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Research Article

Enhancing Morphosyntactic Structure Learning in EFL Learners: A Study of Metacognitive Knowledge and Task Type

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ABSTRACT

This study examines how different types of tasks, both input-based and output-based, with varying levels of cognitive demand, influence the learning of morphosyntactic structures—specifically morphosyntactic structures —among EFL learners. Additionally, the research investigates the role of metacognitive knowledge in predicting learners' abilities to recognize and produce these structures. Ninety Iranian EFL learners were divided into three groups: Group A engaged in reading, Group B in reading with textual enhancement, and Group C in reading combined with text reconstruction. The impact of these tasks on the recognition and production of morphosyntactic structures was measured using grammaticality judgment and editing tests. The cognitive load of these tasks was assessed using Sweller's (1988) criteria, which classify tasks by complexity and cognitive demand. The findings indicated that Group C, which was exposed to tasks with the highest cognitive load outperformed the other groups. Procedural knowledge was found to predict the ability to produce morphosyntactic structures, while declarative knowledge was linked to the recognition of structures. Structural equation modeling highlighted the relationship between metacognitive knowledge, recognition, and production across various task conditions. The study suggests that tasks with higher cognitive demands can significantly enhance the learning of morphosyntactic structures and emphasizes the importance of metacognitive knowledge in predicting learners' success in both recognizing and producing these structures across different task types.

Introduction

The process of acquiring a second or foreign language is complex, involving a dynamic interaction among cognitive, metacognitive, and socio-affective factors. Among these, metacognitive knowledge—defined as the awareness and regulation of one's learning processes—plays a crucial role in developing learners' morphosyntactic knowledge, especially within English as a Foreign Language (EFL) contexts. Learners' metacognitive strategies, which include planning, monitoring, and evaluating their learning activities, have been shown to significantly influence their understanding of both morphological and syntactic aspects of language (Stalyanova & Krejčová, 2023).

Language transfer, the influence of the first language on the acquisition of a second language, can further complicate this process, either aiding the learning of new language structures or causing errors due to interference (Cancino & Tomicic, 2023). Thus, a nuanced understanding of these dynamics is essential for effective EFL instruction, as it allows educators to optimize the language acquisition process by tailoring it to the learners' needs.

Metacognitive knowledge is not only a key factor in language learning but also a determinant in learners' ability to monitor and regulate their learning, set goals, and evaluate their progress (Bouknify, 2023; Khurram, 2023; Payaprom, 2022). While research has extensively explored the impact of morphological awareness on vocabulary acquisition, the relationship between metacognitive awareness and the development of morphosyntactic knowledge remains relatively underexplored. This study seeks to fill this gap by investigating how metacognitive strategies can influence the acquisition of morphosyntactic structures through tasks that vary in cognitive demand. By incorporating metacognitive strategies into learning activities, educators can potentially foster a deeper understanding of morphosyntactic structures, leading to greater accuracy and fluency in both sentence comprehension and production.

Cognitive load theory posits that the mental effort required during learning tasks can significantly affect language acquisition, particularly in the context of grammar learning (Liu et al., 2023). Tasks that require a higher cognitive load can lead to better internalization and retention of grammar rules and structures, as they encourage learners to focus more intently on specific grammar points (Arcipe & Balones, 2023). Conversely, tasks with lower cognitive demands may allow learners to devote more mental resources to the internalization of grammar rules, resulting in improved mastery of morphosyntactic structures (Pei-Shan & Wang, 2023). Therefore, optimizing the cognitive load in language tasks is essential for achieving successful language learning outcomes, particularly in the area of grammar (Sweller, 2023).

Further research is needed to explore the specific mechanisms through which cognitive load influences the acquisition of morphosyntactic structures in an EFL context. Such insights could enhance pedagogical practices and improve instructional methods (Qiu, 2022). The timing of form-focused instruction (FFI) has also been shown to significantly impact grammar development, suggesting that the sequencing of tasks plays a critical role in language acquisition (Xu & Li, 2022). Additionally, Content and Language Integrated Learning (CLIL) approaches, which combine content instruction with language learning, have been found to affect learners' use of verb morphology, influencing both the omission and target-like use of verb forms (Vraciu, 2020).

Literature Review

Involvement Load Hypothesis (ILH) and L2 Skills Development

The Involvement Load Hypothesis (ILH), introduced by Laufer and Hulstijn (2001), posits that the cognitive load imposed by a task significantly influences the effectiveness of second language (L2) vocabulary acquisition. This hypothesis suggests that tasks requiring greater cognitive engagement, such as active manipulation of language items, enhance learning outcomes. While the ILH has been extensively studied in the context of vocabulary acquisition, especially when compared to other frameworks like the Technical Feature Analysis (TFA) (Phadungsilp & Supasiraprapa, 2023), its application to L2 grammar acquisition remains underexplored. Most research to date has focused on vocabulary, particularly word form recognition and passive meaning recall, rather than on grammar learning.

The ILH is structured around a motivational-cognitive construct comprising three key components: need, search, and evaluation. "Need" reflects the motivational aspect, varying in intensity depending on whether the task is learner-initiated or imposed by an instructor. "Search" involves the cognitive effort invested in understanding the meaning or structure during a task, while "evaluation" requires comparing new structures with existing knowledge to assess their appropriateness in context. These components collectively predict the extent of learning and retention, with both motivational and cognitive aspects playing a crucial role (Liu & Nesbit, 2023). Despite certain criticisms regarding the limited contribution of the Input Learning Hypothesis (ILH) to broader second language (L2) learning theories, recent evidence underscores its significance, particularly in the context of Data-Driven Learning tasks (Alanazi, 2023).

Empirical Investigations on Involvement Load Hypothesis in EFL Contexts

The ILH suggests that tasks requiring higher cognitive load increase the likelihood of successful recall. However, empirical evidence supporting this hypothesis is mixed. For example, Aotani and Takahashi (2023) reported inconsistent results, with some studies failing to demonstrate a significant impact of task-induced involvement load on vocabulary acquisition. Alanazi (2023) similarly found no significant differences in vocabulary knowledge across groups engaged in tasks with varying cognitive loads, such as reading versus translation. However, Yanagisawa and Webb (2022) conducted a meta-analysis showing that integrating ILH into a broader framework can improve predictions of incidental vocabulary learning.

