

Teaching English Time Prepositions Using Mnemonics

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How to cite this paper: Alghonaim, S. H., & Wulf, D. J. (2024). Teaching English Time Prepositions Using Mnemonics. *Open Journal of Modern Linguistics*, 14, 401-424. <https://doi.org/10.4236/ojml.2024.143022>

Received: March 14, 2024

Accepted: June 4, 2024

Published: June 7, 2024

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Abstract

A challenging grammatical category that learners of English must acquire is prepositions. We describe a preliminary study to investigate a technique inspired by Skill Acquisition Theory (SAT) to help English language learners acquire accurate use of temporal prepositions. Study participants were taught four mnemonics covering basic usage of the temporal prepositions *at*, *in* (in two distinct usage patterns), *on*, *for*, *from*, *since*, and *until*. The experimental group displayed significant improvement using all four mnemonics when performance before and after instruction was compared. A control group, not provided instruction, displayed no improvement between the pre-test and post-test. These findings suggest such mnemonics have the potential to help students achieve higher accuracy rates in the appropriate use of temporal prepositions, provided students understand the instruction and can proceduralize the grammatical patterns by using the mnemonics, which function to encapsulate the instruction. Therefore, these results suggest that more in-depth research would be beneficial.

Keywords

Prepositions, Mnemonics, Second Language Acquisition, English Grammar, English as a Second Language, Skill Acquisition Theory, Temporal Prepositions

1. Introduction

Prepositions are challenging for English language learners (ELLs), who have difficulties choosing prepositions in discourse contexts (Mahmoodzadeh, 2012; Ahmad et al., 2011; Alotaibi et al., 2018; Arjan et al., 2013). Even native English speakers are occasionally unsure about selecting a preposition for a given context (Celce-Murcia & Larsen-Freeman, 1999: p. 403).

Quirk et al. (1985: p. 657) describe prepositions as a small set of function words expressing relationships between two entities. Prepositions constitute a closed class, so novel prepositions are often not introduced (Quirk et al., 1985; Biber et al., 1999). The object of a preposition can be a noun phrase, nominal *wh*-clause, or nominal *-ing* clause. The combination of a preposition with its object is a prepositional phrase, which can serve various adjectival or adverbial functions (Quirk et al., 1985: p. 657). Thus, in *The boy sat on a chair*, *on* is a preposition, and *a chair* is the object of the preposition. This prepositional phrase communicates spatial information about the boy's location. However, prepositional phrases can serve other purposes.

Prepositions broadly have three major functional categories: spatial (location, e.g., The ball is *on the table*), directional (movement through space, e.g., I walked *to the park*), and temporal (time relationships, e.g., I have a meeting *on Monday*) (Clark, 1973; Bennett, 1975; Jackendoff, 1983; Lindstromberg, 1998). Prepositions can also have figurative interpretations via metaphorical connection. In *The temperature is above/below 30 degrees*, spatial prepositions *above* and *below* are used metaphorically (Quirk et al., 1985).

This pilot study was designed to investigate a pedagogical tool, mnemonics, for teaching temporal prepositions to ELLs via Skill Acquisition Theory (SAT), a theory that “accounts for how people progress in learning a variety of skills, from initial learning to advanced proficiency” (Anderson, 1976; DeKeyser, 1998; McLaughlin, 1987). If the utility of such mnemonics can be demonstrated, they could be employed to help learners acquire temporal uses of prepositions.

We begin by discussing reasons why prepositions cause difficulties for ELLs and survey common teaching techniques used. The use of mnemonics is then described. The preliminary study investigating this technique is presented, consisting of methodology, results, discussion of results, and a conclusion.

2. Previous Studies of Prepositions

2.1. The Challenge of Prepositions

There have been various studies of preposition acquisition, with some concluding prepositions are too complex to teach in a comprehensive way (Mahmoodzadeh, 2012; Ahmad et al., 2011; Alotaibi et al., 2018; Arjan et al., 2013). Mahmoodzadeh (2012) examined preposition use by Iranian adult intermediate-level ELLs. In a translation task, learners frequently misapplied or redundantly added prepositions, suggesting the ELLs were aware of prepositions and were not avoiding them, but lacked skills to use them accurately. Ahmad et al. (2011) examined Pakistani secondary school students learning English and analyzed preposition errors in their writing, revealing difficulties in comprehending temporal prepositions. Alotaibi et al. (2018) found Kuwaiti ELLs faced challenges in selecting appropriate prepositions across various contexts. Arjan et al. (2013) noted how Malaysian students often confused the spatial prepositions *in* and *on*.

To develop effective preposition pedagogy, it is important to understand fac-

tors making prepositions difficult. First, prepositions that appear equivalent in different languages may exhibit distinct usage patterns, leading to negative transfer (Celce-Murcia & Larsen-Freeman, 1999). For instance, the Spanish preposition *por* possesses multiple English translations (i.e., *for*, *through*, *by*, *during*), which vary depending on context (Lam, 2009: p. 2).

Secondly, we note the sheer number of prepositions, making comprehensive systematization arduous. There is no agreed upon number of prepositions, but an approximate list from Klammer et al. (2004) identifies in English 60 simple (i.e., one-word) and 39 complex (i.e., multiple-word) prepositions (e.g., *instead of*, *in need of*, etc.). Whereas ELLs must deal with about a dozen tense-aspect patterns in English, there are approximately 100 prepositions to master.

Third, English prepositions generally are polysemous (Lorincz & Gordon, 2012). From context, the relevant meaning must be selected from a variety of semantic interpretations. Thus, *in* can indicate location (e.g., *She was in the stadium*), direction (e.g., *He walked in the room*), time (e.g., *I saw him in April*), or a metaphorical concept (e.g., *We are in trouble*). Most obviously, a preposition's meaning is affected by the meaning of its complement (Koffi, 2010).

