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Electronic Journal of Foreign Language Teaching
2025, Vol. 22, No. 1, pp. 134–164

Korean Learners' Grammatical Knowledge of the Meaning Differences Among "-ten," "-essten," and "-(u)n" and Their Combinations with Lexical Aspects

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Abstract

This study elucidates Korean language learners' knowledge regarding the meanings of the relative clause endings "-ten", "-essten," and "-(u)n" and their combinations with predicates of different lexical aspects. The items were designed to test the substitution possibilities between "-ten" and "-(u)n" and between "-ten" and "-essten." Each item included a predicate selected based on its lexical aspect features. Three types of Grammaticality Judgment Tests (GJTs) and a Self-Paced Reading Test (SPRT) were performed with intermediate learners, advanced learners, and native Korean speakers. Despite their proficiency, even advanced learners encountered difficulty distinguishing "-ten," "-essten," and "-(u)n" correctly, particularly in terms of their semantic contrasts and distributional constraints. However, they still outperformed intermediate learners, even though their acquisition of implicit and explicit knowledge remained uneven. Learners had greater difficulty substituting "-ten" and "-(u)n" than substituting "-ten" and "-essten," particularly in contexts involving predicates with [–state] and [–punctual] features. The study suggests educational implications regarding these endings based on the meaning differences between "-ten" and "-essten" and between "-ten" and "-(u)n," particularly in relation to their combinations with lexical aspects.

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Kim, B., Jeong, H., & Song, C., & Kim, H. (2025). Korean learners' grammatical knowledge of the meaning differences among "-ten," "-essten," and "-(u)n" and their combinations with lexical aspects. *Electronic Journal of Foreign Language Teaching [e-FLT]*, *22*(1), 134–164. https://doi.org/10.56040/kjsk2218

1 Introduction

This study sought to explore the acquisition of Korean relative clause ending "-ten," "-essten," and "-(u)n" by intermediate and advanced Korean learners based on data collected from 69 learners and 31 native speakers.

The Korean past tense relative clause modifying endings are different from other relative clause modifying endings, such as "-nun" and "-(u)l," in that these three endings, "-ten," "-essten," and "-(u)n," are used, and their meanings are not simply about tense, but also contain aspectual meanings. Considering these characteristics, "-ten," "-essten," and "-(u)n" are considered difficult grammatical items to acquire; "-ten" and "-essten" have evidentiality or retrospective meanings, as well as aspectual meanings, such as continuous, movement of perspective, or disconnection (Kim, 2015; Nam, 2012; Takachi, 2008; Xu, 2012). Additionally, "-ten" and "-essten" convey the event meaning of the past tense similarly to "-(u)n", yet the meanings of these two endings are also not identical. The complicated nature of their meanings makes learning challenging, because only after learners are aware of the differences in the meanings and constraints of the combined verbs can they understand and produce them correctly. To resolve these difficulties, this research aimed to identify the meanings and functions of "-ten," "-essten," and "-(u)n," categorize the cases in which they can or cannot be used, and distinguish the parts where learners have difficulty in acquiring implicit and explicit knowledge.

This study used three types of Grammaticality Judgment Tests (GJTs) and a Self-Paced Reading Test (SPRT) to determine the acquisition status of learners from different perspectives (Kim et al., 2022). The GJT has been reported to measure different types of knowledge based on time limit, modality, and grammaticality (Bowles, 2011; Ellis, 2005; Gutiérrez, 2013; Kim & Nam, 2017; Vafaee et al., 2017). Therefore, this research developed and used an Aural Grammaticality Judgment Test (AGJT) with a time limit, a Written Grammaticality Judgment Test (WGJT) with a time limit, and an Untimed Written Grammaticality Judgment Test (UGJT) without a time limit. Sentence processing was also analyzed to examine learners' knowledge from perspectives other than simple grammaticality. Determining the part of the sentence that learners focus on to process the sentence and whether they show sensitivity to grammatical errors provides insights into learners' knowledge relative to the grammatical features. Therefore, this research used SPRT to examine learners' language processing ability by measuring the reading time for certain units such as words, word-phrases, or phrases (Marsden et al., 2018). Based on previous research that showed a higher correlation to SPRT in the order of AGJT, WGJT, and UGJT (Kim et al., 2022), this study employed GJTs with a time limit to measure implicit knowledge and a GJT without a time limit to measure explicit knowledge (Ellis, 2005; Ellis & Roever, 2021; Kim & Nam, 2017).

Accordingly, this research developed three types of GJTs and an SPRT based on the substitution of "-ten" and "-(u)n" and "-ten" and "essten," and the characteristics of combined verbs to gauge learners' grammatical knowledge acquisition and cognitive process. GJTs were used to identify learners' grammaticality acquisition by focusing on: 1) the difference between learners' proficiency; 2) the difference between substitution and characteristics of combined verbs; and 3) test variables, which were time and modality. SPRT was used to examine how learners processed sentences by focusing on: 1) the difference between learners' proficiency; 2) the difference between substitutions and characteristics of combined verbs; and 3) the differences between the grammaticality of the stimuli.

The research questions were as follows:

1. How is the acquisition status of Korean language learners of "-ten" or similar endings substituted, based on proficiency and tasks?
2. How is the acquisition status of "-ten" and similar endings substituted by the lexical aspects of combined verbs, based on proficiency and tasks?

2 Theoretical background

2.1 Formation of Korean relative clauses and meaning of "-ten," "-(u)n," and "-essten"

Korean relative clauses are formed by combining the stem of the predicate with one of the relative clause modifying endings, "-(u)n," "-nun," "-(u)l," and "-ten." (Koo et al., 2016; Park, 2016; Woo, 1987). Each ending is related to modal meanings, such as realization or realis (J.-Y. Park, 2009, 2019; Mun, 2009; Shin, 1982). However, the primary meaning of the endings is tense; for instance, "-(u)l" is considered the future tense, "-nun" the present, and "-(u)n" and "-ten" the past tense. These tenses are related to the tense of the main clause.

However, unlike the present or future, the past tense is expressed by "-(u)n" and "-ten." While both forms mark past tense, they differ in aspectual meaning. Some scholars have analyzed "-ten" as a combination of "-te-" and "-(u)n" (Oh, 2011; J.-K. Park, 2009; Shim & Lee, 2012). In this perspective, "-te-" is considered the element that contributes to the semantic distinction between the two forms, conveying evidential modality (Park, 2011; Song, 2007) and an imperfect aspect (Park, 2011). However, many scholars—including Seo (1990), Park (2003), and Choi (2015)—have argued that in the case of "-ten," these modal features are secondary to its core tense and aspectual functions. Shin (1982) analyzed "-(u)n" as carrying the features of [+realization] and [+completion], whereas "-ten" is characterized by [+realization], [-completion], and [+distance]. Notably, she identified [+distance]—referring to the speaker's psychological, spatial, or temporal detachment—as the key semantic feature that distinguishes "-ten." Ko and Koo (2008) classified "-(u)n" as a simple past marker and "-ten" as expressing past recollection, continuation, repetition, incompletion, or interruption. Kim and Park (2017) argued that "-(u)n" and "-ten" can be used interchangeably when referring to repeated events in the past. However, when "-(u)n" denotes completed actions and "-ten" indicates incomplete ones, their meanings diverge.

Meanwhile, there is "-essten," which is the combined form of "-ten" and the past tense morpheme "-ess-." Normally, "-ess-" is considered the past tense; however, based on its relative location to other grammatical morphemes, it can also imply a perfect aspect (Kim, 2017; Mok, 2000). Therefore, "-essten" as a combination of "-ess-" and "-ten," in addition to the evidentiality of "-ten," has the meaning of the end of an event or a strong disconnection with the present. Lee (1983) viewed "-ten" as indicating a state that persisted for a certain period in the past but is now disconnected from the present, while "-essten" denotes either the completion following continuation or the continuation following completion. Song (2006) analyzed "-ten" as expressing incompletion and repetition, and "-essten" as indicating completion and repetition, noting that no semantic difference arises in the context of repeated actions. Ko and Koo (2008) described "-ten" as conveying past recollection, continuation, repetition, incompletion, or interruption, and characterized "-essten" as referring to the completion of an action or the recollection of repeated actions. Lee (2010) regarded "-ten" as expressing habitual actions, repetition, and past incompletion, and "-essten" as indicating habitual actions, repetition, and completion, and he also asserted that the two forms do not differ semantically when used to describe habitual or repeated actions.

In summary, "-essten" differs from "-ten" in that it encodes the notion of completion, while both forms are commonly associated with repetition. Kim and Park (2017) argued that "-ten" and "-essten" can be used interchangeably when the verb refers to repeated or continuous past experiences, when the verb inherently implies continuity, when used with adverbs of repetition, or in the case of adjectives. However, they also noted that a semantic distinction emerges when "-ten" expresses incompletion and "-essten" denotes completion. In such cases, "-essten" may refer to a single completed past action, whereas "-ten" is sometimes unacceptable for describing one-time events.

The examples in (1), presented below, illustrate that "-(u)n" and "-essten" express meanings related to completion, which contrast with those of "-ten," thereby highlighting differences in grammatical acceptability. For explanations of the abbreviations used in the examples, please refer to Appendix I.

(1) a. *동생은 먹은 사과를 책상 위에 두었다.
tongsayng-un mek-un sakwa-lul chayksang wi-ey twu-ess-ta.
younger.sibling-TC eat-PPVR apple-AC desk top-LOC put -PST-DC:PLN
"*My sister put the apple that she had eaten on top of the desk."

b. ?동생은 먹었던 사과를 책상 위에 두었다.
tongsayng-un mek-essten sakwa-lul chayksang wi-ey twu-ess-ta.
younger.sibling-TC eat-PPR apple-AC desk top-LOC put -PST-DC:PLN
"?My sister put the apple that she had eaten before on top of the desk."

c. 동생은 먹던 사과를 책상 위에 두었다.
tongsayng-un mek-ten sakwa-lul chayksang wi-ey twu-ess-ta.
younger.sibling-TC eat-PIR apple-AC desk top-LOC put -PST-DC:PLN
"My sister put the apple that she had been eating on top of the desk."