Research by Phadungsilp and Supasiraprapa (2023) explored the effects of task-induced involvement load and gloss language on L2 word learning among low-proficiency EFL learners. They found that tasks with higher involvement loads, combined with L1 glosses, were most effective in facilitating L2 vocabulary acquisition. This study emphasizes that the choice of gloss language can influence involvement load, and that higher loads lead to greater engagement with unfamiliar L2 words, irrespective of gloss language. Additionally, Qin (2023) compared the ILH and TFA in explaining the impact of different task types on EFL vocabulary acquisition, providing valuable insights for educators aiming to enhance vocabulary teaching methodologies. Despite these studies, the overall mixed results indicate a need for further research on the ILH, particularly in EFL contexts.

L2 Metacognitive Knowledge

Metacognitive knowledge refers to an individual's awareness and understanding of their cognitive processes and strategies. In the context of L2 grammar learning, it involves recognizing one's knowledge gaps, setting goals for improvement, and activating prior knowledge to facilitate learning (Sato, 2022). This knowledge extends to understanding effective strategies for applying grammar rules and can be influenced by both internal factors, such as personality traits and prior knowledge, and external factors, such as task demands (Saffari, 2019). Teachers play a crucial role in fostering metacognitive awareness by modeling strategies and helping students become more aware of their learning processes (Hasibuddin, 2022).

Metacognition encompasses a set of transferable skills that enhance cognition and performance across various learning contexts (Stebner et al., 2022; Sumitha & Mandal, 2022). These skills, considered domain-general, can be applied across different subjects and tasks. Training interventions targeting both metacognitive and cognitive strategies can support the transfer of these skills to new learning contexts (Schuster et al., 2020). Hybrid approaches that combine metacognitive and cognitive strategies have shown improvements in both near and far transfer, though the effectiveness of such transfers depends on the proximity of the transfer task (Scharff et al., 2017). Metacognition enables students to plan, monitor, and evaluate their learning, making it a critical component of self-regulated learning. Overall, metacognitive knowledge, including conditional, procedural, and declarative knowledge, positively impacts EFL grammar learning and performance, though factors like personality traits may also influence outcomes (Sato, 2022).

Rationale for the Study

A deeper understanding of learners' metacognitive awareness and cognitive processes can aid educators in predicting task success and developing targeted instructional strategies to enhance performance. Investigating how metacognition predicts grammar learning outcomes in tasks with varying involvement loads offers valuable insights into learners' engagement with and interest in L2 grammar learning. Previous research suggests that metacognitive factors, such as cognitive control, working memory, and statistical learning, are critical for grammar acquisition (Chen et al., 2023). Moreover, early metacognitive efficiency is associated with improved task performance, highlighting its importance in guiding learning processes (Teng & Zhang, 2021). Exploring the interaction between metacognition and involvement load in tasks can help educators tailor strategies to improve learners' metacognitive functioning, interest, and engagement in L2 grammar learning (Taouki et al., 2022).

The Target Forms

Morphosyntactic structures are integral morphosyntactic structures in English and other Germanic languages, evolving from adverb-verb sequences in Proto-Germanic languages. These constructions consist of a main verb followed by one or more particles (adverbs or prepositions) that collectively create a new meaning.

Morphosyntactic structures can be categorized into two types: separable and inseparable. Separable morphosyntactic structures allow the particle to be positioned either before or after the object, while inseparable morphosyntactic structures require the particle to remain attached to the verb:

- "I will put on my coat before we go out." (The particle "on" can be separated from the verb "put" by the object "my coat.")
- "I will look after the children while you are gone." (The particle "after" must remain attached to the verb "look.")

morphosyntactic constructions can also be either compositional or idiomatic. Compositional morphosyntactic structures have meanings that can be deduced from the individual meanings of the verb and particle, whereas idiomatic morphosyntactic structures have meanings not easily inferred from their components:

- "He looked up the word in the dictionary." (The meaning of "look up" can be understood from "look" and "up" individually.)
- "He ran into an old friend at the store." (The meaning of "ran into" is not obvious from "ran" and "into.")

Research Questions

1. How do tasks varying in cognitive demand differentially affect receptive and productive knowledge of English morphosyntactic structures?
2. To what extent does learners' metacognitive knowledge predict the effects of tasks on learning English morphosyntactic structures?
3. Is there a significant correlation between EFL learners' metacognitive knowledge and their mastery of morphosyntactic structures?

Aim of the Study

This study aims to investigate the relationship between EFL learners' metacognitive knowledge and their understanding of morphosyntactic structures. It builds on the premise that metacognitive strategies are essential for successful language acquisition (Payaprom, 2022; Wongdaeng & Higgins, 2022). By examining how these strategies influence the acquisition and application of morphosyntactic structures across various linguistic contexts, this research seeks to provide insights into the cognitive processes involved in second language learning. The findings are expected to offer valuable guidance for instructional approaches that can effectively enhance learners' language skills.

Method

Research Design

This research employed a quasi-experimental design, incorporating both pre-tests and post-tests to assess participants' knowledge of morphosyntactic structures through both receptive and productive measures. Participants were randomly assigned to one of three groups, each exposed to distinct task conditions characterized by varying levels of cognitive engagement. To facilitate comparisons among these conditions, pre- and post-test scores on grammatical knowledge were analyzed. A one-way independent ANOVA was conducted to determine the presence of significant differences among the three groups based on their performance. Additionally, the study explored the correlation between the types of tasks and the application of metacognitive strategies by learners during their learning processes. Regression analysis was utilized to assess whether learners' metacognitive strategies could predict the effects of task conditions on the acquisition of morphosyntactic structures.

Participants

The study involved 90 first-semester Bachelor of Arts students, aged between 18 and 24, enrolled at the Islamic Azad University, Tehran South Branch. All participants were native speakers of Farsi and classified as non-English majors, with fields of study including Accounting, Management, and Psychology. This demographic context provided valuable insights into their prior language exposure and learning experiences. Participants were randomly selected from an initial cohort of 285 students, with the final sample comprising 90 individuals to ensure homogeneity. To achieve this, participants were assessed using the Oxford Placement Test (OPT), which indicated that most of them reached proficiency levels ranging from A2 to B1.1 on the Common European Framework of Reference for Languages (CEFR). This classification suggested that the learners possessed a foundational understanding of morphosyntactic structures and were capable of engaging in basic conversations. The reliability of the OPT was confirmed with a Cronbach's alpha coefficient of 0.85 for GJT and 0.88 for ET, indicating consistency.