Finally, unstressed monosyllabic prepositions (e.g., *in*, *on*, *at*, *for*) are often produced with reduced vowels, making them less acoustically salient for the learner (Lam, 2009).

2.2. Approaches to Teaching Prepositions

There have been three common approaches for teaching prepositions: the traditional approach, the collocation approach, and the prototype approach.

2.2.1. The Traditional Approach

In the traditional approach, students are taught prepositions individually using lists of prepositions in context (Lorincz & Gordon, 2012). This approach implies prepositions must be acquired on a case-by-case basis, without making broader generalizations (Lam, 2009). Since each preposition is introduced in isolation without explaining how context can affect its interpretation, it is understandable that learners may struggle to use prepositions communicatively (Lam, 2009).

However, requiring learners to memorize extensive lists of prepositions is impractical. Pinto and Rex (2006) examine the accuracy of college students using the Spanish prepositions *por* and *para*, discovering that lists of unrelated individual prepositions did not enhance understanding of the versatile nature and broad range of meanings these prepositions convey. According to Lam (2009), students learning prepositions through traditional methods display minimal retention and lack confidence employing prepositions in communication.

2.2.2. The Collocation Approach

The collocation approach teaches prepositions through collocations rather than in isolation. Thus, instead of treating *on* as an individual lexical item, it is taught within a "chunk," such as part of the phrasal verb *rely on*. Similarly, formulaic

sequences are taught, such as frequently used prepositional phrases (e.g., *on schedule*). According to [Mueller \(2011\)](#), associative learning is necessary to account for the acquisition of irregular forms and firmly established idioms. However, [Lindstromberg \(1996\)](#) argues that this approach can fail to cover the different meanings associated with a single preposition.

2.2.3. The Prototype Approach

The prototype approach, inspired by [Lakoff \(1987\)](#), posits that although each preposition possesses multiple meanings, only one interpretation is dominant: its spatial sense. For example, the prototypical meaning of *on* is “contact of an object with a line or surface” ([Lindstromberg, 1996](#)). It is hoped non-prototypical meanings can then be connected to the prototype via metaphorical extension.

For this approach, a teacher first introduces the concept of prototypes, such as by asking students to think of any type of bird. Students will tend to think of songbirds more than flightless birds, such as ostriches. Although some birds are flightless, birds that fly serve as better prototypes for birds overall. Furthermore, songbirds are more representative of the typical size of a bird. Teachers can describe how prepositions seem to exhibit prototypical spatial meanings, which is sometimes extended to less prototypical interpretations ([Lam, 2009](#)). The teacher may ask students to construct sentences using *on*. Students will often generate sentences using the spatial sense of *on*, such as *The cup is on the table*. Non-spatial senses of *on*, such as *The meeting is on Tuesday* (temporal), can potentially be understood as metaphorical extensions of the spatial sense.

Though the prototype approach is nuanced, its effectiveness has not been established. In [Wijaya and Ong \(2018\)](#), students taught prepositions through the traditional approach were compared to those using prototypes. Results showed no significant difference between the two groups in a delayed post-test. Thus, as none of these approaches has achieved conspicuous success, it still seems helpful to suggest other ideas for teaching prepositions.

2.3. Mnemonic Tools

One novel strategy is the use of mnemonics. This technique can be conceptualized under Skill Acquisition Theory (SAT) ([Anderson, 1976](#); [DeKeyser, 1998](#); [McLaughlin, 1987](#)). This theory applies to the acquisition of any skill, such as playing a sport or driving a car, but has also been applied to second language acquisition. Skill acquisition consists of three stages: learning relevant declarative knowledge, converting this into procedural knowledge, and, finally, automatizing the procedural knowledge. In declarative knowledge acquisition, individuals consciously learn a rule or pattern. The learner next attempts to convert this into skill performance, which is procedural knowledge. With practice, automatization is reached, so the skill can be executed without conscious attention to its implementation. Thus, in learning to swim, one must first understand what to do (declaratively), then attempt to use this knowledge in initial attempts to swim (procedurally), and finally develop smooth performance under subconscious

control after extensive practice (automatically).

Mnemonics aim to summarize relevant declarative knowledge efficiently to facilitate proceduralization, potentially leading to more rapid automatization. Some studies have found positive results in teaching language patterns via mnemonics. For example, Alkhonini and Wulf (2018) used a mnemonic to help learners pronounce onset consonant clusters in a more native-like way. Wulf (2016) used mnemonics to assist learners with the English article system.

2.4. Mnemonics

Mnemonics are first known from the Greek poet Simonides in 447 BC (Patten, 1990). Mnemonics vary from simple acronyms to intricate strategies (Putnam, 2015). The two most commonly used mnemonics are fact mnemonics and process mnemonics. Fact mnemonics, which Putnam (2015) calls single-use mnemonics, are employed to aid in the retention of specific information. For example, *Richard of York gave battle in vain* (Manalo, 2002: p. 69) assists in remembering the colors of the spectrum (red, orange, yellow, green, blue, indigo, violet). A similar mnemonic for the same purpose is the invented name *Roy G. Biv*. Process mnemonics, which Putnam (2015) calls repeated-use mnemonics, assist in remembering rules or procedures. For example, “*I before e, except after c*” helps to choose between *ie* and *ei* in English spelling (Manalo, 2002: p. 69). This mnemonic is useful even though exceptions exist. Of course, it is possible to elaborate a mnemonic to capture more exceptions: “*I before e except after c, or when sounded like a, as in neighbor and weigh.*”

Mnemonics are valuable tools for accessing students’ existing knowledge. They serve as retrieval plans rather than substitutes for lessons. Putnam (2015) stresses that mnemonics provide students with a retrieval plan for understanding declarative knowledge, aiding in information recall, and making it usable. This accessibility is crucial for proceduralization, as it enables quick access to relevant information, such as the usage of temporal prepositions, thereby enhancing fluency. The discussion of mnemonics centers on their role in making declarative knowledge more accessible and proceduralizable rather than replacing lessons, and this aligns with skill acquisition theory.