In (1a), since the action of eating the apple occurred in the past, it is difficult to assume that there is any apple left. This semantic mismatch renders the sentence ungrammatical. In (1b), the expression also indicates that the eating event took place in the past and was likely completed, which may lead to a sense of semantic awkwardness when considering the plausibility of the apple's current presence. In contrast, (1c) implies that the action of eating the apple was incomplete, allowing for the interpretation that some portion of the apple remains. This makes (1c) a natural and grammatically acceptable sentence.

As seen above, Korean uses "-(u)n," "-ten," and "-essten" for the past tense in relative clauses, and these forms differ primarily in aspect, with some secondary differences in modality. "-(u)n" is past and perfective; "-ten" is past imperfect with evidential overtones; and "-essten" is past and perfect, also carrying an evidential nuance. Unlike the future or present tense, learners face difficulty choosing one of these three forms when expressing past tense in Korean relative clauses.

2.2 Lexical aspect and "-ten," "-(u)n," "-essten"

Unlike the simple past tense suffix "-(u)n," "-ten" and "-essten" have more complex meanings that become particularly salient depending on the lexical aspect of the accompanying verb. Vendler (1957) categorized the lexical aspects of verbs into four types: activity, accomplishment, achievement, and state. As summarized by Van Valin and LaPolla (1997), these categories are defined in terms of three semantic features: [±telic], [±static], and [±punctual]. Specifically, state verbs are [+static], [–telic], [–punctual]; activity verbs are [–static], [–telic], [–punctual]; accomplishment verbs are [–static], [+telic], [–punctual]; and achievement verbs are [–static], [+telic], [+punctual]. Although some studies, including Dowty (1979), have pointed out that it is difficult to group all verbs strictly within these four categories, this framework has nonetheless been widely acknowledged as fundamental for understanding the lexical aspects of Korean predicates (Koo et al., 2016). This study also adopted this framework in analyzing lexical aspect.

To apply this lexical aspect framework to Korean predicates as a whole, including adjectives, their grammatical properties must also be considered. In Korean, adjectives are conjugated similarly to verbs and are categorized as predicates. However, they are often regarded as a separate verbal category due to different constraints on the grammatical endings they combine with. Consequently, Korean adjectives are sometimes referred to as stative verbs, and some Korean textbooks name Korean verbs as action verbs and Korean adjectives as descriptive verbs (*Yonsei Korean*; Yonsei University Korean Language Institute, 2013) or stative verbs (*Get It Korean Grammar*, Kyunghee Korean; Kyunghee Korean Textbook Editorial Committee, 2020). Additionally, the copula "-ita" is conjugated in the same manner as adjectives after they combine with nouns.

Certain types of verb-relative clause modifying ending combinations are preferred based on the lexical aspect of the verb and the aspectual meaning of the endings. First, owing to the imperfect meaning of "-ten," it frequently combines with [-state] and [-punctual] predicates, as in (2a), and is not often combined with adjectives, copulas, or punctual verbs (Nam, 2012; Yang, 2017). However, this does not mean that the combination of "-ten" with those verbs is never possible. When "-ten" is combined with [+state] verbs, as shown in (2b), it signifies a moving prospect to the past (Kim, 2015; J.-K. Park, 2009; Oh, 2011) or has a retrospective meaning (Nam, 2012; Shim & Lee, 2012; Xu, 2012), emphasizing evidential over imperfect meaning (Takachi, 2008). When "-ten" is combined with a punctual verb, it indicates repetition of the action rather than an extension of its punctual nature, as in (2c).

(2) a. 강을 건너던 사람들은 모두 피해를 입었어. (Mun, 2009)
kang-ul kenne-ten salam-tul-un motwu phihay-lul ip-ess-e.
river-AC cross-PIR person-PLR-TC all damage-ACC suffer-PST-DC:INT
"The people who were crossing the river all suffered damage."

b. 그 즐겁던 시절이 그립구나. (Lee, 2005)
ku culkep-ten sicel-i kulip-kwuna.
that joyful-PIR time-SUB miss-EXCL
"I miss those joyful days."

c. 아이가 눈을 깜빡이던 모습이 기억나요.
ai-ka nwun-ul kkamppaki-ten mosup-i kiekna-yo.
child-SUB eye-AC blink-PIR image-SUB remember-DC:POL
"I remember the image of the child blinking."

Compared to "-ten," "-essten" has fewer aspectual constraints, and thus combines freely with different types of verbs. When combined with [-state], as seen in (3a), it shows that the action is completed and emphasizes the disconnection between the event and the present (Luo, 2018; J.-K. Park, 2009; Shim & Lee, 2012; Xu, 2012). When combined with [+state] as in (3b), "-essten" has a retrospective meaning similar to "-ten." However, the meaning of disconnection is also emphasized, and "-essten" is preferred to "-ten" (Oh, 2011; J.-K. Park, 2009). Meanwhile, "-essten" is also preferred when combined with punctual verbs, as in (3c), because it is unlikely for the punctual event to be perceived as imperfect; however, the usage of "-ten" is not necessarily ungrammatical.

(3) a. 강을 건넜던 사람들은 모두 피해를 입었어. (Mun, 2009)
kang-ul kenne-essten salam-tul-un motwu phihay-lul ip-ess-e.
river-AC cross-PPR person-PLR-TC all damage-AC suffer-PST-DC:INT
"The people who had crossed the river all suffered damage."

b. 잔뜩 흐렸던 하늘이 지금은 맑게 개었다. (Kim & Park, 2017)
canttuk huly-essten hanul-i cikum-un malk-key kay-ess-ta.
heavily clouded-PPR sky-SUB now-TC clear-ADV open-PST-DC:PLN
"The sky, which had been heavily clouded, has now cleared up."

c. 그 말을 꺼냈던 이유를 알 수가 없다. (Yang, 2017)
ku mal-ul kkenay-ssten iyu-lul al swu-ka eps-ta.
that word-AC bring.up-PPR reason-AC know way-SUB not.exist-DC:PLN

"I can't figure out why (they/you) brought up those words."

In summary, "-ten" frequently combines with [-state], [-punctual] predicates, and when it does, it carries an imperfect aspect. Consequently, combinations with [+state] predicates are less preferred, and when they occur, the modal meaning tends to be emphasized. Combinations with [+punctual] predicates are also possible, but less preferred, typically conveying a meaning of repeated or habitual action. In contrast, "-essten" has fewer combinational constraints than "-ten" and is associated with the perfect aspect and a sense of disconnection.

The meaning of "-(u)n" is more closely associated with past tense than with any modal interpretation. It functions as a perfective aspect marker, which does not reveal the internal temporal structure of the event, allowing it to combine relatively freely with various types of predicates. However, when the predicate carries an imperfective meaning, it becomes difficult to use "-(u)n," as shown in the previous example (1a).

Based on the meanings of the endings and constraints derived from them, Korean learners are expected to be exposed to the combination with "-essten" or "-(u)n" when it comes to stative or punctual verbs, compared to the low frequency of the input of "-ten" and these lexical aspects. This low frequency of input leads learners to use "-essten" or "-(u)n" while avoiding "-ten," which results in higher accuracy. However, for [-state] or [-punctual] verbs, learners need to decide which one to use by considering the meaning of the whole sentence, including the aspectual characteristics of verbs, as well as the aspectual and modal meanings of the endings. Therefore, these types of verbs may impose a greater cognitive load on learners, potentially making them more difficult to acquire.

2.3 Measuring second language grammatical knowledge

In second language acquisition theories, learners' grammatical knowledge can be categorized into implicit and explicit knowledge (Bialystok, 1978; Butzkamm, 1990; DeKeyser, 2003; Ellis, 2005; Ellis et al., 2009). The relationship between implicit and explicit knowledge has been described differently by researchers; however, implicit knowledge is mostly intuitive, automatic, and immediate, while explicit knowledge is conscious, controlled, and takes time to access and be activated. Therefore, implicit knowledge is particularly useful when fluency is vital. Similarly, explicit knowledge is likely to be used under circumstances where accuracy is more important than proficiency and there is no time limit. Different types of measurement tests should be used to access the different types of knowledge learners possess.

The measurement of learners' implicit knowledge has been an issue since this distinction was introduced, mostly through GJTs. Bialystok and Frolich (1977) stated that immediate and automatic responses are implicit knowledge, and intentional and delayed responses are explicit knowledge. Early studies proposed that GJTs tap into implicit knowledge, as learners often rely on intuitive judgments or a "feeling" when evaluating sentence grammaticality (Bialystok, 1979; Ellis, 1991). However, subsequent empirical studies have demonstrated that the type of knowledge assessed by GJT is highly dependent on specific task design factors, including the presence or absence of a time constraint, the mode of stimulus presentation, and whether the sentence is grammatical or ungrammatical (Ellis, 2005; Han & Ellis, 1998). In particular, GJTs are more likely to reflect implicit knowledge when they involve a time limit, auditory stimuli, and grammatically correct sentences (Ellis, 2005).

However, a thorough standard for measuring implicit knowledge was recently applied (e.g., Jiang, 2007; Vafaee et al., 2017). Although metalinguistics is unlikely to be used with a time limit, judging grammaticality requires a focus on form, which leads to the activation of explicit knowledge. Online measuring tasks using response time, like the Word Monitoring Test (WMT) or SPRT, have been suggested as alternatives to measure implicit knowledge.