The participants were categorized into three distinct groups of 30 students each based on their pretest scores, which evaluated their reading proficiency and responsiveness to various instructional strategies. Group A included 17 females and 13 males who engaged exclusively in reading activities. Group B comprised 21 females and 9 males who participated in reading with textual enhancement, while Group C consisted of 20 females and 10 males who took part in both reading and writing activities. In terms of gender distribution, the overall sample consisted of 58 females (64.4%) and 32 males (35.6%). The average age of participants was 20.5 years. Students whose pretest scores deviated by more than 20% from the mean or who did not complete the treatment were excluded from the study. Ultimately, a final sample of 90 students was analyzed, ensuring the groups' homogeneity for the study's objectives. Ethical considerations for this study included obtaining informed consent from all participants prior to their involvement, ensuring confidentiality of their data, and allowing them the option to withdraw from the study at any time without repercussions. Additionally, the research was conducted in accordance with the ethical guidelines of the institution, ensuring the well-being of all participants throughout the study.

Instruments

To facilitate the learning of morphosyntactic structures, three tasks with varying cognitive load levels were implemented. A pre-test and post-test, including a 20-item Grammar Judgment Test (GJT) and a 20-item Editing Test, were administered to evaluate both Recognition and production knowledge. In both the GJT and ET, responses were scored based on accurate recognition and production of morphosyntactic structures. Each test had a score range from 0 to 20. The GJT and ET were validated through expert reviews and alignment with IELTS and TOEFL formats. Content validity was ensured by targeting slightly higher-level structures as per the CEFR guidelines. These standardized assessments were designed to measure participants' grammar proficiency (see Appendix). Additionally, the Grammar Learning Metacognitive Strategies Inventory (Pawlak, 2018) was employed to assess participants' metacognitive knowledge, while the OPT ensured participant homogeneity. Learners at the elementary A2 and pre-intermediate B1.1 levels, specifically those with scores between 21 and 50, were selected as the primary participants for this research.

The targeted morphosyntactic structures were sourced from various online materials and were intentionally chosen to be slightly more advanced than the participants' current proficiency levels. Typically, A2 and B1 learners have a basic understanding of Subject-Verb Agreement, Tense Formation, and Noun Pluralization. Therefore, the structures targeted in this study were aligned with the B2 level as defined by the CEFR, enabling learners to manage the following aspects:

- **Subject-Verb Agreement**: Ensuring subject-verb concord in terms of number and person (e.g., "He runs" vs. "They run").
- **Tense Formation**: Modifying verb forms to indicate temporal aspects (e.g., present,

past, future) through various inflections (e.g., "I eat" vs. "I ate").

- **Noun Pluralization:** Adjusting nouns to denote singular or plural forms (e.g., "cat" vs. "cats").
- **Article Usage**: Correctly applying definite and indefinite articles (e.g., "the apple" vs. "an apple").
- **Adjective and Adverb Placement:** Properly positioning adjectives and adverbs (e.g., "The quickly running dog" vs. "The dog runs quickly").
- **Pronoun Antecedent Agreement:** Ensuring pronouns align with their antecedents in terms of number and gender (e.g., "Each student should bring his or her notebook").
- **Compound Sentences:** Employing coordinating conjunctions to connect independent clauses (e.g., "I wanted to go, but it was raining").
- **Subordinate Clauses**: Formulating dependent clauses that add detail (e.g., "If it rains, we will stay indoors").
- **Question Formation**: Structuring questions accurately with auxiliary verbs (e.g., "Are you coming?" vs. "You are coming?").
- **Separable vs. Inseparable Phrasal Verbs**:

1. **Separable**: The particle can be placed before or after the object (e.g., "put on my coat").
2. **Inseparable**: The particle stays attached to the verb (e.g., "look after the children").
3. **Compositional:** The meaning can be understood from the verb and particle (e.g., "look up the word").
4. **Idiomatic**: The meaning cannot be inferred from the individual words (e.g., "ran into an old friend").

The instructional materials were tailored to the specific tasks designated for each group. Group A engaged in reading texts that incorporated morphosyntactic structures. Group B read similar texts, but with highlighted morphosyntactic structures to draw their attention. Group C undertook tasks requiring them to reconstruct texts that included the targeted morphosyntactic structures in their writing. These tasks were developed using an AI tool, which generated texts reflecting various functional applications of the morphosyntactic structures. The texts were meticulously designed to align with learners' proficiency levels and included diverse contexts such as narrative, descriptive, explanatory, and persuasive forms. This methodological approach ensured a balanced variety of tasks while maintaining a focused emphasis on the essential language components necessary for enhancing understanding of morphosyntactic structures. The utilization of AI-generated materials was vital in ensuring that the tasks were both relevant and engaging for a diverse learner population.

In a study assessing cognitive load levels during text reading, three groups were analyzed based on the complexity of their tasks. Group A, engaged in text reading in isolation, exhibited a low cognitive load as participants focused solely on comprehension and recognition of morphosyntactic structures without any additional tasks. This group served as a baseline for comparison against the others. In contrast, Group B, which read texts with textual enhancement (e.g., bolding or color-coding), experienced a moderate cognitive load. The enhancement required learners to not only decode the text but also identify and manipulate highlighted structures, thus demanding more cognitive resources. Finally, Group C faced the highest cognitive load as participants analyzed the text, identified morphosyntactic structures, and reconstructed their understanding through essay writing, an inherently demanding task that involved comprehension, analysis, synthesis, and creative application. This progressive increase in cognitive demands aligns with Cognitive Load Theory (CLT), which posits that tasks requiring more complex cognitive processes impose greater intrinsic cognitive load on working memory.

Procedure

Instructional sessions were conducted weekly over a 13-week period, following a quasi-experimental design that encompassed three groups, each engaging in tasks characterized by varying levels of involvement, as proposed by Laufer and Hulstijn (2001) see table 1. To guarantee group homogeneity, participants completed the OPT prior to the study's initiation. The instructional framework for each group was as follows:

- **Group A**: Participants read a text focused on a specific morphosyntactic structure, emphasizing comprehension. They read the text aloud multiple times to enhance fluency, aiming to complete a one-page text predominantly utilizing the target morphosyntactic structure (e.g., Separable vs. Inseparable Phrasal Verbs) within a three-minute time-frame. Upon completion, recordings of their readings were submitted to the instructor via Telegram or WhatsApp.
- **Group B**: This group received the same text as Group A; however, their version highlighted occurrences of the target morphosyntactic structure (e.g., Separable vs. Inseparable Phrasal Verbs) to direct their focus. The highlighted texts were then submitted to the instructor in the subsequent session.
- **Group C**: Participants first engaged with the same texts as the other groups. Following their reading, they were tasked with writing ten keywords pertinent to the text's content. Subsequently, the text was removed, and they were required to reconstruct it using only their keywords while accurately employing the target morphosyntactic structure. The reconstructed texts were submitted to the instructor in the following session.