Many researchers provided evidence that mnemonics have many pedagogical applications (Levin et al., 1982; McDaniel, Pressley, & Dunay, 1987; McDaniel & Pressley, 1989). Levin et al. (1982) utilized pictorial fact mnemonics to teach children vocabulary. An experimental group received pictures related to a stimulus recording, along with words associated with the pictures, serving as mnemonics. For example, for *surplus*, children were shown a picture of syrup poured over pancakes and told there was a *surplus* of *syrup*. The keyword *syrup* was a mnemonic due to its phonetic similarity to *surplus*. A control group was only provided pictures without keywords. The experimental group demonstrated better word recall (72.3% correct) compared to the control group (48.7% correct). McDaniel et al. (1987) and McDaniel & Pressley (1989) provide evidence that mnemonics can aid in the learning of unfamiliar words.

Furthermore, many researchers have investigated the use of mnemonics in language instruction. For instance, Wang and Thomas (1992) employed these techniques for teaching Chinese characters, van Hell and Mahn (1997) used them for teaching concrete and abstract foreign words, and others have used them in other areas of language instruction, particularly vocabulary learning (e.g., Hall, 1988; Dunlosky et al., 2013). These studies support the notion that mnemonics can contribute to accelerated learning, improved understanding, and long-term retention of acquired information.

Temporal Preposition Mnemonics

As a preliminary investigation into the usefulness of mnemonics for the acquisition of temporal prepositions, a study was conducted with 60 participants: 40 ELLs and 20 native English speakers. The goal was to locate evidence ELLs could proceduralize knowledge of temporal prepositions using mnemonics. In a one-hour instruction session, ELLs in the experimental group practiced applying four mnemonics describing the use of English temporal prepositions. The mnemonics are short, just 8 to 10 words each. They are designed to reduce extensive, complicated declarative knowledge to brief, clear, memorable examples. Here are the mnemonics:

- 1) *At that moment, on that day, in May* (location in time)
- 2) *Walk for a day, arrive in a day* (duration of events in time)
- 3) *From when the sun rises to when the sun sets* (measuring time).
- 4) *Since I was born until I die* (also for measuring time).

“*At that moment, on that day, in May*” summarizes three patterns for the expression of temporal location. When a moment in time is described, *at* is used. Thus, in *I saw him at 12:05*, the expression *12:05* can be regarded as a moment of time, so *at* is used. However, when a day is explicitly referenced, *on* is used. Thus, in *He will work on Wednesday morning*, the expression *Wednesday morning* explicitly references a day (*Wednesday*), so *on* is used. Lastly, *in* is used for all other cases, such as months, years, and other time intervals. Here, the expression *May* is a placeholder acknowledging this miscellaneous pattern, and ELLs are explicitly told this. Thus, in *She bought a coat in the winter*, the expression *the winter* is neither a moment nor references a day, so *in* is used. *May* represents any non-moment, non-day interval. It also allows the mnemonic to rhyme, making it more memorable. Crucially, in teaching this mnemonic and others, it is not sufficient just to provide the mnemonic. Rather, mnemonics act as brief, memorable summaries of much longer explanations.

“*Walk for a day, arrive in a day*” summarizes two patterns expressing duration of events. First, when a predicate does not explicitly describe an endpoint, *for* is used. Thus, in *He read for an hour*, the predicate *read* is an activity that takes time, but there is no indication that some particular goal was reached. Thus, *for* is used in *He read for an hour*. By contrast, *He read the report* can be understood to indicate the conclusion of the action (i.e., the end of the report), so *in* is used: *He read the report in five minutes*. In the mnemonic, the predicate *walk*

does not include a description of the endpoint of the walking activity (in contrast to, for example, *walk to the park*). In the classification of predicates from Vendler (1967), a predicate like *walk* or *read* is described as atelic (without a described endpoint). However, predicates like *arrive*, *walk to the park*, or *read the report* are telic (with a described endpoint).

“*From when the sun rises to when the sun sets*” means *from* marks the beginning of a relevant time interval and *to* marks its conclusion. The mnemonic shows it is possible to use *from...to* with *when*-clauses, though the mnemonic can also be shortened to “*From sunrise to sunset*,” showing the mnemonic can also be used with nominal expressions. Another example is “*He talked from when he arrived to when he departed*,” which can be shortened to “*He talked from his arrival to his departure*.”

“*Since I was born until I die*” similarly describes an interval of time and can be shortened to use nominal expressions: “*Since my birth until my death*.” Crucially, *since* is used to indicate that an event or state is going on from a certain past time to the present moment. Both *since* and *until* can be prepositions (taking nominal expressions) or subordinating conjunctions (taking full clauses), also called complementizers. Thus, although we often think of these as prepositions, *since* and *until* can also work as temporal complementizers. The mnemonic (in its longer form) is designed to demonstrate this pattern. The shorter version, by contrast, demonstrates their use as prepositions. For example, in *She has been studying since the afternoon*, the expression *the afternoon* explicitly references the beginning of studying to the present moment. Similarly, *until* deals with the period of time, but the focus is often from the present moment to when the activity or event ends in the future. For example, in *He is staying at the library until the evening*, the expression *the evening* explicitly references the end of his stay, meaning he will leave the library in the evening. The mnemonic does not attempt to capture the subtle point that whereas *since* describes a time interval ending with the present moment, *until* can describe an interval that does not necessarily begin at the present moment (e.g., *Yesterday, he worked until 4:00 PM*). However, mnemonics are only intended to give learners a leg up in acquiring patterns of usage. This detail is simply not addressed.