Jiang (2007) suggested that previous measuring tools cannot exclude the possibility of explicit knowledge being used and thus adapted SPRT to measure the time taken by learners to read a certain unit of a sentence. SPRT involves reading sentences one word at a time by pressing a key, with the

reading time for each word recorded. The stimuli include both grammatical and ungrammatical sentences; however, participants are not informed of this distinction and are instead encouraged to focus on meaning through comprehension questions. This task is focused on meaning rather than form, in that participants are required to understand the meaning of the sentences and are not directly asked about grammaticality, but instead activate relevant knowledge indirectly through the time needed to process the form of interest.

WMT, on the other hand, requires participants to listen to sentences and press a key as soon as they identify a target word, which appears after the grammatical structure of interest to the researchers. Like SPRT, the stimuli include both grammatical and ungrammatical sentences. In both SPRT and WMT, the difference in response times between the target regions of grammatical and ungrammatical sentences reflects grammatical sensitivity, serving as an indicator of learners' implicit grammatical knowledge (Ellis & Roever, 2021; Suzuki, 2017).

Although these alternatives are appealing, the relationship between the types of knowledge measured by SPRT or WMT and GJT is nevertheless controversial. Vafaee et al. (2017) demonstrated the relationship between SPRT, WMT, Metalinguistic Knowledge Test (MKT), ungrammatical stimuli of TGJT, and ungrammatical stimuli of UGJT using Confirmatory Factor Analysis (CFA), which suggested that SPRT and WMT measure implicit knowledge while others measure explicit knowledge. Marsden et al. (2018) conducted a meta-analysis of studies that adopted SPRT and showed that it was mostly used to explain "automatized knowledge," not "explicit knowledge," and "implicit knowledge" when used for knowledge research. Therefore, even if GJT measures implicit knowledge under certain conditions, the likelihood of using explicit knowledge is not as low as in SPRT.

In summary, considering the categorization of second language grammatical knowledge into implicit and explicit types, this study designed tasks to measure each type of knowledge (Bialystok & Frolich, 1977; Ellis et al., 2009). Implicit knowledge was measured using the SPRT, which assessed grammatical sensitivity through behavioral reaction times. Explicit knowledge was measured using the UGJT, which served as the primary tool for capturing explicit grammatical knowledge. The AGJT and WGJT were used to measure knowledge falling between implicit and explicit knowledge (Ellis, 2005; Ellis & Roever, 2021; Kim & Nam, 2017; Kim et al., 2022).

3 Research method

3.1 Participants

The study involved 100 participants aged 18 years and older, who were categorized into three groups: 31 native Korean speakers, 26 intermediate Korean language learners, and 43 advanced Korean language learners. Participants were recruited through an online bulletin board for university students. This study was approved by the Ethical Committee of the Institutional Review Board at Seoul National University (Seoul, Korea; SNU IRB No. 2001/002–006), and all participants provided informed consent before engaging in the study. Native Korean speakers included individuals who had not lived abroad for more than a year prior to adolescence. Intermediate learners were defined as those who achieved Test of Proficiency in Korean (TOPIK) levels 3 or 4, whereas advanced learners achieved TOPIK levels 5 or 6.[1] The detailed proficiency levels and additional participant information are presented in Table 1.

[1] The participants' native languages consisted of Chinese (26 participants, 37.14%), Burmese (8 participants, 11.43%), Japanese (7 participants, 10%), Russian (5 participants, 7.14%), Mongolian (4 participants, 5.71%), Vietnamese (4 participants, 5.71%), Cantonese (2 participants, 2.86%), Spanish (2 participants, 2.86%), Kazakh (2 participants, 2.86%), Thai (2 participants, 2.86%), Persian (2 participants, 2.86%), German (1 participant, 1.43%), Slovak (1 participant, 1.43%), Sinhalese (1 participant, 1.43%), Uzbek (1 participant, 1.43%), Chinese/Kazakh (1 participant, 1.43%), and Turkish (1 participant, 1.43%).

Table 1. Participant information

Group	Proficiency (TOPIK)	N	
Intermediate	Level 3	8	26
	Level 4	18	
Advanced	Level 5	17	43
	Level 6	26	
Native speakers		31	31
Total			100

Note. TOPIK: Test of Proficiency in Korean

3.2 Materials

To explore the acquisition patterns of grammatical knowledge among Korean language learners from diverse perspectives, this study employed three variations of GJTs and one SPRT as research instruments. The three types of GJTs in this study differed in terms of time constraints (timed/untimed) and modality (aural/written).

1) Timed Aural GJT (referred to as AGJT)
2) Timed Written GJT (referred to as WGJT)
3) Untimed GJT (referred to as UGJT)

In contrast, the SPRT required participants to read sentences one unit at a time, controlling the pace themselves, while their reading time (RT) for each segment was recorded. This task was designed to examine learners' grammatical sensitivity by identifying delays in RTs at the target region—where the grammatical feature of interest was located—and in the spillover region that immediately followed. To maintain focus during the task, grammaticality judgments or comprehension questions were occasionally inserted between sentences. The inclusion of comprehension questions served to direct participants' attention toward meaning, thereby reducing the likelihood of conscious attention to linguistic forms.

In the SPRT conducted in this study, sentences were presented using a "moving window" approach, in which a segment of the sentence appeared on the screen alongside each keypress made by the participant. With every keypress, the previously read section was concealed, and the next part of the sentence was revealed. Each sentence was partitioned into six segments, with the target grammar items "-ten" and "-essten" featured in the initial segment. Additionally, to ensure that participants concentrated on the sentence meaning during the task, comprehension questions were included for 50% of the sentences, with participants required to respond with "correct" or "incorrect." Sentence length in the SPRT was standardized to 21 syllables. The number and types of items for each test are listed in Table 2.

Table 2. Item types for each test

Item types	Grammaticality	AGJT	WGJT	UGJT	SPRT
Target sentences	Grammatical	20	20	20	20
	Ungrammatical	20	20	20	20
Filler sentences	Grammatical	20	20	20	20
	Ungrammatical	20	20	20	20
Total		80	80	80	80

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; SPRT: Self-Paced Reading Test

As shown in Table 2, the three types of GJTs and the SPRT included an equal number of grammatical and ungrammatical items. The ungrammatical items mainly resulted from substitutions between verb endings "-ten" and "-essten," as well as between "-ten" and "-(u)n." In the context of substitutions between "-ten" and "-essten," we analyzed the subtypes to distinguish when "-ten" should be used from when "-essten" was required. Furthermore, to prevent participants from identifying the target grammatical features, we introduced 20 grammatical and 20 ungrammatical filler sentences, while maintaining a one-to-one ratio with the target items. The vocabulary used to create the sentence stimuli was limited to beginner- and intermediate-level vocabulary obtained from the Korean Language Teaching and Learning Center of the National Institute of Korean Language (https://kcenter.korean.go.kr/). The presentation order of the stimuli was randomized.

3.3 Procedure

Participants initially undertook the meaning-focused task, the SPRT, and subsequently, in descending order of form-focused likelihood, completed the AGJT, WGJT, and UGJT tasks. Each task typically took between 10 and 20 minutes to complete, with participants having the option to take sufficient breaks between tasks.

In the SPRT, sentences were segmented into six parts, and participants read one segment at a time by pressing keys. The real-time RT for each segment was recorded using PsychoPy v3.0 software.

Regarding the GJTs, AGJT required participants to judge grammaticality using auditory stimuli, whereas WGJT involved visual stimuli for grammaticality judgments. Given the real-time stimulus presentation, we employed PsychoPy v3.0 software. For UGJT, where no time constraints were imposed, participants' responses were recorded in a spreadsheet, and they were tasked with assessing the grammaticality of written stimuli. In all tasks, including SPRT, four practice items were presented prior to the initiation of the actual tasks.

3.4 Data analysis

In the data analysis process, participants were categorized into three proficiency levels: 3 (intermediate), 2 (advanced), and 1 (native Korean speaker). Items were classified based on the type of substitution, with 1 denoting "-ten," "-(u)n" substitution, and 2 representing "-ten," "-essten" substitution. Similarly, items related to vocabulary were coded 1 ([-state], [-punctual] verbs); and 2 (verbs that did not fall under [-state] and [-punctual], such as punctual verbs, adjectives, or copulas).

In terms of the results, GJT data were converted into A' scores using the principles of Signal Detection Theory (Snodgrass & Corwin, 1988). An A' score differentiates hits (accurate identification of ungrammatical items as ungrammatical) from false alarms (inaccurate identification of grammatical items as ungrammatical) and provides a weighted measure to account for guessing in grammaticality judgments.[2]

In the case of SPRT, the mean RT for regions 1 (target region) and 2 (spillover region) was examined. Statistical analysis considered random effects due to repeated measurements and utilized the Mixed-Effects Modeling approach (Gries, 2021). The analysis was conducted with a 95% confidence level, and the significance level was set at 0.05. Statistical analyses were performed using the R programming language.

[2] HIT=(#wrong+0.5)/(#ungrammatical sentence+1); FA=(#wrong+0.5)/(#grammatical sentence+1); A'=If HIT≥FA, (0.5+((HIT-FA)*(1+HIT-FA))/(4*HIT*(1-FA)) or If HIT<FA, (0.5-((FA-HIT)*(1+FA-HIT))/(4*FA*(1-HIT))

4 Results and analysis

Descriptive statistics and regression analyses that are critical to interpreting the study's primary findings are presented in the main text. Due to space constraints, detailed tables and figures concerning interaction effects and post hoc tests are provided in Appendix II.