Each session (13 sessions of 90 minutes each week within 3 months) introduced a new morphosyntactic structure with a similar text for all groups but different form of task levels. To evaluate participants' grammatical knowledge, Grammaticality Judgment (Recognition) Test and Editing (Production) test were administered at both the beginning and conclusion of the course. These assessments measured the changes in learners' understanding and application of morphosyntactic structures. Additionally, the Grammar Learning Metacognitive Strategies Inventory (Pawlak, 2018), employing a Likert scale, was utilized to evaluate participants' use of metacognitive strategies in grammar learning.

At the end of the instructional period, a post-test was conducted to compare the results with those of the pre-test and to evaluate the learning outcomes of students across the different groups. The gathered data were analyzed using one-way ANOVA to determine performance differences among the three groups, with post-hoc tests performed to identify specific inter-group differences. The analytical framework was guided by the involvement load hypothesis, which examined how different levels of task involvement (need, search, evaluation) interacted in the retention and comprehension of morphosyntactic structures:

The Task-Induced Involvement Load Hypothesis suggests that the level of cognitive engagement in a task significantly influences learners' acquisition and retention of morphosyntactic structures. This hypothesis, as proposed by Laufer and Hulstijn (2001), is built on three primary components: need, search, and evaluation. The level of involvement increases with the cognitive demands of the task, influencing the retention of the linguistic structures. Table 1 presents an analysis of cognitive load across three tasks: reading only (Task 1), reading with textual enhancement (Task 2), and reading combined with text reconstruction (Task 3). The criteria assessed are "Need," "Search," and "Evaluation," each reflecting a distinct cognitive aspect of the tasks. For each item, the intensity levels are indicated by symbols (-), (+), and (+++), representing low, moderate, and high levels of cognitive demand, respectively.

Table1.
Criterion Regarding the Cognitive Load Level

Cognitive load	Task 1 (reading only)	Task 2 (reading+ textual enhancement)	Task 3(reading + Text Reconstruction)
Need	(-) / learners not imposed	(+) / learners less imposed	(+++)/ learners want to learn

Cognitive load	Task 1 (reading only)	Task 2 (reading+ textual enhancement)	Task 3(reading + Text Reconstruction)
Search	(-)When structure is present but not bold	(+)When structure is present and enhanced	(+++) learners focus
Evaluation	(-) no ability to find the structure	(+) learners think less about the structure(limited ability)	(+++) learners make original text by thinking and using it
Involvement load indicator	1	3	9

In this study, the criterion for assessing cognitive load levels in grammar learning is grounded in the "involvement index" proposed by Laufer and Hulstijn (2001). This index evaluates cognitive load in grammar learning tasks through three key components: need, search, and evaluation.

Need: This component reflects the motivational aspect of involvement, categorized as moderate when imposed externally (e.g., a teacher's request to identify the grammatical structure of a sentence) and strong when self-imposed (e.g., the learner's initiative to analyze sentence structure independently).

Search: This aspect pertains to the learner's effort to find the meaning or function of an unfamiliar grammatical element in the second language (L2). This often involves consulting grammar references or seeking clarification from a teacher.

Evaluation: This component involves assessing the appropriate use or meaning of a grammatical structure within context. It requires learners to compare different grammatical forms to determine which one fits best. The intensity of evaluation can vary; moderate evaluation might occur when learners are tasked with identifying the correct grammatical structure in a sentence, while stronger evaluation is needed when they must create original sentences demonstrating the grammatical concept.

The involvement index is calculated by assigning values: (-) for absence, (+) for moderate presence, and (+++) for strong presence. For example, a task requiring learners to analyze sentences using specific grammatical structures might yield an index of 3 ((+)for moderate need, (-) for search, and (+++) for strong evaluation). In contrast, a grammar reading task with annotations may result in an index of (+) (moderate need with no search or evaluation).

This framework facilitates empirical investigation of the relationship between task involvement load and grammatical retention by comparing performance across tasks with varying involvement indexes. Consequently, cognitive load levels can be effectively measured and correlated with outcomes in grammar acquisition.

Results

This study explores the influence of task-induced cognitive load on the acquisition of morphosyntactic structures by English as a Foreign Language (EFL) learners, with a specific focus on how different task types affect both recognition and production of these structures. Additionally, the role of metacognitive knowledge in predicting learners' performance across these tasks is examined. Understanding these relationships is crucial for optimizing teaching strategies that enhance language acquisition and for providing insights into the interplay between cognitive and metacognitive processes in language learning.

The first research question investigates whether the level of cognitive load in tasks differentially impacts learners' receptive and productive knowledge of morphosyntactic structures. Analysis of the Variance revealed no statistically significant differences among the three groups in terms of both Recognition and Production tests; $p = .380$ in Recognition and $p = .334$ in Production.

Table 2.
Descriptive Statistics for Morphosyntactic Structure Recognition and Production Posttests Across Three Tasks

	N	Minimum	Maximum	Mean	Std. Deviation
GJT: Recognition posttest					
Group A	30	5	14	8.60	2.541
Group B	30	7	17	11.80	2.905
Group C	30	5	19	14.03	3.690
ET: Production posttest					
Group A	30	5	8	5.53	.776
Group B	30	5	15	8.83	2.730
Group C	30	9	18	13.97	2.157
Valid N (listwise)	30				

The data presented in Table 2 provide descriptive statistics for the recognition and production of morphosyntactic structures across three task types, represented by groups A, B, and C. The results indicate that Group C outperformed the other groups in both the recognition and production tests. Group B also demonstrated significant performance in both tests, while Group A achieved the lowest scores. These findings suggest that different task types have a considerable impact on learners' ability to recognize and produce morphosyntactic structures. The Levene's test for homogeneity of variance across the groups was conducted, and the significance level exceeded 0.05, confirming the validity of the paired sample statistics.