These mnemonics are not meant to exhaustively cover all cases of the temporal uses of these prepositions. Rather, it is hoped by depicting typical patterns, exceptional circumstances may be reduced to a small number of minor details. Also, the mnemonics are meant to summarize complete lessons. Using mnemonics, ELL performance is predicted to improve. Admittedly, participants’ performance with each mnemonic might vary depending on their prior knowledge of these prepositions.

2.5. Research Question

The study’s research question was *Will ELLs be able to proceduralize their temporal prepositional knowledge for later automatization using these mnemonics?* Specifically, temporal uses of *at*, *on*, *in* (in two senses), *for*, *from*, *to*, *since*, and

until were examined. The pilot study was designed to note any positive indication this technique could be helpful for ELLs to proceduralize the relevant declarative knowledge, regardless of age, gender, native language, and length of residency in an English-speaking country. If any positive indication could be found among study participants taught the mnemonics in contrast to study participants not taught these mnemonics, more extensive research could subsequently be conducted in the future.

To clarify, the control group in our study would be given no instruction whatsoever as opposed to giving instruction in some non-mnemonic approach for teaching these prepositions. The reason for this was that our aim was not to demonstrate that our pedagogical procedure would be particularly superior to another. Indeed, as merely a pilot study without a longitudinal component, we would not be tracking the usefulness to learners of the mnemonic over time, which would more clearly demonstrate the full potential of the mnemonic approach. Rather, this pilot study only aimed at demonstrating that learners would be able successfully to use the mnemonics to arrive at more accurate preposition use. That is, we initially hoped to show that these mnemonics could usefully be employed as a concise summary of the usage patterns for these temporal prepositions.

Indeed, this mnemonic approach delivers to learners essentially the same content as any other way of teaching the prepositions. The key value, as we see it, is that the declarative knowledge of temporal prepositions is packaged in a very concise way. Such conciseness would be valuable, but only if being concise would not impair its usability. Thus, this pilot study was designed simply to verify that learners could take these mnemonics and successfully employ them to guide them to making accurate temporal preposition choices.

These mnemonics would be, for example, similar to the very popular strategy of teaching the conjunctions (*for, and, nor, but, or, yet, so*) by providing learners with the acronym FANBOYS. Assuming that learners can successfully employ this acronym to remember this list of conjunctions, it seems to be a handy tool. Obviously, conjunctions can also be taught without the acronym. It might not be possible to demonstrate in a controlled study that this acronym produces better immediate results than not teaching it to learners. Actually, the acronym FANBOYS contains no more declarative information than the list *for, and, nor, but, or, yet, so*. However, it would be necessary to check that learners can indeed unpack FANBOYS to arrive at the list of conjunctions to verify that the concise packaging of the list could be used. It was with the aim of verifying this ability to unpack the temporal preposition mnemonics successfully that this pilot study was undertaken. We also needed to verify that the learners would not be confused by the mnemonic and thus fail to show positive change from pre-test to post-test.

3. Methodology

3.1. Participants

This study had 60 participants, consisting of three groups: an experimental

group of 20 ELLs, a control group of 20 ELLs, and a baseline group of 20 native English speakers. The purpose of the baseline group was to compare ELL performance to native-speaker performance. Some ELLs (experimental group and control group) were currently enrolled in language programs either at the beginner or intermediate level. For those ELL participants who did not come from a language program, they were assigned a proficiency level according to the score they received on a recent International English Language Testing System (IELTS) test. Since this study merely sought to locate any positive indication that the mnemonic rules could benefit typical ELLs of beginner or intermediate proficiency, there was no attempt made to examine participant proficiency in finer detail.

For our experiment, we carefully selected participants for the experimental and control groups. We recruited individuals with a diverse range of language backgrounds to determine whether mnemonic techniques would be beneficial to people regardless of their first language. Also, to ensure that age was not a factor in our study, we made sure that all participants in the experimental, control, and baseline groups were of comparable age.

3.1.1. The Experimental Group

In the experimental group, there were 10 participants from Saudi Arabia, 1 from China, 2 from Türkiye, 2 from Bolivia, and 4 from Colombia. Their mean age was 28.15, with ages ranging from 18 to 50. There were 7 males and 13 females. 11 participants were enrolled in an English language program at the intermediate level. The other 9 were not in any language program but had recently taken an IELTS test. Their levels were all intermediate except for 1 at beginner level. Participants from language programs had been living in the United States for at least a year. Participants not from a language program had never lived in an English-speaking country. All participants had begun to learn English between the ages of 6 and 19 in a school setting. All reported having no known hearing or speech problems.

3.1.2. The Control Group

In the control group, there were 13 participants from Saudi Arabia, 1 from China, 1 from South Korea, 1 from Afghanistan, 1 from the United Arab Emirates, 1 from Guinea, and 2 from Colombia. Their mean age was 27.05, with ages ranging from 19 to 44. There were 4 males and 16 females. All participants in this group were enrolled in a language program, 17 at intermediate level and 3 at beginner level. All had been living in the United States for at least a year and had begun to learn English between the ages of 5 and 15 in a school setting. All reported having no known hearing or speech problems.

3.1.3. The Native-Speaker Baseline Group

In the native-speaker baseline group, all 20 native English speakers were born and raised in the United States and were enrolled in an undergraduate or graduate program at a university. Their mean age was 20.0, with ages ranging from 18

to 27. There were 12 females and 8 males. All participants reported having no known hearing or speech problems.

