both SE-*always* and SE-*absent* tasks, along with the improvements seen in the latter. These scores are averaged across all difficulty levels for both Declarative and Imperative forms. The top-2 highest scores in each column are highlighted in bold or underlined.

## 6 Conclusion

We proposed the Korean Sentence Endings (**KoSEnd**) dataset to evaluate the ability of various LLMs to understand the use of diverse Korean sentence endings, considering the language's agglutinative nature. The dataset was categorized into three difficulty levels to reflect the varying contextual nuances from different sources. We expanded all sentences with 15 types of sentence endings, including Declarative and Imperative forms, and applied a two-stage annotation process to label their natural usage.

By evaluating the performance of LLMs under two tasks SE-*always* and SE-*absent*, whether they were informed that a sentence ending might be absent, we found that models such as Llama3-ko, Synatra, and KULLM achieved high accuracy in

both tasks. Furthermore, we examined performance variations based on the model parameters and the consistency of predictions through cyclic permutation. We observed that all models performed better when aware that a sentence ending might be missing. Moreover, the models instruction-tuned with a Korean dataset demonstrated strong prediction consistency and overall performance improvements. Our study provides significant insights into evaluating linguistic knowledge in low-resource agglutinative language, especially in Korean. We expect this approach to be applied to similar languages in future research.

## Limitations

**The Risks of LLM-based Annotation** While we incorporated some human annotations to capture natural sentence ending usage, most samples were annotated using an LLM-based annotation, raising concerns about label quality and potential biases. To mitigate this, we conducted a pilot test as shown in Table 3 to assess the reliability of this process. We further minimized bias by using human annotations as few-shot examples and employing cyclic permutation to reduce option order bias.

**Constraints on Model Selection** Due to resource limitations, we focused on models with fewer parameters rather than larger 70B models, conducting an in-depth analysis to assess each model's understanding of Korean sentence endings from various perspectives.

## Ethics Statement

Our proposed dataset comes from diverse sources with varying difficulty levels, which may lead to sentences that reflect biases or contain discriminatory language based on the nature of these corpora. As the proposed dataset focuses on expanding and annotating Korean sentence endings, we did not leverage potentially biased information from the original sources.

In our experiments to evaluate Korean sentence ending comprehension across various LLMs, there is a possibility that the inherent biases of the model could have influenced the predictions. We designed the task with multiple-choice questions to minimize such effects, focusing on the usage of each sentence ending. By framing this as a classification task and using greedy decoding, we aimed to avoid introducing additional biases from the models.

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# A Details in Dataset Construction

## A.1 Corpus Collection

We used the language learner corpora (Yoon et al., 2023) for the `Easy` corpus. We expected sentences from these less-proficient writers to contain simple vocabulary and more straightforward contexts. For the `Intermediate` and texttttHard corpus, we used a newspaper corpus from the National Institute of the Korean Language[8] and summaries from academic papers[9]. We expected these texts to contain more complex vocabulary and fewer immediately accessible contexts compared to those in the previous difficulty corpora. Their information is presented in Table 8.

We selected sentences that ended with verbs and adjectives, as these were suitable for expanding sentence endings. Sentences considered too short to provide adequate context for understanding sentence endings were excluded.

## A.2 Sentence Ending Expansion

In Korean, sentence endings can be categorized into `Declarative`, `Interrogative`, and `Imperative` forms (Lee, 2005). For the `Interrogative` form, the presence of a question mark makes the use of specific endings straightforward. Therefore, we only focused on the endings used in `Declarative`

[8]Version 2023, https://kli.korean.go.kr/corpus/request/corpusRegist.do#none

[9]https://www.aihub.or.kr/aihubdata/data/view.do?currMenu=115&topMenu=100&aihubDataSe=data&dataSetSn=90

| Difficulty | Collected Sentences |
|---|---|
| `Easy` | 1,000 sentences from corrected Korean Learner Corpus |
| `Intermediate` | 1,000 sentences for each of the 9 news topics (*IT and Science*, *Economy*, *Culture*, *Beauty and Health*, *Society*, *Lifestyle*, *Sports*, *Entertainment*, *Politics*) |
| `Hard` | 1,000 sentences for each of the 8 academic fields (*Humanities*, *Agricultural and Marine Sciences*, *Social Sciences*, *Interdisciplinary Studies*, *Arts and Sports*, *Engineering*, *Natural Sciences*, *Medicine and Pharmacy*) |

Table 8: Corpus information for each difficulty level. For `Intermediate` and `Hard`, we ensured that the texts were gathered from diverse topics and fields.

and Imperative forms, which are more distinct and challenging.