Table 3.
Post-hoc Comparisons for recognition and production posttest Across Three Task Types

	Mean difference	n	Std. D	Std. Error Mean	95% confidence interval		sig
					Lower	**upper**	
GJT: Recognition							
Group A & B	-3.200	30	2.54	.464	-4.407	-1.993	.000
Group A & C	-5.433	30	2.54	.464	-7.421	-3.446	.000
Group B & C	-2.233	30	2.90	.530	-4.199	-.268	0.027
ET: Production							
Group A & B	-3.300	30	.776	.142	-4.410	-2.190	.000
Group A &C	-8.433	30	.776	.142	-9.330	-7.536	.000
Group B &C	-5.133	30	2.73	.498	-6.321	-3.945	.000

Table 3 presents post-hoc comparisons for recognition and production test scores across three task types (Groups A, B, and C). The numerical values provide insight into the differences between group performances, along with some statistical metrics that help interpret the findings. For the Recognition, the mean difference between Group A and B is 3.200 with a standard deviation of 2.54. The standard error mean is 0.464, and the 95% confidence interval ranges from -4.407 to -1.993. The significance level is .000. This indicates a statistically significant difference in recognition performance between Groups A and B, where Group B scored higher on average by 3.200 points. The mean difference between Group A and C is -5.433 with a standard deviation of 2.54 and a standard error mean of 0.464. The confidence interval is from-7.421 to -3.446, and the significance is also .000. Similar to the previous comparison, it shows that Group C outperformed Group A significantly, with an average difference favoring Group C by 5.433 points. The mean difference between Group B and C is -2.233 with a standard deviation of 2.90 and a standard error mean of 0.530. The confidence interval ranges from -4.199 to 0.268, and the significance is 0.027. This result indicates a statistically significant difference, with Group C performing better than Group B by 2.233 points.

For the structure production, the mean difference between Group A and Group B is -3.300, with a standard deviation of 0.776. The standard error mean is 0.142, and the 95% confidence interval ranges from -4.410 to -2.190. The significance level is .000. This indicates a statistically significant difference in production performance between Groups A and B, where Group B outperformed Group A on average by 3.300 points. The mean difference between Group A and Group C is -8.433, with a standard deviation of 0.776 and a standard error mean of 0.142. The confidence interval spans from -9.330 to -6.321, and the significance is also .000. This highlights a substantial and statistically significant difference, showing that Group C significantly surpassed Group A with an average difference favoring Group C by 8.433 points. The mean difference between Group B and Group C is -5.133, with a standard deviation of 2.73 and a standard error mean of 0.142. The 95% confidence interval ranges from -6.321 to -3.945, and the significance is .000. This result indicates a statistically significant difference, with Group C outperforming Group B by 5.133 points on average.

Overall, the results from both recognition and production tests indicate that Group C consistently outperformed both Groups A and B, with statistically significant mean differences. The smaller mean differences between Groups B and A suggest that while there are differences, they are more pronounced when comparing Group C to the other two groups. The p-values of .000 and .027 indicate that these differences are unlikely due to chance, highlighting the superior performance of Group C in both task types.

The second research question addresses whether learners' metacognitive knowledge predicts the effect of task type on the learning of target forms. To investigate this, a multiple linear regression analysis was conducted.

Table 4.

Descriptive Statistics for posttest Recognition, Production, and Metacognitive Knowledge (Declarative, Procedural, Conditional) Across Three Task Types

	N	Min	Max	mean	Std. D
Group A					
Recognition	30	5	14	8.60	2.541
Production	30	5	8	5.53	.776
Declarative	30	4	30	15.60	7.113
Procedural	30	1	15	6.87	4.083
Conditional	30	2	20	11.03	4.491
Group B					
Recognition	30	7	17	11.80	2.905
Production	30	5	15	8.83	2.730
Declarative	30	2	25	11.97	5.684
Procedural	30	2	15	8.33	3.642
Conditional	30	3	19	9.03	4.476
Group C					
Recognition	30	5	19	14.03	3.690
Production	30	9	18	13.97	2.157
Declarative	30	10	29	17.10	5.189
Procedural	30	1	16	6.73	3.939
Conditional	30	3	17	9.50	3.848

Table 4 presents descriptive statistics for morphosyntactic structure tests (Recognition and Production) and metacognitive knowledge (declarative, procedural, conditional) across three task types; Group A, B, and C. The data reveal that Group C achieved the highest mean scores in both Recognition (14.03) and Production (13.97) tests, as well as in declarative knowledge (17.10). In contrast, the Group A scored lowest in both tests and in conditional knowledge (11.03), highlighting the variability in task effectiveness.

Table 5.

Correlation Results Between Metacognitive Knowledge and Posttest Performances

		Recognition	Production	Declarative	procedural	Conditional
Recognition	**Pearson Correlation**	1	.552**	.022	-.134	-.265*
	Sig.(2-tailed)		.000	.838	.206	.012
	Covariance	14.320	8.437	.526	-1.993	-4.335
	N	90	90	90	90	90
Production	**Pearson Correlation**	.552**	1	.040	.030	-.159
	Sig.(2-tailed)	.000		.708	.777	.134
	Covariance	8.437	16.317	1.027	.478	-2.778
	N	90	90	90	90	90
Declarative	**Pearson Correlation**	.022	.040	1	-.311**	.196
	Sig.(2-tailed)	.838	.708		.003	.064
	Covariance	.526	1.027	40.482	-7.752	5.388
	N	90	90	90	90	90
Procedural	**Pearson Correlation**	-.134	.030	-.311**	1	-.003
	Sig.(2-tailed)	.206	.777	.003		.975
	Covariance	-1.993	.478	-7.752	15.340	-.056
	N	90	90	90	90	90
Conditional	**Pearson Correlation**	-.265*	-.159	.196	-.003	1
	Sig.(2-tailed)	.012	.134	.064	.975	
	Covariance	-4.335	-2.778	5.388	-.056	18.664
	N	90	90	90	90	90

****. Correlation is significant at the 0.01 level (2-tailed).**

The correlation analysis in Table 5 demonstrates a significant positive correlation between procedural knowledge and performance in productive tasks ($r = 0.552$, $p < 0.01$), indicating that higher procedural knowledge predicts better performance in production-based tasks. A similar pattern is observed for declarative knowledge in relation to recognition-based tasks, with a significant positive correlation ($r = 0.311$, $p < 0.01$). These results underscore the critical role of metacognitive knowledge in learners' ability to recognize and produce morphosyntactic structures.