4.1 Knowledge of "-ten" and its substitutional forms

4.1.1 GJT

Type 1 is related to substitution errors between the ending "-ten" and the different ending "-(u)n." Type 2 is related to substitution errors between the ending "-ten" and the different ending "-essten." The A' scores for each level of proficiency for Types 1 and 2 are shown in Table 3 and Figure 1 below.

Table 3. Descriptive statistics of GJT scores by substitution type

Test	Type	Group (Proficiency)	N	Mean (SD)	Minimum	Maximum
AGJT	1	1	31	0.82(0.12)	0.5	0.98
		2	43	0.56(0.16)	0.25	0.95
		3	26	0.48(0.15)	0.21	0.82
	2	1	31	0.78(0.14)	0.28	0.93
		2	43	0.64(0.14)	0.31	0.89
		3	26	0.57(0.16)	0.21	0.82
WGJT	1	1	31	0.86(0.09)	0.5	0.98
		2	43	0.5(0.2)	0.21	0.93
		3	26	0.42(0.2)	0.1	0.77
	2	1	31	0.83(0.08)	0.59	0.98
		2	43	0.6(0.17)	0.25	0.93
		3	26	0.57(0.19)	0.14	0.85
UGJT	1	1	31	0.9(0.07)	0.69	0.98
		2	43	0.52(0.18)	0.11	0.82
		3	26	0.51(0.19)	0.14	0.95
	2	1	31	0.88(0.09)	0.5	0.98
		2	43	0.71(0.19)	0.25	0.95
		3	26	0.66(0.13)	0.42	0.9

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items related to substitution errors between the ending "-ten" and the different ending "-(u)n;" Type 2: Items related to substitution errors between the ending "-ten" and the different ending "- essten;" N: Number of participants; SD: Standard deviation

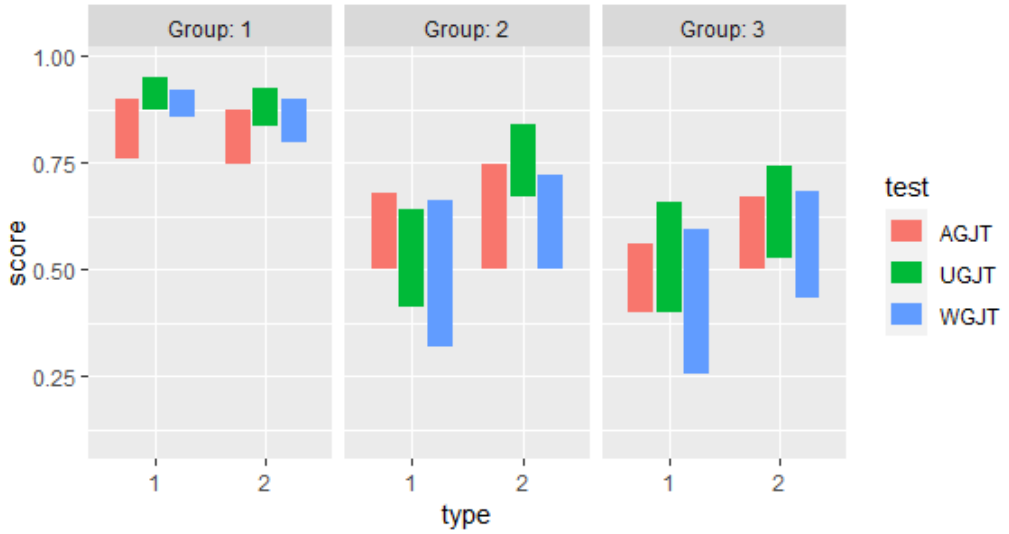

Fig. 1. GJT results based on group * substitution type * test type

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items related to substitution errors between the ending "-ten" and the different ending "-(u)n;" Type 2: Items related to substitution errors between the ending "-ten" and the different ending "- essten"

Group 2 (advanced learners) and Group 3 (intermediate learners) showed lower average scores across all tasks and types than Group 1 (native Korean speakers). Looking at the scores by test, Group 1 scored lower in AGJT and higher in UGJT. Group 2 had a different percentage of correct answers for each test depending on the type. In Group 3, the score distribution of WGJT widened in Type 1. A linear mixed-effects regression analysis was conducted to confirm the statistical significance of this pattern. The results are summarized in Table 4.

Table 4. Linear mixed effects regression results of GJT by item classification according to substitution type

Predictors	Estimates	Std. Error	CI	Statistic	p
(Intercept)	0.82	0.03	0.77 – 0.88	29.54	**<0.001*****
Group [2]	-0.26	0.04	-0.33 – -0.19	-7.16	**<0.001*****
Group [3]	-0.35	0.04	-0.43 – -0.26	-8.38	**<0.001*****
Type [2]	-0.04	0.03	-0.11 – 0.03	-1.21	0.228
Test [UGJT]	0.08	0.03	0.01 – 0.15	2.32	**0.021***
Test [WGJT]	0.04	0.03	-0.03 – 0.11	1.14	0.253
Group [2] × Type [2]	0.12	0.05	0.03 – 0.21	2.61	**0.009****
Group [3] × Type [2]	0.13	0.05	0.03 – 0.23	2.6	**0.01****
Group [2] × Test [UGJT]	-0.12	0.05	-0.21 – -0.03	-2.7	**0.007****
Group [3] × Test [UGJT]	-0.05	0.05	-0.15 – 0.05	-0.93	0.351
Group [2] × Test [WGJT]	-0.1	0.05	-0.19 – -0.02	-2.3	**0.022***
Group [3] × Test [WGJT]	-0.1	0.05	-0.20 – 0.00	-1.91	0.057
type [2] × Test [UGJT]	0.02	0.05	-0.08 – 0.11	0.31	0.758
type [2] × Test [WGJT]	0.01	0.05	-0.08 – 0.11	0.29	0.771
(Group [2] × Type [2]) × test [UGJT]	0.1	0.06	-0.02 – 0.23	1.63	0.104
(Group [3] × Type [2]) × test [UGJT]	0.04	0.07	-0.10 – 0.19	0.61	0.541
(Group [2] × Type [2]) × test [WGJT]	0.01	0.06	-0.11 – 0.14	0.21	0.837
(Group [3] × Type [2]) × test [WGJT]	0.05	0.07	-0.10 – 0.19	0.64	0.523

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items related to substitution errors between the ending "-ten" and the different ending "-(u)n;" Type 2: Items related to substitution errors between the ending "-ten" and the different ending "-essten;" CI: Confidence interval; p: p-value; Sig. code: '***' 0.001 '**' 0.01 '*' 0.05

The analysis revealed that the main effect of the group and test was significant, but it was difficult to confirm whether the main effect according to the difference in type, that is, substitutional forms, was significant (p = .227). Since the main effects of the group and test type were significant, a Tukey post hoc test was conducted, and the results are shown in Table 5 and Table 6 in Appendix II. The post hoc test showed no clear difference between tests, although the difference between the two learner groups was not statistically significant compared to the clear difference between advanced learners and native speakers, and intermediate learners and native speakers.

Next, the interaction effect between variables was confirmed. The interaction effect between group and type is shown in Figure 2 in Appendix II. As shown in Figure 2, the difference in scores by substitution type was not noticeable in the native speaker group; however, the difference increased in the learner group. As shown in Table 4, the effect of substitution type on GJT scores in the advanced learners (p = .009) and intermediate learner groups (p = .01) showed a different pattern from the native speaker group. Essentially, learners were more affected by the substitution type and scored higher for Type 2.

Figure 3 in Appendix II shows the interaction effect between the groups and the test. As can be seen from the figure above, native speakers scored higher in the order of UGJT, WGJT, and AGJT, but learners scored higher in the order of UGJT, AGJT, and WGJT. However, when statistical significance was confirmed in Table 4, the pattern difference between AGJT and UGJT for native speakers and advanced learners (p = .007) and the difference in pattern between AGJT and WGJT (p = .022) were significant. However, the pattern difference between AGJT and UGJT for native speakers and intermediate learners (p = .351) and between the AGJT and WGJT (p=.057) was not

significant. Both intermediate and advanced learners had higher UGJT scores than WGJT's, but advanced learners had relatively higher AGJT scores than the other groups, and the difference in scores between AGJT and UGJT was relatively marginal compared to the other groups.

Finally, the effect of interaction between type and test was examined. As shown in Figure 4 in Appendix II, in Type 1, the score difference was revealed for each test, but in Type 2, the score difference between WGJT and AGJT was very narrow. However, looking at Table 4, it is difficult to say that the effect of the difference in the test on the GJT score differed for each substitution type (p = .771).

4.1.2 SPRT

The SPRT results are presented in Table 7 and Figure 5.