3.2. Instrument

Data-collection instruments were multiple-choice tasks developed by the researcher. The stimuli were 29 multiple-choice questions for each test (see Appendices A and B). For each test and for each participant, questions were randomly ordered. Participants were instructed to choose the appropriate preposition (*at, on, in, for, in, from, to, since, or until*) to fill in the blank in a sentence. Answers were divided into three categories: location in time, duration of time, and measurement of time.

Location in time questions consisted of three questions each for typical uses of *at*, typical uses of *on*, and typical uses of *in*, plus five questions investigating exceptional uses. One exceptional pattern is the use of *at* in the expression *at night* (used to reference night in general), as in *The moon appears at night*. By contrast, *in* is used when referencing a specific night, such as *There was rain in the night*. Another exception concerns reference to holidays. When a holiday references a day, *on* is used, as expected: *The children opened their presents on Christmas Day*. However, when describing time during the holiday season, *at* is possible: *I visited my family at Christmas*. The third exceptional case involves reference to a weekend, which is normally regarded as two days in duration (Saturday and Sunday). The mnemonic predicts *in*, but American English uses *on*, and British English uses *at* (e.g., *I will see them on/at the weekend*). Duration of time questions consisted of three questions each of typical uses of *for* and *in*. Measurement of time questions consisted of three questions each of typical uses of *for...to, since, and until*.

For all participants, two tests, A and B, were used for both pre-test and post-test in the following way: half the participants were given A as the pre-test and B as the post-test, and the other half were given B as the pre-test and A as the post-test. This was to verify that both tests represented approximately the same difficulty level for participants. It was also planned to give study participants a delayed post-test, but most members of the experimental group were unfortunately not available to take it, so this was not a component of this preliminary study.

3.3. Procedure

The pilot study was conducted online via Zoom for all ELLs, but in person for the native-speaker baseline group. This was just for the convenience of the participant groups. All participants filled out a consent form and demographic questionnaire asking about their nationality, native language, age, gender, and, for ELLs, language proficiency, age when learning English began, and length of residency in an English-speaking country. Forms, questionnaires, and tests were provided via Google Form.

3.3.1. The Baseline Group

Baseline participants took a pre-test (half taking A, and half taking B), followed by the post-test, taking the test version not taken as the pre-test. Each test took about 15 minutes. For this group, tests were given one after the other in one sitting, and they were not provided with any type of instruction.

3.3.2. The Control Group

The procedure for the control group was the same for the baseline group except participants were met individually on Zoom. Again, for this group, 15-minute tests were given one after the other in one sitting, and they were not provided with any type of instruction.

3.3.3. The Experimental Group

For this group, participants were met individually on Zoom. Participants took a 15-minute pre-test (half taking A, and half taking B). Next, the lesson was given for approximately an hour. A PowerPoint slide show was presented during the instruction. In conformity with SAT, it was necessary to package relevant information so as to facilitate its proceduralization and automatization. The lesson was divided into three sections. The first covered the location in time prepositions *at*, *on*, and *in*, using the mnemonic *At that moment, on that day, in May*. The second covered the duration of time prepositions *for* and *in*, using *Walk for a day, arrive in a day*. The last section covered the measurement of time prepositions *from/to*, *since*, and *until*, using the mnemonics *From when the sun rises to when the sun sets (from sunrise to sunset)* and *Since I was born until I die (Since my birth until my death)*. Each section was followed by practice with multiple-choice questions similar to the test questions.

The last part of the instruction session was an overall review covering all three sections, completing additional multiple questions covering all the prepositions discussed. Practice questions were similar to those from the pre-test. The researcher addressed any questions or concerns. Lastly, the 15-minute post-test (A or B, as the case may be) was administered.

4. Results

Data were entered into R (R Core Team, 2021) for analysis. Performance on each mnemonic was assessed to check for improvement from pre-test to post-test using mixed-effects linear models. Results are presented below.

4.1. Overall Performance

4.1.1. Overall Baseline Group Performance

Overall baseline group performance assesses whether baseline performance was consistent throughout the two tests. Results are shown in **Figure 1**.

Table 1 shows total mean scores of baseline group pre-test and post-test. Overall, both tests were very similar. Pre-test mean was 26.05 (89.8%), and post-test mean was 26.8 (92.4%). These results suggest native speaker overall performance was stable across the two tests. It is also noted that native speakers exhibited a