The study's findings highlight the differential impact of task-induced cognitive load on EFL learners' acquisition of morphosyntactic structures, with tasks involving higher cognitive demands leading to superior performance. Moreover, the significant correlations between metacognitive knowledge and test performance emphasize the importance of metacognition in language learning. These insights suggest that educators should carefully consider task design and the development of metacognitive skills to enhance learners' language acquisition.

The analysis presented in Table 6 examines the relationship between different components of metacognitive knowledge, namely declarative, procedural, and conditional knowledge, and learners' performance in tasks related to the recognition and production of morphosyntactic structures. The multiple regression analysis was conducted to evaluate whether these components of metacognitive knowledge can predict the effectiveness of various instructional treatments across three experimental groups. Before performing the regression analysis, several key assumptions were checked to ensure the validity of the results. The independence of residuals was confirmed using the Durbin-Watson statistic, which fell within the acceptable range of 1 to 3. Additionally, multicollinearity was assessed by examining the variance inflation factors (VIFs), all of which were below the critical value of 10, indicating no significant multicollinearity among the predictors.

Table 6.
Multiple Regression Analysis of the Variables

GJT Recognition: Group A	Unstandardized Coefficients		Standardized Coefficients	T	Sig.		
	B	Std. Error	Beta			R^2	Adjusted R^2
Declarative	.374	.124	.494	3.009	**.005***	.109	.006
Procedural	.085	.128	.136	.661	.514		
Conditional	-.157	.115	-.277	-1.366	.184		
GJT Recognition: Group B							
Declarative	.354	.143	.425	2.482	**.019***	.046	-.064
Procedural	-.174	.160	-.218	-1.088	.286		
Conditional	-.006	.126	-.009	-.047	.963		
GJT Recognition: Group C							
Declarative	.273	.120	.395	2.274	**.031***	.226	.136
Procedural	-.329	.183	-.351	-1.793	.085		
Conditional	-.168	.190	-.175	-.886	.384		
ET Production: Group A							
Declarative	.003	.022	.023	.114	.910	.222	.132
Procedural	.071	.037	.337	1.894	.069		
Conditional	-.053	.033	-.305	-1.612	.119		
ET Production: Group B							
Declarative	.013	.096	.026	.132	.896	.063	-.045
Procedural	.465	.145	.518	3.202	**.003***		
Conditional	-.110	.118	-.180	-.932	.360		
ET Production: Group C							
Declarative	.146	.077	.351	-1.901	.069	.138	.039
Procedural	.532	.164	.523	3.243	**.003***		
Conditional	.050	.117	.089	.428	.672		

*$p < .05$

Table 6 provides the results of the multiple regression analysis, where the R^2 value indicates the proportion of variance in learners' test performance explained by the metacognitive predictors. The Beta (β) coefficients represent the degree to which each predictor contributes to the dependent variable, adjusted for the influence of other variables. The adjusted R^2 accounts for the number of predictors, ensuring that only significant variables are reflected in the model. The findings reveal that declarative knowledge significantly predicts learners' performance on the Recognition test in all three groups, indicating its strong role in recognizing morphosyntactic structures. However, declarative knowledge did not predict outcomes on the Production posttest, suggesting that while it aids in recognition, it may not be as effective in supporting production tasks.

Procedural knowledge, on the other hand, was a significant predictor of performance on the Learners' production across most groups, except for Group A, where its predictive power was marginally insignificant ($p = .06$). This suggests that procedural knowledge, which involves the application of rules and strategies, is crucial for tasks requiring production but may not be as critical for recognition tasks, as indicated by its lack of influence on Recognition performance.

Conditional knowledge, which involves the ability to apply knowledge based on context, did not exhibit any predictive value in recognition or production tasks across all groups. This indicates that while learners may apply their knowledge effectively in various contexts, it did not translate to improved performance in either recognition or production tasks across the groups studied.

To further elucidate the relationship between metacognitive knowledge and performance on morphosyntactic tasks, structural equation modeling (SEM) was employed. In structural equation modeling (SEM), various model fit indices are used to assess how well a proposed model represents the data. Among these indices, the Chi-Square (χ^2) statistic is one of the most traditional and frequently reported. The Chi-Square statistic tests the null hypothesis that the model fits the data perfectly. In other words, it assesses the discrepancy between the observed covariance matrix and the expected covariance matrix based on the model. In the present study, as the Chi-Square is non-significant ($p = .071$), there is no significant difference between the observed and predicted data, suggesting good model fit. Figure 1 illustrates the SEM results, showing standardized parameter estimates. The model demonstrates that higher cognitive load in tasks leads to better performance in both the recognition ($\beta = 0.93$, $p < .05$) and production ($\beta = 0.92$, $p < .05$) of morphosyntactic structures.

The SEM analysis also supports the earlier findings, with procedural knowledge having a positive impact on production tasks ($\beta = 0.013$, $p > .05$) but not on recognition tasks ($\beta = 0.19$, $p < .05$). Conversely, declarative knowledge was a strong predictor for recognition tasks ($\beta = 0.15$, $p < .05$) but not for production tasks ($\beta = 0.011$, $p > .05$). Conditional knowledge did not show significant predictive effects on either task type, suggesting its role may be more nuanced or context-dependent.

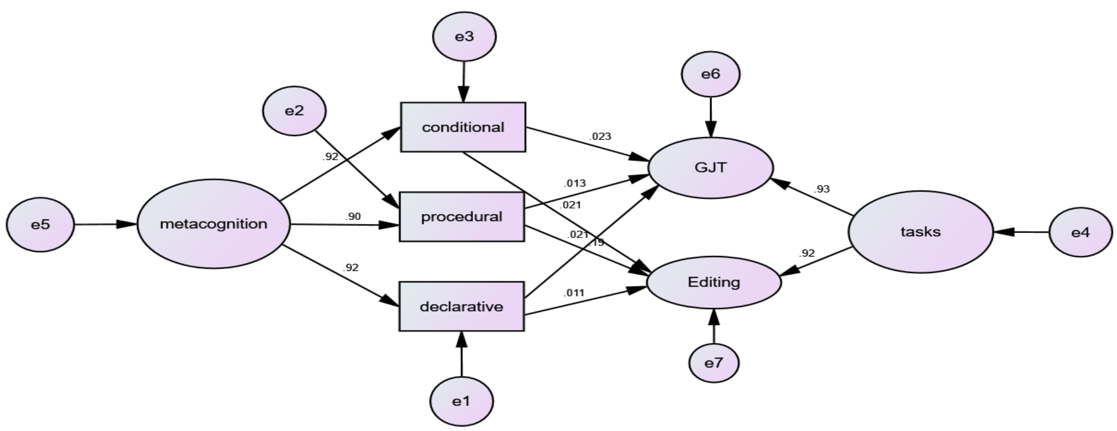

Figure 1. *Relationship between Metacognitive knowledge and morphosyntactic reception and production*

Discussion

This study investigated the differential impact of tasks with varying cognitive demands on learners' receptive and productive knowledge of English morphosyntactic structures. Additionally, it explored the role of metacognitive knowledge in predicting the effectiveness of these tasks, focusing on its influence on learners' ability to recognize and produce the target structures. The findings indicated that tasks involving text reconstruction, which imposed the highest cognitive load, led to superior performance in both the production and recognition of these structures compared to reading and textual enhancement tasks.