Table 7. Descriptive statistics of SPRT RT by substitution type

Type	Grammaticality	Group (Proficiency)	N	Mean (SD)	Minimum	Maximum
1	UG	1	31	666.66(279.23)	328.85	1624.25
		2	43	2660.31(1240.73)	623.68	6116.95
		3	26	2299.45(1255.22)	691.6	4936.35
	G	1	31	664.78(277.37)	328.7	1617.8
		2	43	2769.37(1256.68)	719.08	6010.8
		3	26	2610.77(1505.81)	652.9	5865.62
2	UG	1	31	700.03(234.73)	340.6	1252.58
		2	43	3111.43(1920.88)	590.99	12938.15
		3	26	3081.44(2218.51)	895.54	10514.6
	G	1	31	623.62(243.52)	289	1523.9
		2	43	2692.14(1347.16)	562.8	5651.59
		3	26	2491.61(1507.55)	385.88	6428.64

Note. SPRT: Self-Paced Reading Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items related to substitution errors between the ending "-ten" and a different ending "-(u)n;" Type 2: Items related to substitution errors between the ending "-ten" and the different ending "-essten,;" UG: Ungrammatical sentences; G: Grammatical sentences; N: Number of participants; SD: Standard deviation

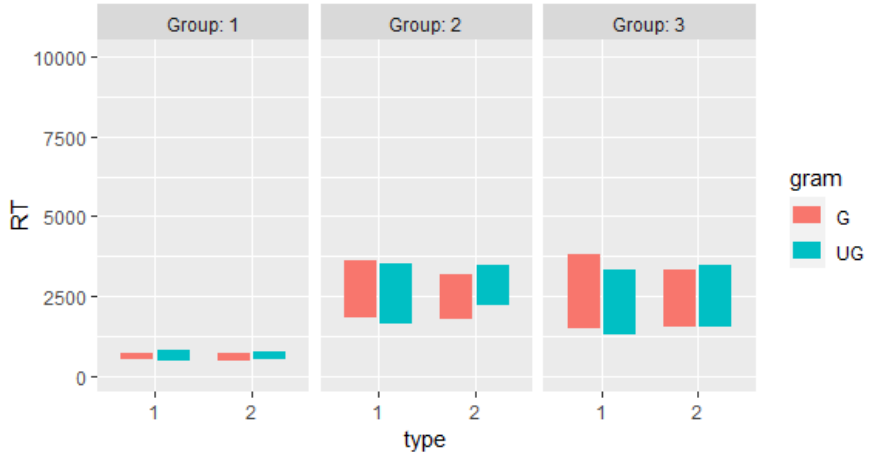

Fig. 5. SPRT RT based on group * substitution type * test type

Note. SPRT: Self-Paced Reading Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items related to substitution errors between the ending "-ten" and a different ending "-(u)n;" Type 2: Items related to substitution errors between the ending "-ten" and the different ending "- essten;" gram: grammaticality; UG: Ungrammatical sentences; G: Grammatical sentences; RT: Response time

Accordingly, the native speaker group demonstrated a faster reading speed than the learner group, and the reading time was marginally longer in ungrammatical sentences than in grammatical sentences. Conversely, the group of advanced and intermediate learners showed a similar pattern to that of native speakers in Type 2, while the reading time for grammatical sentences was longer in Type 1. A linear mixed-effects regression analysis was conducted to confirm the statistical significance of the above pattern, and the results are shown in Table 8.

Table 8. Linear mixed effects regression results of SPRT RT by substitution type

Predictors	Estimates	std. Error	CI	Statistic	p
(Intercept)	664.78	231.78	209.06 – 1120.49	2.87	**0.004****
Group [2]	2104.59	304.07	1506.76 – 2702.43	6.92	**<0.001*****
Group [3]	1945.99	343.19	1271.23 – 2620.75	5.67	**<0.001*****
Type [2]	-32.16	174.12	-374.50 – 310.19	-0.18	0.854
Gram [UG]	1.89	174.12	-340.46 – 344.23	0.01	0.991
Group [2] × Type [2]	-45.08	228.42	-494.18 – 404.03	-0.2	0.844
Group [3] × Type [2]	-87	257.81	-593.89 – 419.90	-0.34	0.736
Group [2] × Gram [UG]	-110.95	228.42	-560.05 – 338.16	-0.49	0.627
Group [3] × Gram [UG]	-313.2	257.81	-820.09 – 193.69	-1.21	0.225
Type [2] × Gram [UG]	65.52	246.25	-418.63 – 549.67	0.27	0.79
(Group [2] × Type [2]) × gram [UG]	462.83	323.03	-172.30 – 1097.96	1.43	0.153
(Group [3] × Type [2]) × Gram [UG]	835.61	364.6	118.76 – 1552.47	2.29	**0.022***

Note. SPRT: Self-Paced Reading Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items related to substitution errors between the ending "-ten" and the different ending "-(u)n;" Type 2: Items related to substitution errors between the ending "-ten" and the different ending "-essten;" UG: Ungrammatical sentences; G: Grammatical sentences; CI: Confidence interval; p: p-value; Sig. code: '***' 0.001 '**' 0.01 '*' 0.05

The analysis revealed that the main effect of the group was significant, but the main effects of substitution type and grammaticality were not. Since the main effect of the group was significant, we examined the group in which the difference in reading time occurred through a post-analysis. Table 9 in Appendix II presents the results. The post-analysis results showed differences in reading time between native speakers and advanced learners ($p < .001$), and the difference in reading time between native speakers and intermediate learners ($p < .001$) was statistically significant. However, the difference in reading times between the two learner groups was not statistically significant ($p = .874$).

The interaction effect was typically insignificant. However, when looking at the interactions of the three types: group, grammaticality, and substitution, there appeared to be differences between native speakers and intermediate learners. The main effect of grammaticality was not significant; however, the difference in reading time between ungrammatical and grammatical sentences by substitution type was significant for both native speakers and intermediate learners ($p = .022$). As shown in Figure 5, unlike native speakers, intermediate learners spent more time reading ungrammatical sentences in Type 2 than in Type 1.

4.2 Knowledge according to lexical aspectual types

In Type 1, the lexical aspects of the verbs are neither punctual nor stative. Type 2, by contrast, includes items involving punctual verbs, adjectives, or the copula—all of which exhibit stative or punctual characteristics. The GJT and SPRT results by type are as follows:

4.2.1 GJT

The GJT results by lexical aspects, group, and task are shown in Figure 6 and Table 10.

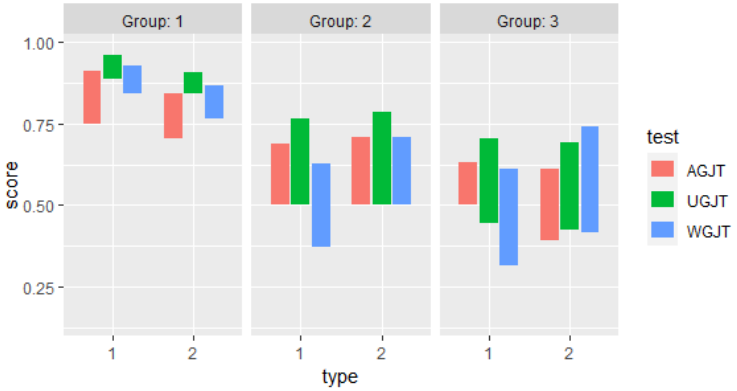

Fig. 6. GJT results based on group * lexical aspects * test type

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items involving verbs whose lexical aspects are neither punctual nor stative; Type 2: Items involving punctual verbs, adjectives, or the copula, which share similar stative or punctual characteristics.

Table 10. Descriptive statistics of GJT *A´* scores by lexical aspect

Test	Type	Group (Proficiency)	N	Mean (SD)	Minimum	Maximum
AGJT	1	1	31	0.83(0.12)	0.5	0.98
		2	43	0.59(0.15)	0.31	0.91
		3	26	0.55(0.13)	0.31	0.78
	2	1	31	0.76(0.15)	0.23	0.91
		2	43	0.62(0.13)	0.29	0.94
		3	26	0.5(0.19)	0.16	0.86
WGJT	1	1	31	0.88(0.07)	0.66	0.98
		2	43	0.51(0.18)	0.15	0.86
		3	26	0.44(0.18)	0.15	0.77
	2	1	31	0.8(0.12)	0.5	0.97
		2	43	0.62(0.16)	0.16	0.86
		3	26	0.55(0.2)	0.19	0.82
UGJT	1	1	31	0.9(0.09)	0.69	0.98
		2	43	0.62(0.18)	0.14	0.91
		3	26	0.58(0.17)	0.31	0.98
	2	1	31	0.87(0.06)	0.7	0.97
		2	43	0.63(0.19)	0.2	0.91
		3	26	0.57(0.17)	0.23	0.87

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items involving verbs whose lexical aspects are neither punctual nor stative; Type 2: Items involving punctual verbs, adjectives, or the copula, which share similar stative or punctual characteristics; N: Number of participants; SD: Standard deviation

Native speakers had a higher overall average score than the two learner groups, and advanced learners scored slightly higher than intermediate learners. Native speakers had a higher Type 1 score than Type 2 and a lower AGJT score than the other tests. The WGJT score of Type 1 was low in the advanced learner group, which was similar to the intermediate learner group, but the WGJT score distribution in the intermediate learner group was wide for Type 2.

A linear mixed-effects regression analysis was conducted to confirm the statistical significance of this pattern, and the results are presented in Table 11.