In Declarative sentences, sentence endings such as the case (1) [다, 는다, ㄴ다] in Table 1 can be used to convey different meanings such as [*statements*, *exclamations*, *questions*]. The correct choice of sentence endings can vary depending on the reader's interpretation. For instance, "최선을 다하으마" is incorrect due to the verb stem form, while "최선을 다하마" is correct from the case (5). However, sentences such as "목숨을 바치는구나" and "목숨을 바치구나" from the case (2) are both acceptable and cannot be considered incorrect. In this situation, we conducted a two-stage annotation process to label the most natural sentence endings after expanding all the sentences using fifteen different endings.

### A.3 Two-stage Annotation

**Human Annotation** Three native Korean-speaking university graduates volunteered to human annotation. We provided sentences with various sentence endings and asked them to determine whether each ending was appropriate for the context. We especially noted that, depending on the context, there might be no single best option or several acceptable options. The results in the Table 2 revealed that, despite all participants being fluent in Korean, the choice of natural sentence endings can be inconsistent. In this context, we used majority voting for the results of the human annotation to determine the gold labels for each usage.

**LLM-based Annotation** We used following two strategies to improve the model's ability to label sentence endings. First, we employed few-shot learning (Brown et al., 2020) by selecting a random sample of sentences and their sentence endings from human-annotated results that matched the usage patterns to predict. Second, we employed cyclic permutation (Izacard et al., 2023) when presenting options in the prompts to ensure unbiased model predictions independent of the order of the options, allowing it to focus on consistent patterns across different arrangements.

## B Details in Sentence Endings Evaluation

### B.1 Task Definition

In the two-stage annotation process, only specific sentence endings relevant to each usage were presented to the human annotators and models. For instance, options such as the case (1) [다, 는다, ㄴ다] and (2) [구나, 는구나] in Table 1 were presented separately and not mixed. This approach ensured that, given the sentence ending form, annotators or models could select the most appropriate sentence ending within that form, leading to the most natural choice for the dataset.

| | Difficulty | *no usages* Counts | *no usages* Ratio |
|---|---|---|---|
| Declarative Forms | Easy | 1,703 | 18.92% |
| | Intermediate | 568 | 6.31% |
| | Hard | 1,379 | 15.32% |
| Imperative Forms | Easy | 3,149 | 52.48% |
| | Intermediate | 2,770 | 46.16% |
| | Hard | 2,973 | 49.55% |

Table 9: Counts and proportions of sentences labeled as '*no usages*' in the proposed dataset, categorized by sentence ending types and difficulty levels.

In contrast, when evaluating the LLMs' understanding of sentence endings, we assumed that the model had no prior knowledge of the specific usage of the sentence. Thus, we combined options from all the forms and required the model to select the most natural sentence endings. To prevent the model from being influenced by the order of options, we applied cyclic permutation (Izacard et al., 2023), expecting results would remain consistent regardless of the arrangement of options.

A sentence may have multiple possible sentence endings depending on the context, or none at all. In the dataset construction process, sentences labeled as 'no usages', indicating the absence of an ending across 15 possible cases of Declarative and Imperative endings, are detailed in Table 9.

### B.2 Experimental Settings

The models to evaluate the understanding of Korean sentence endings are as follows: Llama-families (Meta, 2024a,b), Gemma2 (Team et al., 2024), and Qwen2 (Yang et al., 2024) were selected as the multilingual models. In addition, KULLM (Lab and research, 2023) and EXAONE (Research et al., 2024) were instruction-tuned using a Korean dataset.

Specifically, as of September 1, 2024, Openchat and Synatra[10] were ranked as the top-2 models on the Open Ko-LLM Leaderboard[11] (Park et al.,

[10] https://huggingface.co/maywell/Synatra-7B-v0.3-dpo

[11] This leaderboard, a key benchmark for Korean language tasks using private test sets, features the top-performing models in Korean for various downstream tasks.