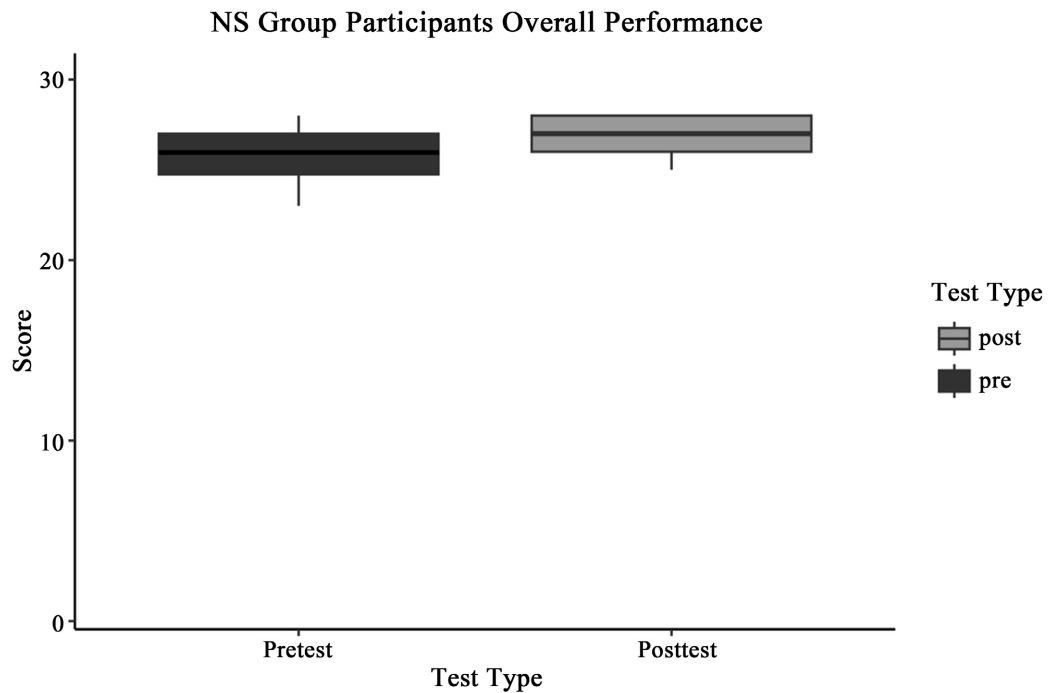


Figure 1. Overall baseline group performance in pre-test and post-test.

Table 1. Descriptive statistics for overall baseline group performance.

| | Mean | Std. Deviation | Std. Error |
|-----------|-------|----------------|------------|
| Pre-test | 26.05 | 1.53 | 0.06 |
| Post-test | 26.8 | 1.07 | 0.04 |

level of variation of preposition choice in both tests. Since even native speakers do not use these prepositions uniformly, it would not be necessary for ELLs to employ these prepositions uniformly either to achieve native-like proficiency.

4.1.2. Overall Control and Experimental Group Performance

Overall control group and experimental group performance assesses whether having an instruction session teaching a mnemonic makes a difference in relative performance with the temporal expressions studied. The difference between the scores of the two groups in the pretest is small. The experimental group scored slightly higher in the pre-test compared to the control group, partially due to a few low-scoring participants in the control group (see **Figure 2**).

Table 2 shows total mean scores for the control and experimental groups in pre-test and post-test. The pre-test means were 15.5 (53.4%) for the control group and 17.2 (59.3%) for the experimental group. Overall, the two groups were fairly comparable in their performance in the pre-test. On the other hand, post-test scores were considerably higher for the experimental group with a mean = 22.85 (78.8%) compared to the control group with a mean = 16.8 (57.9%).

A mixed-effects linear model was employed to investigate interaction between two predictors, namely, group (experimental and control) and test type (pre-test

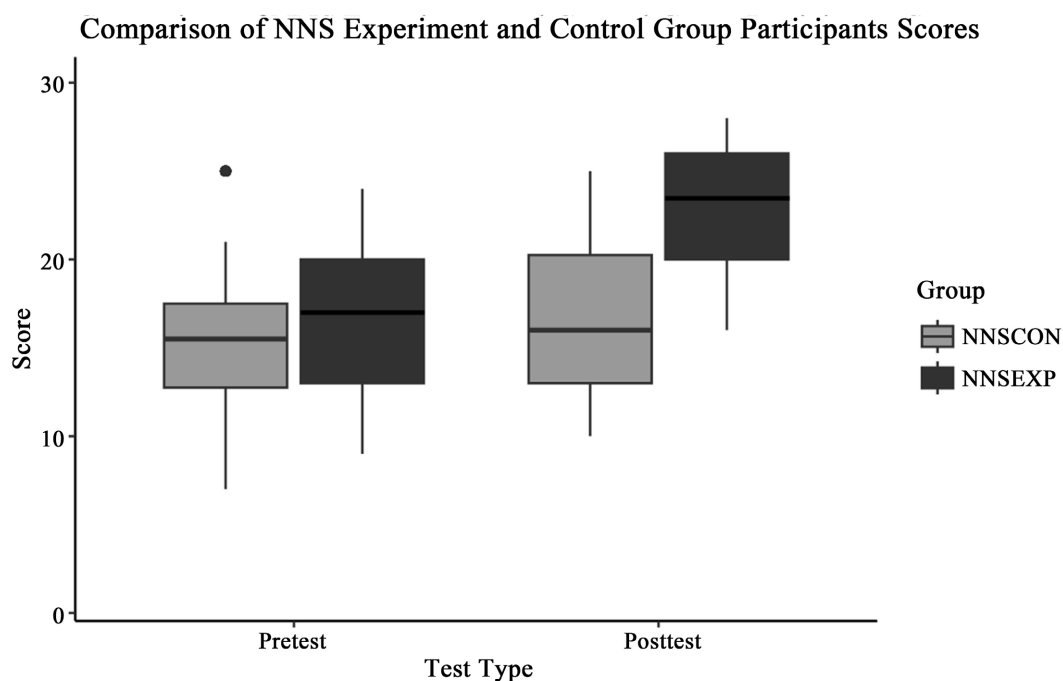


Figure 2. Overall control and experimental group performance.

Table 2. Descriptive statistics for the overall control and experimental group performance.

| Group | Test Type | Mean | Std. Deviation | Std. Error |
|--------------|-----------|-------|----------------|------------|
| Control | Pre-test | 15.5 | 4.784294 | 1.10 |
| | Post-test | 16.8 | 4.795796 | 1.10 |
| Experimental | Pre-test | 17.2 | 3.998445 | 0.917 |
| | Post-test | 22.85 | 3.840955 | 0.880 |

and post-test). The model incorporated fixed effects of the categorical predictors group (control, experimental) and test type (pre-test, post-test), along with their interaction. For group, the effects were coded as follows: experimental (0.5) and control (-0.5), while for test type, pre-test (-0.5) and post-test (0.5). Random intercepts were included in the model for question ID and participant.