Table 11. Linear mixed effects regression results of GJT by item classification according to lexical aspects

Predictors	Estimates	Std. Error	CI	Statistic	p
(Intercept)	0.83	0.03	0.78 – 0.89	30.24	**<0.001*** **
Group [2]	-0.24	0.04	-0.32 – -0.17	-6.76	**<0.001*** **
Group [3]	-0.28	0.04	-0.36 – -0.20	-6.99	**<0.001*** **
Type [2]	-0.08	0.03	-0.14 – -0.01	-2.29	**0.022***
Test [UGJT]	0.07	0.03	0.00 – 0.14	2.04	**0.042***
Test [WGJT]	0.05	0.03	-0.02 – 0.11	1.34	0.182
Group [2] × Type [2]	0.11	0.04	0.02 – 0.19	2.38	**0.018***
Group [3] × Type [2]	0.03	0.05	-0.07 – 0.13	0.62	0.538
Group [2] × Test [UGJT]	-0.04	0.04	-0.13 – 0.05	-0.91	0.361
Group [3] × Test [UGJT]	-0.04	0.05	-0.14 – 0.06	-0.8	0.424
Group [2] × Test [WGJT]	-0.13	0.04	-0.22 – -0.05	-3	**0.003****
Group [3] × Test [WGJT]	-0.15	0.05	-0.25 – -0.05	-2.96	**0.003****
Type [2] × Test [UGJT]	0.05	0.05	-0.05 – 0.14	0.99	0.321
Type [2] × Test [WGJT]	0	0.05	-0.09 – 0.10	0.04	0.972
(Group [2] × Type [2]) × Test [UGJT]	-0.06	0.06	-0.19 – 0.06	-1	0.319
(Group [3] × Type [2]) × Test [UGJT]	-0.01	0.07	-0.15 – 0.13	-0.13	0.899
(Group [2] × Type [2]) × Test [WGJT]	0.09	0.06	-0.04 – 0.21	1.36	0.175
(Group [3] × Type [2]) × Test [WGJT]	0.15	0.07	0.01 – 0.29	2.12	**0.034***

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items involving verbs whose lexical aspects are neither punctual nor stative; Type 2: Items involving punctual verbs, adjectives, or the copula, which share similar stative or punctual characteristics; CI: Confidence interval; p: p-value; Sig. code: '***' 0.001 '**' 0.01 '*' 0.05

The analysis revealed that most of the main effects of the group, test, and lexical aspects were significant. According to the main effects of the lexical aspects, Type 1, which was neither punctual nor stative, scored higher than Type 2 ($p = .022$). However, since the main effects of the group and test were significant, the difference between them was examined using Tukey post hoc test. It demonstrated that the difference between native speakers and intermediate learners ($p < .001$) and the difference between native speakers and advanced learners ($p < .001$) were significant, but the difference between intermediate and advanced learners was not significant ($p = .444$). In addition, no significant differences were observed between the tests. The results of Tukey post hoc test are shown in Table 12 and Table 13 in Appendix II.

Next, the interactions between the group and lexical aspects (type), group and test, and test and lexical aspects (type) were examined. As shown in Figure 7 in Appendix II, the native speaker group had a higher percentage of correct answers in Type 1 than in Type 2, but the learner group had a relatively lower percentage of correct answers in Type 1 than in Type 2, which contradicted

the results of the native speaker group. According to the statistical significance reported in Table 11, the difference in pattern between Types 1 and 2 in the advanced learner group was different from that of the native speaker group (p =.018), and this difference was not statistically significant in the intermediate learner group (p = .538).

As shown in Figure 8 in Appendix II, when dividing the types according to lexical aspects, it was confirmed that native speakers scored higher in the order of UGJT, WGJT, and AGJT, and the two learner groups scored higher in the order of UGJT, AGJT, and WGJT. However, when divided by the substitution error type, there was a significant difference between AGJT and WGJT for native speakers and only in the group of advanced learners, but when divided by lexical aspect, there was a significant difference in the group of intermediate learners (p = .003) and the group of advanced learners (p =.003). However, this difference was not significant for AGJT and UGJT.

As a result of examining the interaction between types and tests, it was revealed that UGJT consistently scored higher in both types, while AGJT scored higher in Type 1 and WGJT in Type 2 (as can be found in Figure 9 in Appendix II). The differences in patterns between Types 1 and 2 in WGJT (p = .972) and UGJT (p = .321) were not significant. However, it was difficult to confirm whether the effect of the lexical aspects was the same for each test. As can be seen in Table 11, in WGJT, the difference in the pattern of lexical aspects on GJT scores differed between the native speaker group and the intermediate learner group (p = .034).

4.1.2 SPRT

The SPRT results according to lexical aspects are shown in Figure 10 and Table 14.

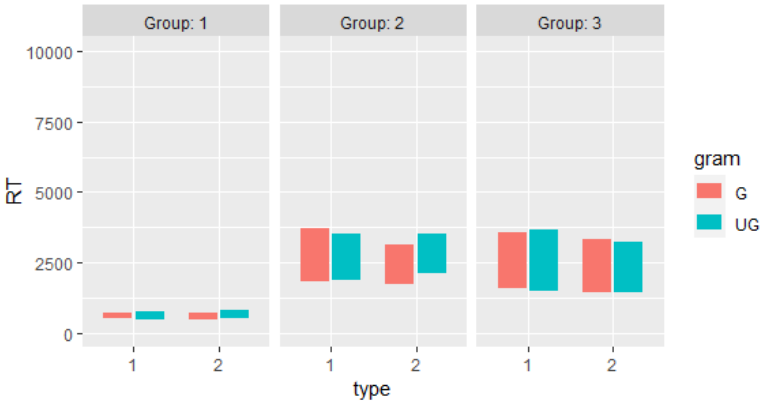

Fig. 10. SPRT RT based on group * lexical aspects * test type

Note. SPRT: Self-Paced Reading Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items involving verbs whose lexical aspects are neither punctual nor stative; Type 2: Items involving punctual verbs, adjectives, or the copula, which share similar stative or punctual characteristics; gram: grammaticality; UG: Ungrammatical sentences; G: Grammatical sentences; RT: Response time

Table 14. Descriptive statistics of SPRT RT by lexical aspects

Type	Grammaticality	Group (Proficiency)	N	Mean (SD)	Minimum	Maximum
1	UG	1	31	680.82(266.92)	354.54	1604.96
		2	43	2817.23(1310.7)	628.68	6306.92
		3	26	2880.33(2018.45)	955.58	9228.39
	G	1	31	657.92(260.32)	320.25	1577.5
		2	43	2777.17(1217.96)	739.51	5589
		3	26	2565.96(1442.47)	602.47	5828.56
2	UG	1	31	687.14(243.8)	339.44	1349.81
		2	43	2988.84(2049)	572.32	14163.5
		3	26	2405.62(1227.28)	743.77	5649.13
	G	1	31	634.86(253.3)	291.75	1560.88
		2	44	2661.13(1489.44)	493.09	8227.94
		3	26	2529.04(1673.25)	467.36	6803.85

Note. SPRT: Self-Paced Reading Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items involving verbs whose lexical aspects are neither punctual nor stative; Type 2: Items involving punctual verbs, adjectives, or the copula, which share similar stative or punctual characteristics; UG: Ungrammatical sentences; G: Grammatical sentences; N: Number of participants; SD: Standard deviation

The results of the SPRT indicated that native speakers had a faster reading time than the learner groups; however, it was difficult to discern any differences in the reading times of all three groups based on lexical aspects or grammaticality.

Linear mixed-effects regression analysis was performed to verify the above differences, and Table 15 shows the results.

Table 15. Linear mixed effects regression results of SPRT RT by lexical aspects

Predictors	Estimates	Std. Error	CI	Statistic	p
(Intercept)	657.92	236.61	192.72 – 1123.13	2.78	**0.006****
Group [2]	2119.25	310.39	1508.98 – 2729.52	6.83	**<0.001*****
Group [3]	1908.03	350.33	1219.24 – 2596.83	5.45	**<0.001*****
type [2]	-23.07	187.13	-390.99 – 344.85	-0.12	0.902
Gram [UG]	22.89	187.13	-345.03 – 390.81	0.12	0.903
Group [2] × Type [2]	-92.98	245.48	-575.63 – 389.68	-0.38	0.705
Group [3] × Type [2]	-13.85	277.07	-558.61 – 530.91	-0.05	0.96
Group [2] × Gram [UG]	17.16	245.48	-465.49 – 499.82	0.07	0.944
Group [3] × Gram [UG]	291.48	277.07	-253.28 – 836.24	1.05	0.293
Type [2] × Gram [UG]	29.39	264.64	-490.93 – 549.70	0.11	0.912
(Group [2] × Type [2]) × Gram [UG]	258.27	347.17	-424.31 – 940.84	0.74	0.457
(Group [3] × Type [2]) × Gram [UG]	-467.17	391.84	-1237.58 – 303.23	-1.19	0.234

Note. SPRT: Self-Paced Reading Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items involving verbs whose lexical aspects are neither punctual nor stative; Type 2: Items involving punctual verbs, adjectives, or the copula, which share similar stative or punctual characteristics; Gram: Grammaticality; UG: Ungrammatical sentences; G: Grammatical sentences; CI: Confidence interval; p: p-value; Sig. code: '***' 0.001 '**' 0.01 '*' 0.05

The analysis revealed that the main effect of the group was significant, but the main effects of lexical aspects and grammaticality were not. The results of the post hoc analysis for the groups are presented in Table 16 in Appendix II. As in the case of division by the substitution error type,

there was a significant difference between the learner and native speaker groups ($p < .001$). However, it was difficult to conclude whether there was a significant difference between the learner groups ($p = .795$).

5 Discussion

5.1 Acquisition of "-ten," "-(u)n," and "-essten" by substitution type

Based on the results of the GJTs, there are three main points to be noted regarding learners' knowledge of "-ten," "-(u)n," and "-essten."

First, the level of acquisition of "-ten," "-(u)n," and "-essten" is very low not only at the intermediate, but also at the advanced level. As shown in Table 5 in Appendix II, the difference in GJT scores between the native speaker group and the intermediate and advanced groups was significant. However, the difference between intermediate and advanced learners was statistically insignificant; this implies that although the score of advanced learners was higher, the acquisition of "-ten" and similar grammar items is not obvious despite the learners' higher proficiency

Second, by comparing the results of each test, although none of the learner groups showed much difference when it came to the scores themselves, it was possible to notice that they were at a different status of acquisition. As shown in Figure 3 in Appendix II, which visualizes the interaction between group and test type in the GJTs, both intermediate and advanced learner groups scored the highest on the UGJT and the lowest on the WGJT. This pattern contrasts with that of the native speakers, who performed consistently well across test types, but showed a relative drop in the AGJT. Notably, advanced learners showed little difference between UGJT and AGJT scores, whereas intermediate learners performed relatively better on the UGJT, but showed lower scores on both the WGJT and AGJT. These results suggest that learners initially develop explicit knowledge, with advanced learners showing partial development of implicit knowledge as indicated by their performance on the AGJT. However, the persistently low WGJT scores imply that even at advanced levels, learners exhibit uneven acquisition across knowledge types.