Discussion on the First Research Question

How do tasks varying in cognitive demand differentially affect receptive and productive knowledge of English morphosyntactic structures?

The results of this study demonstrate that tasks with higher cognitive demands, such as text reconstruction, significantly enhance both receptive and productive knowledge of English morphosyntactic structures. These tasks compel learners to engage more deeply with the language, fostering a stronger grasp of the target structures. The cognitive effort required for reconstructing texts forces learners to process linguistic information more thoroughly, which in turn promotes better retention and application of morphosyntactic structures. In contrast, tasks that required lower cognitive effort, such as reading or textual enhancement, proved less effective in promoting both recognition and production. These findings reinforce the notion that cognitively demanding tasks can lead to deeper processing and more substantial learning gains, especially for complex linguistic structures like morphosyntactic forms.

The positive effect of high cognitive load tasks on language learning is consistent with recent research, indicating that increased cognitive engagement leads to deeper processing of linguistic structures. For instance, Phadungsilp and Supasiraprapa (2023) observed that tasks with higher involvement loads, particularly when paired with first-language glosses, significantly enhanced vocabulary learning in low-proficiency EFL learners. Similarly, Alanazi (2023) found that translation tasks, which induce greater cognitive involvement than simple reading, were more effective for vocabulary acquisition. These findings resonate with the current study's results, which emphasize the effectiveness of complex tasks in promoting both receptive and productive knowledge of morphosyntactic structures. Moreover, the present study's findings align with Alavinia and Rahimi (2019), who demonstrated that tasks requiring high cognitive engagement, such as writing and combining, were more beneficial for vocabulary acquisition than less demanding tasks. Qin (2023) further supported the idea that tasks with a high involvement load surpass those focusing solely on technical feature analysis in vocabulary acquisition. Collectively, these studies suggest that cognitive load is a critical factor in the depth of language processing, which, in turn, enhances learning outcomes.

However, not all research supports the superiority of high cognitive load tasks. Tajeddin and Jabbarpoor (2013), for example, found that input enhancement was more effective than output tasks for learning English inversion structures, suggesting that increased cognitive demand may not always result in better learning outcomes. This contrast highlights the complexity of task-based language learning and implies that the effectiveness of high cognitive load tasks may vary depending on the linguistic feature being targeted. Robinson's (2001) task complexity framework proposes that more complex tasks enhance noticing and learning, providing a theoretical foundation that partially supports the current study's findings while acknowledging potential variability in outcomes.

Discussion on the Second Research Question

To what extent does learners' metacognitive knowledge predict the effects of tasks on learning English morphosyntactic structures?

The study reveals that learners' metacognitive knowledge, particularly procedural and declarative knowledge, plays a crucial role in predicting the effects of tasks on the learning of English morphosyntactic structures. Procedural metacognitive knowledge, which involves the ability to apply strategies and cognitive processes, emerged as a strong predictor of productive knowledge. Learners with higher levels of procedural knowledge performed better in producing morphosyntactic structures, particularly in tasks that required active language manipulation, such as text reconstruction. Conversely, declarative metacognitive knowledge, which pertains to the understanding of linguistic rules and structures, significantly predicted receptive knowledge, helping learners recognize correct forms during reading and listening tasks.

These results suggest that learners who possess a well-developed metacognitive framework are more successful in navigating and performing tasks with varying cognitive demands, ultimately achieving better learning outcomes. Interestingly, the study also shed light on the varying predictive effects of metacognitive knowledge on the recognition and production of target structures. Contrary to Teng and Zhang (2021), who argued that metacognitive knowledge does not significantly predict vocabulary learning, our findings indicate that procedural metacognitive knowledge positively influences the production of morphosyntactic structures, though it is less effective for form recognition. This conclusion is supported by Abdelshiheed et al. (2023), who highlighted that procedural knowledge, which involves the automated use of cognitive strategies, enables learners to manipulate linguistic structures more effectively, thus enhancing productive skills. Conversely, declarative metacognitive knowledge was found to significantly predict form recognition, emphasizing that understanding linguistic rules is essential for recognizing and processing morphosyntactic structures in language input.

The challenges faced by EFL learners in recognizing correct morphosyntactic forms may stem from insufficient exposure or practice, especially in tasks requiring high levels of procedural metacognitive knowledge. While procedural knowledge is vital for effectively applying learning strategies, it may not be as beneficial in tasks that primarily require form recognition, as suggested by Boulware-Gooden et al. (2007). This underscores the need for a balanced approach that integrates both procedural and declarative knowledge to help learners excel in various linguistic tasks. Additionally, the findings highlight the significance of metacognitive knowledge in academic writing, where both procedural and declarative knowledge were strong predictors of writing performance. This aligns with previous research (e.g., Brown, 1987; Schraw, 2001; Teng et al., 2021), which emphasizes that EFL learners must understand and effectively apply available strategies to succeed in academic writing.

Discussion on the Third Research Question

Is there a significant correlation between EFL learners' metacognitive knowledge and their mastery of morphosyntactic structures?

The study identified a significant correlation between EFL learners' metacognitive knowledge and their mastery of morphosyntactic structures. In particular, procedural metacognitive knowledge was found to be strongly correlated with learners' ability to accurately produce these structures. This indicates that the strategies and processes inherent in procedural knowledge are vital for mastering productive language skills. Additionally, declarative knowledge was strongly associated with receptive skills, reinforcing the idea that understanding linguistic rules is essential for recognizing and processing morphosyntactic structures in language input. However, conditional metacognitive knowledge, which involves the ability to adapt learning strategies to different contexts, did not exhibit a significant correlation. This suggests that its role may be less direct or influenced by factors such as the instructional context or learner characteristics.