The analysis produced statistically significant results for the group predictor (estimate = 0.73659, se = 0.22988, z value = 3.204, p -value < 0.001), indicating the experimental group achieved scores that were higher to a statistically significant extent than the control group. Similarly, the analysis revealed a statistically significant effect for the test type predictor (estimate = 0.67605, se = 0.09816, z value = 6.887, p -value < 0.001), suggesting post-test scores were higher to a statistically significant extent compared to pre-test scores. Furthermore, the analysis showed a statistically significant interaction between group and test type (estimate = 0.89782, se = 0.19559, z value = 4.590, p -value < 0.001), indicating the experimental group had higher scores in the post-test to a statistically significant extent compared to the control group.

As was anticipated, there is evidence of significant interaction between group and test type. The experimental group outperformed the control group on both the pre-test and post-test, but the experimental group's improvement from the pre-test to the post-test was particularly notable. These findings support the conclusion that the experimental group performance was superior to the control group to a statistically significant extent, supporting the hypothesis that mnemonic instruction helped the experimental group to proceduralization relevant declarative knowledge effectively for the post-test, as compared to the control group.

4.1.3. Effectiveness of Each Mnemonic

Effectiveness of each mnemonic assesses to what extent each mnemonic made a difference in the performance of the experimental group in the post-test in comparison to the pre-test. Each mnemonic was analyzed separately. Although each sub-model involves only a small amount of data, it is enough to provide a general idea of each mnemonic's effectiveness. Overall, the experimental group scored higher on the post-test compared to the pre-test using each mnemonic (see **Figure 3**).

A generalized linear mixed-effects model was established to test the effect of test type (pre-test and post-test) for each mnemonic. The model included the between-participants categorical predictors group (control, experimental) and test type (pre-test, post-test), as well as their interaction, as fixed effects. The effects were coded as follows: pre-test -0.5 and post-test 0.5. The models included random intercepts by question ID and participant.

The first mnemonic showed a significant positive effect (estimate = 1.2394, se = 0.2921, z value = 4.244, p -value < 0.001), indicating higher post-test scores compared to the pre-test. This suggests the first mnemonic was beneficial.

The second mnemonic likewise demonstrated a significant positive effect (estimate = 0.8357, se = 0.3631, z value = 2.302, p -value = 0.02136), with slightly higher post-test scores. This indicates the second mnemonic was beneficial.

The third mnemonic also revealed a significant positive effect (estimate = 1.1955, se = 0.3675, z value = 3.253, p -value = 0.001143), with slightly higher post-test scores. This suggests the third mnemonic was beneficial.

The fourth mnemonic similarly exhibited a significant positive effect (estimate = 2.3137, se = 0.5610, z value = 4.124, p -value < 0.001), indicating higher post-test scores. This result implies the fourth mnemonic was beneficial.

Number five on the chart represents exceptional cases related to the first mnemonic. The analysis revealed a significant positive effect (estimate = 1.0476, se = 0.3192, z value = 3.282, p -value = 0.00103). These results indicate providing explanations for exceptional cases to the first mnemonic was beneficial.

Table 3 presents statistical analysis of the overall effectiveness of each mnemonic. An important factor perhaps affecting the significance of each is the number of questions that tested each mnemonic and the number of objects analyzed, as discussed below.

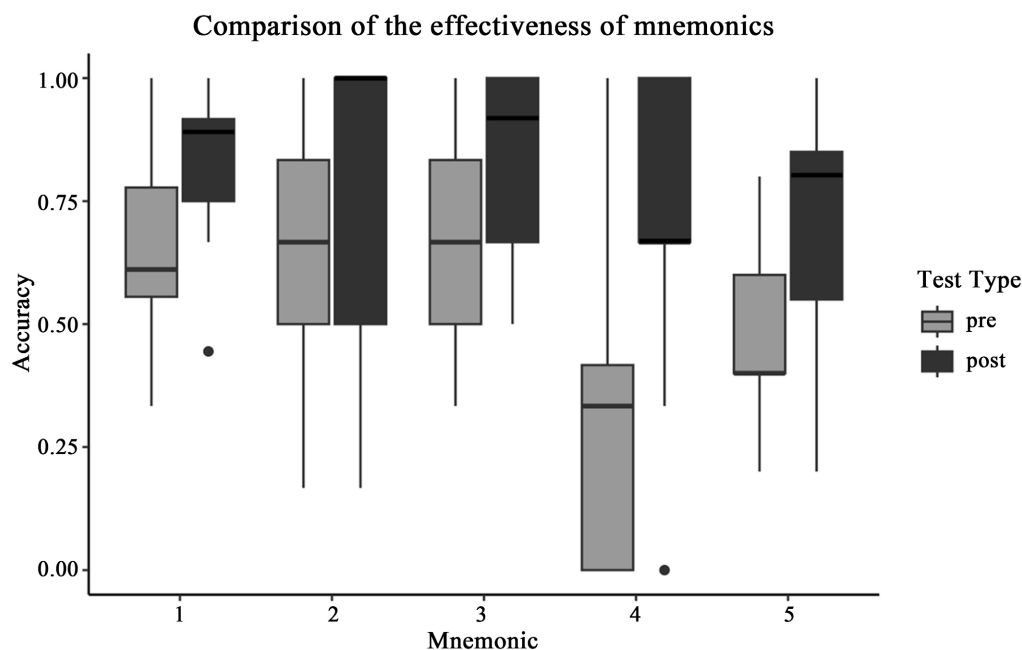


Figure 3. Overall effectiveness of each mnemonic.