Third, the learners distinguished the contrast between "-ten" and "-essten" more clearly than that between "-ten" and "-(u)n." Unlike native speakers, who showed similar levels of accuracy for both pairs, both advanced ($p = .009$) and intermediate learners ($p = .01$) demonstrated significantly higher GJT accuracy for "-ten" and "-essten," as presented in Table 4. This pattern held consistently across all types of GJTs. Notably, native speakers did not show a significant difference in their judgments between the two contrasts. One possible explanation for these results is that learners perceive "-essten" as containing the additional morpheme "-ess-" (past), making the contrast with "-ten" more salient. In contrast, the difficulty in distinguishing "-ten" and "-(u)n" may stem from learners' limited understanding of the retrospective or past perception meaning of "-ten." Without recognizing this nuance, learners may struggle to differentiate it from "-(u)n." Additionally, since both "-essten" and "-(u)n" contrast with "-ten" in terms of imperfective aspect, this difficulty may also reflect learners' insufficient acquisition of the imperfective meaning encoded by "-ten" itself.

Meanwhile, the SPRT results in Table 8 showed that among the main effects of group, grammaticality, and item type, only one of the groups was significant. Therefore, regardless of item type, learners were not able to react sensitively to ungrammatical sentences. This is in accordance with the results from the passive (Song et al., 2023) and causative (Jeong & Kim, 2023) studies, and it indicates that intermediate and advanced learners do not have enough implicit knowledge of "-ten" and "-essten" and have a long reaction time (RT) on these items.

Moreover, Table 9 in Appendix II shows that even at the advanced level, "-ten," "-(u)n," and "-essten" are not acquired well because the difference in RTs between learner groups was insignificant. As shown in Figure 5, both intermediate and advanced learners exhibited slightly longer RTs for ungrammatical stimuli in Type 2 compared to Type 1. Based on the notion that SPRT measures implicit knowledge through delayed responses to ungrammatical sentences (Jegerski, 2013), this pattern suggests that learners were more sensitive to the substitution of "-ten" and "-essten" than to

that of "-ten" and "-(u)n." This may indicate a better understanding of the difference between "-ten" and "-essten," which is reflected in their sentence processing. This tendency is partially supported by the significant three-way interaction observed in the linear mixed-effects model (see Table 8). However, the effect was limited to intermediate learners, and neither the main effects nor the two-way interactions reached statistical significance. These findings suggest that learners may exhibit localized grammatical sensitivity to the substitution between "-ten" and "-essten," although further empirical validation is needed.

5.2 Acquisition of "-ten," "-(u)n," and "-essten" by lexical aspects of verbs combined

As illustrated in Figures 6 and 7 and supported by the statistical results in Table 11, the accuracy patterns across lexical aspect types diverged meaningfully by group. Native speakers (Group 1) consistently performed better on Type 1 items—those involving verbs with neither punctual nor stative lexical aspects (i.e., [-state] and [-punctual])—than on Type 2 items, which included punctual verbs, adjectives, and the copula. In contrast, both advanced (Group 2) and intermediate learners (Group 3) demonstrated the opposite trend, with higher scores on Type 2 items. This divergence was partially supported by the mixed-effects model: a significant Group [2] × Type [2] interaction ($p = .018$) indicated that advanced learners performed significantly better on Type 2 than on Type 1, unlike native speakers. Although the same interaction was not significant for intermediate learners ($p = .538$), a significant three-way interaction involving Group [3], Type [2], and Test [WGJT] ($p = .034$) suggested that intermediate learners exhibited better performance on Type 2 items, specifically in the WGJT condition. This finding indicates that the effect of lexical aspect may vary depending on the test modality and learner proficiency. Interestingly, despite a general main effect indicating slightly lower overall performance on Type 2 items across groups ($p = .022$), the interaction effects reveal that learners were more sensitive to lexical aspect contrasts than native speakers, and in qualitatively different ways. Whereas native speakers appeared relatively unaffected by the lexical aspect type, learners—particularly advanced ones—might rely more on surface-level or form-meaning associations in Type 2 items, possibly due to instructional emphasis or ease of processing.

However, this pattern was not observed in the SPRT. As presented in Table 14, no significant interaction was found for reaction times based on lexical aspects, aside from the main effect of group. This finding suggests that lexical aspect information is not reflected in real-time sentence processing. Nevertheless, the observed divergence between learners and native speakers in GJTs further highlights the need for instructional materials and assessment tools to include a variety of lexical aspect types in order to reflect the complex nature of language knowledge and use.

5.3 Educational implications of "-ten," "-(u)n," and "-essten"

Based on these results, educational implications for teaching "-ten," "-(u)n," and "-essten" can be suggested, taking learners' proficiency levels into account. First, since both intermediate and advanced learners have been shown to lack sufficient understanding of these grammatical forms, it is necessary to reinforce instruction on them starting from the intermediate level. In particular, instructional content should be developed to help learners understand the distinctions between "-ten" and "-essten" as well as between "-ten" and "-(u)n."

As discussed earlier, the findings of this study indicate that learners tend to have a better understanding of combinations involving punctual verbs, adjectives, and predicates, rather than those with [-state] [-punctual] verbs. In other words, learners appear to struggle with distinguishing among "-ten," "-essten," and "-(u)n" in contexts where all three forms are grammatically acceptable. This difficulty can be attributed to an insufficient grasp of the imperfective aspectual meaning associated with "-ten."

Therefore, instruction should aim to raise learners' awareness of the differences, depending on whether the verbal action has been completed, such as those involving the verb "citta" ("to build")

in contexts such as "Yonghee-ka cit-ten cip-i saenggakna-nta" ("I recall the house that Yonghee was building") versus "Yonghee-ka ci-essten cip-i saenggakna-nta" ("I recall the house that Yonghee had built"). Moreover, examples where substitution between "-ten" and "-essten" is not possible should also be addressed in the classroom, such as "*Cen-ey han pen ka-ten umsikcem-ul tasi chac-ass-ta" ("*I went back to the restaurant I used to go to once before") versus "Cen-ey han pen ka-ssten umsikcem-ul tasi chac-ass-ta"("I went back to the restaurant I had been to once before"). According to Kim and Park (2017), it is necessary to teach that "-essten" is used for single, non-repetitive events, and it is often accompanied by temporal adverbials indicating a specific point in the past, which distinguishes it from "-ten."

Compared to the distinction between "-ten" and "-essten," learners were found to experience even greater difficulty distinguishing between "-ten" and "-(u)n." This also seems to be attributable to insufficient instruction regarding the imperfective aspectual meaning encoded by "-ten." In many instructional materials, "-ten" is often introduced as a modifier indicating recollection.[3] Despite such descriptions, learners often confuse "-ten" with "-(u)n" in examples like "mantul-ten os" ("the clothes [someone] was making") and "mantu-n os" ("the clothes [someone] made"), since both refer to actions that occurred in the past (Kim & Park, 2017; Xu, 2012; Xu & Liu, 2021). Given these points, it is necessary to provide more explicit instruction that, unlike "-(u)n," the ending "-ten" indicates that the verbal action was in progress at the time it was perceived in the past.

The results of this study show that although advanced learners performed relatively better on the AGJT, indicating possession of more implicit knowledge than explicit knowledge, their performance was still lower than that of native Korean speakers. This underscores the ongoing need for explicit instruction on these endings. To this end, pedagogical strategies that foster comprehensive knowledge of the three forms—"-ten," "-essten," and "-(u)n"—should be employed. These may include techniques such as "input flood" (exposing learners to a high frequency of relative clause endings), "input enhancement" (drawing learners' attention to the forms of relative clause endings), and "garden path" techniques (intentionally inducing errors in the use of relative clause endings and guiding learners to correct them), as proposed by Doughty and Williams (1998). In addition, considering the importance of teaching the aspectual meanings of "-ten," raising learners' awareness of these relative clause endings through instructional methods—such as observing their usage patterns, forming hypotheses, and verifying them (Lewis, 1993)—may serve as an effective approach.

6 Conclusion

This research employed three types of GJTs and an SPRT, and compared and analyzed data to determine learners' knowledge of the differences in the meanings and combination with lexical aspects between "-ten," "-essten," and "-(u)n." The test items were developed based on the substitution type, with the substitution of "-ten" and "-(u)n" type and the substitution of "-ten" and "-essten" type. Furthermore, items included a balanced number of lexical aspects categorized by [±state] and [±punctual]. This is because the meanings of these endings have both similarities and differences, and the constraints on the combinations with lexical aspects can also affect learning.

The results of the GJTs and SPRT showed that not only intermediate learners, but also advanced learners demonstrated low acquisition of "-ten," "-essten," and "-(u)n." This shows that even with

[3] Some textbooks provide the following explanations:
"With the noun-modifying suffix '-ten', the speaker describes an actual past situation (event or state) as if he/she were observing or perceiving it at the moment." (*Integrated Korean: Intermediate 1*; Cho et al., 2020, p. 19)
"'-ten' is also a relative clause ending marker which is used when reflecting on a past event in the same way as '-ass/essten.' However, '-ten' tends to be used when expressing repeated activity over a long period of time and is often combined with such adverbs like 'cacwu' (often), 'congcong' (frequently), and 'cwulo' (mainly)." (*Sogang Korean New Series 3B Student's Book – Grammar and Vocabulary Reference*; KLEC of Sogang University, 2008/2014, p. 23)

an overall higher proficiency, learners did not understand and process the meanings and constraints of these forms well. They showed less accuracy in understanding and processed more slowly when perceiving the difference between "-ten" and "-(u)n" than between "-ten" and "-essten" and when these were combined with [-state] and [-punctual] verbs. In addition, even though advanced learners showed higher accuracy in understanding, they showed less sensitivity to ungrammatical sentences and a higher gap within the group, which indicates unstable and non-internalized knowledge.