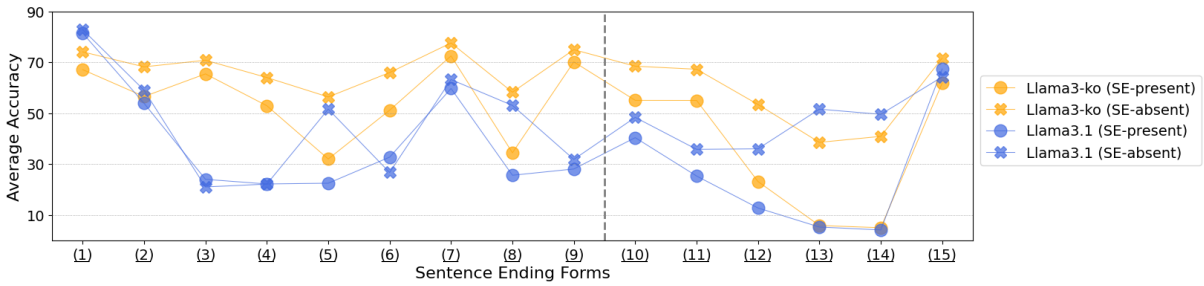


Figure 5: Average scores for each sentence ending form of the two models, `Llama3-ko` and `Llama3.1`, which exhibited the best and worst performance in our experiments. The x-axis displays (1)–(9) for `Declarative` forms and (10)–(15) for `Imperative` forms, as shown in Table 1. These scores represent the average across all difficulty levels and cycles for each sentence ending form.

2024a). We set the temperature to 0 to enable greedy decoding for predicting the most natural usage of sentence endings. We used the vLLM library (Kwon et al., 2023) to enable efficient inference using these models.

We designed prompts and asked the models to select their answers in a multiple-choice format. We measured the accuracy by comparing the models' responses with the gold labels derived from the two-stage annotation process. Each model responded to the same prompt three times using cyclic permutation, aligning the accuracy metrics with the patterns in previous work (Kim et al., 2024a).

## C Details in Experiments

### C.1 Post Processing

When we instructed the models to evaluate them, some models generated additional explanations alongside their selections. To refine these outputs, we applied post-processing, which involved prioritizing the alphabet following phrases such as 'correct answer' or removing irrelevant characters not representing the answer. If we still couldn't identify the answer after this process, we classified it as a hallucination. The hallucination rates for each model are shown in Table 10. We excluded those hallucination samples from the metric evaluation.

### C.2 Experimental Results on Each Sentence Ending Form

To examine which sentence ending form most influenced each model's performance, we reported the results for each form individually in Figure 5. Based on the results in Table 7, we selected `Llama3-ko` and `Llama3.1`, which exhibited the best and worst performance in both SE-*always* and SE-*absent* tasks.

| | Model (Parameters) | Easy | Intermediate | Hard |
|---|---|---|---|---|
| SE-*always* Task | EXAONE (7.8B) | 0.013% | - | - |
| | Qwen2 (7B) | - | - | 0.002% |
| | Gemma2 (9B) | - | - | 0.002% |
| | Synatra (7B) | 0.006% | - | - |
| SE-*absent* Task | KULLM (10.7B) | 0.002% | 0.008% | 0.04% |
| | EXAONE (7.8B) | 0.02% | - | - |
| | Synatra (7B) | - | 0.004% | 0.002% |

Table 10: Hallucination rates for each task, based on the selected models. Any values not listed in the table were not classified as hallucinations according to our post-processing process.

In most cases, regardless of the sentence ending form, we observed significant improvements in performance when the models were informed of the potential absence of a sentence ending. This trend was consistent across two models `Llama3-ko` and `Llama3.1`, indicating that recognizing the possibility of an absent sentence ending enhances their understanding of Korean sentence endings.

Although `Llama3-ko` demonstrated strong performance across most sentence-ending forms, we observed that `Llama3.1` either outperformed or achieved comparable results with `Llama3-ko` in cases (1) and (13)~(15). Cases (1), (13), and (14) are the most commonly used form, including usages *statements* and *informal speeches*, and `Llama3.1`'s enhanced performance can be attributed to its training on larger dataset as a more recent model. Case (15) from the `Imperative` forms includes six different usages, the highest number of usages for any sentence ending form. This suggests that `Llama3.1`'s ability to handle a broader range of variations, as previously mentioned, allowed it to perform comparably to `Llama3-ko`.