Overall, these findings highlight the importance of metacognitive knowledge in mastering complex linguistic structures in EFL learning contexts. This conclusion aligns with the study's results pointing to the necessity of diverse metacognitive strategies tailored to learners' needs. Additionally, metacognitive knowledge enhances active engagement with the language-learning process, ultimately improving outcomes. This critical metacognitive engagement implies that educators should provide opportunities for learners to develop their metacognitive skills alongside their language proficiency, ensuring that strategies for both recognition and production are utilized effectively. This study offers valuable insights into the interaction between cognitive load, metacognitive knowledge, and task performance in EFL contexts. While high cognitive load tasks can enhance learning outcomes, the role of metacognitive knowledge is equally critical in predicting learners' success. These findings carry important implications for language instruction, suggesting that task design should consider both cognitive demands and metacognitive support to optimize learning outcomes.

Conclusion and Implications

This study has demonstrated that output-based tasks with higher cognitive demands significantly improve EFL learners' performance in acquiring English grammar structures. These findings extend the Involvement Load Hypothesis (ILH), traditionally associated with vocabulary acquisition, to L2 grammar learning. The results highlight the necessity of incorporating more output-oriented tasks into grammar instruction, aligning with individual cognitive capacities and metacognitive skills.

Moreover, the study revealed a significant correlation between declarative and procedural knowledge with learners' abilities to recognize and produce grammatical forms. This underscores the critical role of metacognitive knowledge in facilitating grammar acquisition. Customizing tasks to meet both cognitive and metacognitive needs can potentially enhance learning outcomes. However, this study has certain limitations that must be acknowledged. The sample size, consisting of only ninety Iranian EFL learners, may limit the generalizability of the findings to broader contexts or larger populations. The controlled academic environment in which the study was conducted might not accurately reflect real-world language learning scenarios. Furthermore, the study's focus on specific grammar structures limits the applicability of the findings to those particular constructs, potentially neglecting other critical aspects of grammar learning. The deliberate focus on three experimental groups and tasks designed to test the ILH also defines the study's scope.

Future research should address these limitations by expanding the sample size and including participants from diverse linguistic and cultural backgrounds to improve the generalizability of the results. Additionally, applying the ILH to various grammatical structures and language skills could provide a more comprehensive understanding of its effectiveness. Longitudinal studies that monitor learners' progress over time would offer valuable insights into the long-term effects of output-based tasks and metacognitive knowledge on grammar acquisition. Furthermore, exploring the integration of technology and digital tools in implementing output-oriented tasks could be particularly relevant given the increasing use of digital platforms in language learning. Finally, examining the interaction between different types of metacognitive knowledge and various learning contexts could lead to more effective instructional strategies tailored to individual learner needs.

Conflict of interest

The authors of this paper have conducted all stages of the research and writing process with full cooperation and agreement, and there has been no disagreement during this process.

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Appendix

Sample of a Standard Grammatical Judgment Test (Intermediate Level - CEFR B1)

Instructions:

Read the following sentences carefully. For each sentence, decide if it is grammatically correct or incorrect. Circle **Correct** or **Incorrect.** If you think the sentence is incorrect, please underline the part of the sentence you believe needs correction.

1. I will turn off the lights before leaving the room.
   - Correct / Incorrect
2. She looked up the number in her phone.
   - Correct / Incorrect
3. I'm excited to find out about the new job.
   - Correct / Incorrect
4. He put on quickly his jacket before going out.
   - Correct / Incorrect
5. She ran into a famous actor while shopping yesterday.
   - Correct / Incorrect

Sample of a Standard Editing Test (Intermediate Level - CEFR B1)

Instructions:

In the following sentences, one part contains an error in the use of morphosyntactic structures (phrasal verbs). Identify the error and correct it by rewriting the sentence correctly.

1. She ran after quickly her little brother when he crossed the street.
   - ____________________
2. The manager gave in the new assignment to the team yesterday.
   - ____________________
3. I have to look for up that information in the library tomorrow.
   - ____________________
4. They asked their teacher for to explain the homework again.
   - ____________________
5. He finally decided to call off the meeting after waiting for hours.
   - ____________________

Group B: Sample Reading Text with Target Morphosyntactic Structures Bolded

An Unforgettable Adventure

Emma had always dreamed of going on an exciting adventure. One day, she decided to **set out** on a trip to explore a hidden beach that she had heard about from her friend, David. Early in the morning, she **put** her backpack **on** and **packed** a few snacks **up** before heading towards the coast. She knew the journey wouldn't be easy, but she was ready for the challenge.

As she walked through the forest, she suddenly **came across** an old map lying on the ground. She couldn't believe her luck! The map seemed to lead directly to the hidden beach. Excited, Emma **picked it up**, quickly unfolded it, and continued on her way, carefully following the directions.

After a few hours, she **ran into** some hikers who were also exploring the area. They chatted briefly, and Emma offered to help them **look** a nearby waterfall **up** on the map. Together, they found the waterfall and decided to **take** their shoes **off** and enjoy the cool water. They took a short break, listening to the sound of the rushing water, and **soaked** the peaceful atmosphere **up**.

Once they were rested, Emma and the hikers said goodbye and **packed** their things **up** before parting ways. Emma was determined to reach the beach before sunset. After what felt like an eternity, she finally **came upon** the hidden cove. The sight was breathtaking—white sand, crystal-clear water, and the sound of gentle waves lapping at the shore.

Emma knew that this adventure would stay with her forever. She quickly **took** her phone **out** to capture the moment and promised herself that she would **write** every detail **down** in her travel journal later. As she sat by the shore, watching the sunset, she felt a deep sense of accomplishment. Her adventure had been everything she had hoped for, and more.

Target Forms:

- **Separable Phrasal Verbs:**
  - **Put on** (e.g., "put on her backpack")
  - **Pick up** (e.g., "picked up the map")
  - **Pack up** (e.g., "packed up a few snacks")
  - **Look up** (e.g., "look up a nearby waterfall")
  - **Take off** (e.g., "take off their shoes")
  - **Soak up** (e.g., "soaked up the atmosphere")
  - **Write down** (e.g., "write down every detail")
  - **Take out** (e.g., "took out her phone")
- **Inseparable Phrasal Verbs:**
  - **Set out** (e.g., "set out on a trip")
  - **Come across** (e.g., "came across an old map")
  - **Run into** (e.g., "ran into some hikers")
  - **Come upon** (e.g., "came upon the hidden cove"