Based on these results, educational implications for substitution within past-tense relative clause modifiers and their combinations with lexical aspects according to learners' proficiency levels were suggested. Given that learners tend to prefer higher frequency forms when distinguishing between "-ten" and "-(u)n" or "-ten" and "-essten," they should be encouraged to focus on these forms combined with lexical aspects, especially [-state] and [-punctual] verbs, which are more difficult to acquire.

This research has implications for education based on the results of the substitution and combination types, in which intermediate and advanced learners face difficulty. However, further research is needed to expand the list of possible predicates and to generalize the results by conducting GJTs and SPRTs with more diverse ages, learning environments, and learning groups using items developed from the new list.

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Appendices

Appendix I. Abbreviations

AC: Accusative particle
ADV: Adverbial derivational suffix
DC: Declarative sentence-type suffix
EXCL: Exclamative suffix
INT: Intimate speech level or suffix
LOC: Locative particle
PIR: Past imperfect relative clause suffix (e.g., "-ten")
PLN: Plain speech level or suffix
PLR: Plural suffix
POL: Polite speech level or suffix
PPR: Past perfect relative clause suffix (e.g., "-essten")
PPVR: Past perfective relative clause suffix (e.g., "-(u)n" with perfective meaning)
PST: Past tense suffix
SUB: Subject particle
TC: Topic-contrast particle

Appendix II. Tables and figures

Table 5. Tukey post hoc test results for proficiency (group) in GJT by item classification according to substitution type

	b	SE	95%CI	z	p
2-1	-0.261	0.365	-0.347022 - 0.175899	-7.159	<0.001 ***
3-1	-0.345	0.416	-0.441958 -0.248817	-8.378	<0.001 ***
3-2	-0.089	0.387	-0.174142 0.006288	-2.179	0.0744

Note. 1: Native speakers; 2: Advanced learners; 3: Intermediate learners; b: estimates; SE: Standard error; CI: Confidence interval; z: statistic; p: p-value; Sig. code: '***' 0.001 '**' 0.01 '*' 0.05

Table 6. Tukey post hoc test results for test types in GJT by item classification according to substitution type

	b	SE	95%CI	z	p
UGJT -AGJT	0.08018	0.034	-0.0003842 0.1607517	2.323	0.0526
WGJT -AGJT	0.03946	0.034	-0.0411088 0.1200271	1.143	0.487
WGJT -UGJT	-0.04072	0.034	-0.1212925 0.0398434	-1.180	0.465

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; b: estimates; SE: Standard error; CI: Confidence interval; z: statistic; p: p-value

Table 9. Tukey post hoc test results for proficiency (group) in SPRT RT by item classification according to substitution type

	b	SE	95%CI	z	p
2-1	2104.6	304.1	1392.6444 2816.5452	6.922	<0.001 ***
3-1	1946,0	343.2	1142.4297 2749.5517	5.670	<0.001 ***
3-2	-158.6	320.6	-909.2802 592.0720	-0.495	0.874

Note. Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; b: estimates; SE: Standard error; CI: Confidence interval; z: statistic; p: p-value; Sig. code: '***' 0.001 '**' 0.01 '*' 0.05

Table 12. Tukey post hoc test results for proficiency (group) in GJT scores by item classification according to lexical aspects

	b	SE	95%CI	z	p
2-1	-0.244	0.036	-0.32883 -0.15970	-6.765	<0.001***
3-1	-0.284	0.040	-0.380197 - 0.18930	-6.987	<0.001***
3-2	-0.040	0.038	-0.12964 0.04868	-1.063	0.536

Note., Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; b: estimates; SE: Standard error; CI: Confidence interval; z: statistic; p: p-value; Sig. code: '***' 0.001 '**' 0.01 '*' 0.05

Table 13. Tukey post hoc test results for test types in GJT scores by item classification according to lexical aspects

	b	SE	95%CI	z	p
UGJT -AGJT	0.068	0.03373	-0.00996 0.14767	2.041	0.103
WGJT -AGJT	0.045	0.03373	-0.033693 0.12393	1.338	0.374
WGJT -UGJT	-0.023	0.03373	-0.10254 0.05508	-0.704	0.761

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; b: estimates; SE: Standard error; CI: Confidence interval; z: statistic; p: p-value

Table 16. Tukey post hoc test results for proficiency (group) in SPRT RT by item classification according to lexical aspects

	b	SE	95%CI	z	p
2-1	2119.2	310.4	1392.2790 2846.2142	6.828	<0.001***
3-1	1908.0	350.3	1087.5232 2728.5443	5.446	<0.001***
3-2	-211.2	327.3	-977.7229 555.2973	-0.645	0.795

Note. Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; b: estimates; SE: Standard error; CI: Confidence interval; z: statistic; p: p-value; Sig. code: '***' 0.001 '**' 0.01 '*' 0.05

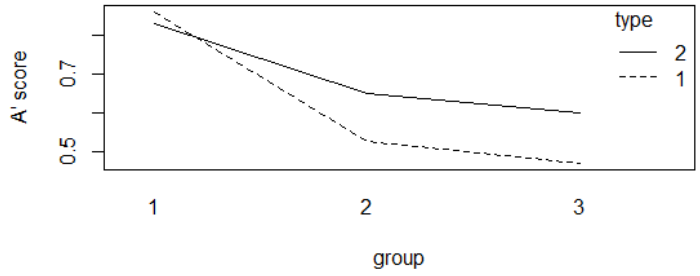

Fig. 2. The interaction between group * substitution type in GJT

Note. Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items related to substitution errors between the ending "-ten" and a different ending "-(u)n,"; Type 2: Items related to substitution errors between the ending "-ten" and the different ending "-essten"

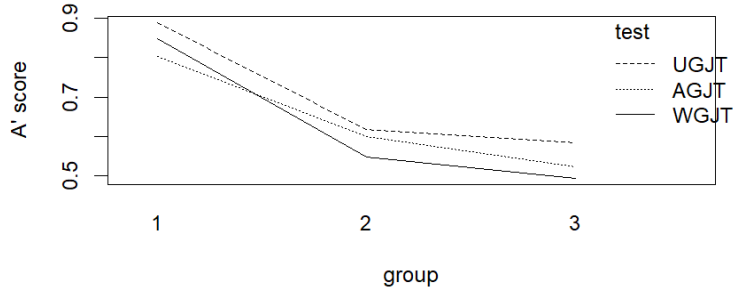

Fig. 3. Interaction between group * test type in GJT (by item classification according to substitution type)

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners

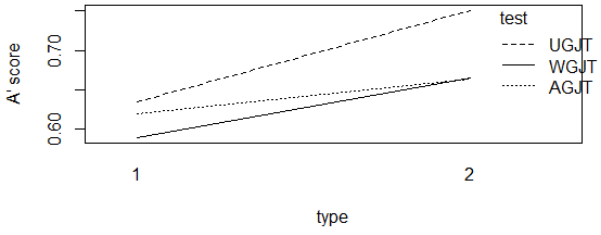

Fig. 4. Interaction between substitution type * test type in GJT

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Type 1: Items

related to substitution errors between the ending "-ten" and the different ending "-(u)n;" Type 2: Items related to substitution errors between the ending "-ten" and the different ending "-essten"

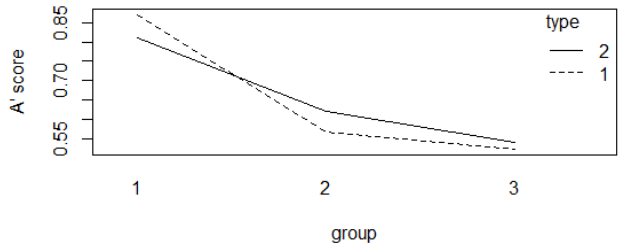

Fig. 7. Interaction between group * lexical aspects in GJT

Note. Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners; Type 1: Items involving verbs whose lexical aspects are neither punctual nor stative; Type 2: Items involving punctual verbs, adjectives, or the copula, which share similar stative or punctual characteristics

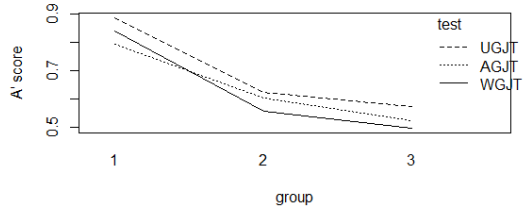

Fig. 8. Interaction between group * test type in GJT (by item classification according to lexical aspects)

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Group 1: Native speakers; Group 2: Advanced learners; Group 3: Intermediate learners

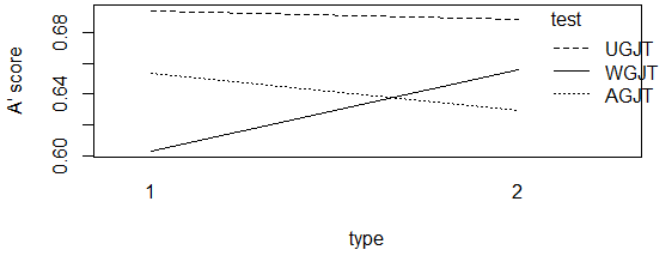

Fig. 9. Interaction between lexical aspects * test type in GJT

Note. AGJT: (Timed) Aural Grammaticality Judgment Test; WGJT: (Timed) Written Grammaticality Judgment Test; UGJT: Untimed (Written) Grammaticality Judgment Test; Type 1: Items

involving verbs whose lexical aspects are neither punctual nor stative; Type 2: Items involving punctual verbs, adjectives, or the copula, which share similar stative or punctual characteristics