Table 3. Descriptive statistics for overall effectiveness of each mnemonic.

| | Number of questions | Number of items | Mean Accuracy rate pre-test | Mean Accuracy rate post-test |
|------------------------------------|---------------------|-----------------|-----------------------------|------------------------------|
| Mnemonic 1 (<i>at, on, in</i>) | 9 | 360 | 0.65 | 0.83 |
| Mnemonic 2 (<i>for, in</i>) | 6 | 240 | 0.65 | 0.77 |
| Mnemonic 3 (<i>since, until</i>) | 6 | 240 | 0.68 | 0.84 |
| Mnemonic 4 (<i>from, to</i>) | 3 | 120 | 0.33 | 0.73 |
| Exceptional cases for Mnemonic 1 | 5 | 200 | 0.47 | 0.69 |

5. Discussion

As noted previously, this pilot study sought any positive indication that mnemonics could be helpful for a general population of beginner/intermediate-level ELLs for learning temporal prepositions. The study's outcomes reveal that mnemonics may indeed improve ELL accuracy rates using temporal prepositions, in conformity with previous studies showing the potential positive impact of mnemonics in language instruction (Alkhonini & Wulf, 2018; Wulf, 2016).

5.1. Experimental Group Performance

Improvement exhibited by the experimental group using mnemonics is consistent with SAT (Anderson, 1976; DeKeyser, 1998; McLaughlin, 1987). The experimental group was given declarative knowledge, and then by successfully employing mnemonics, this knowledge could be proceduralized via extensive practice prior to the post-test. Post-test results indicated the experimental group

successfully proceduralized relevant knowledge with all four mnemonics, yielding improved results. This suggests extensive practice and using mnemonics may potentially enhance ELL overall performance, though without a delayed post-test, we cannot tell for now if the utility of these mnemonics will be retained over a longer time period.

5.2. Baseline Group Performance

The performance of the native-speaker baseline group was interesting. **Table 4** shows the breakdown of their mean accuracy rates for each preposition studied.

Native speakers exhibited only a low level of variation for the temporal location prepositions *on*, *at*, and *in*, as the mean rate was between 94% and 100%. For prepositions of duration of time, they identified *in* more frequently (mean rate = 100%) compared with *for* (mean rate = 98%). Prepositions of measurement of time were somewhat more variable (83% for *from* and *to*, 85% for *until*, and 99% for *since*).

As for exceptional cases, participants had some variation distinguishing between the specific and general use of *night* (95% for the specific situation using *at* and 85% for the general situation using *in*). For *weekend* patterns, participants selected *on* here with a mean rate of 90%. The most interesting results involved the holiday exceptions. Participants almost always used *on* when the question asked about the holiday day with a mean rate of 90%. However, when dealing with the holiday season, most participants did not choose *at*, but rather chose *on* or *for*. Thus, *at* was only selected with a mean rate of 7.5%.

Table 4. Baseline group overall accuracy mean rate for each preposition.

| Preposition | Overall accuracy mean rate | Alternative preposition(s) used |
|---|----------------------------|----------------------------------|
| <i>on</i> (location in time) | 98% | <i>from, until</i> |
| <i>at</i> (location in time) | 100% | <i>n/a</i> |
| <i>in</i> (location in time) | 94% | <i>at, on, for, from, until</i> |
| <i>for</i> (duration of time) | 98% | <i>in, since</i> |
| <i>in</i> (duration of time) | 100% | <i>n/a</i> |
| <i>from-to</i> (measurement of time) | 83% | <i>on, in, for, since, until</i> |
| <i>since</i> (measurement of time) | 99% | <i>until</i> |
| <i>until</i> (measurement of time) | 85% | <i>in, on, for, since</i> |
| Exceptional Cases | | |
| <i>at night</i> (location in time) | 95% | <i>in, until</i> |
| <i>in the night</i> (location in time) | 85% | <i>at, from, since</i> |
| <i>on holiday day</i> (location in time) | 90% | <i>for</i> |
| <i>on the weekend</i> (location in time) | 90% | <i>in, for, until</i> |
| <i>at holiday season</i> (location in time) | 7.5% | <i>on, for</i> |

These mean rates do not indicate native speakers were using prepositions incorrectly. Rather, their choices are based on several factors, to include employing conversational uses of prepositions rather than a formal standard. This variation in native speaker usage should be kept in mind when teaching rules of preposition usage to ELLs.

Another finding in **Table 4** is that native speakers select *for* in many cases where some other preposition is expected. *For* is used with location in time, measurement of time, with *night*, with *weekend*, and with holidays. Observing such tendencies provides us a better understanding of how native speakers use prepositions in context.

6. Conclusion

Providing ELLs with declarative knowledge of the temporal uses of *at*, *on*, *in* (in two senses), *for*, *from*, *to*, *since*, and *until* in a form that permits their proceduralization (mnemonics) could, with practice, result in higher accuracy using these prepositions in communication. Despite ELLs having only a brief exposure to the relevant mnemonics, all four mnemonics, including exceptional patterns, were shown in this study to be helpful. Mnemonics can provide learners with crucial declarative knowledge, packaged to make it memorable and easy to practice, facilitating proceduralization and eventual automatization. This pilot study was undertaken with the aim of seeing if ELLs exhibit evidence of being able to comprehend and apply these mnemonics. In the future, it will be important to undertake more extensive research on temporal preposition use by ELLs by tracking error rates in ELLs' writing samples longitudinally over an extended period of time.

Acknowledgements

We extend our appreciation to Professor Cynthia Lukyanenko for her continuous valuable insights, feedback, and support during the research process. We would also like to express our gratitude to all the participants in this study.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix A. Form A

For each of the following sentences, choose the most appropriate prepositions from the multiple choices.

- 1) There's a party _____ *Friday*. It starts at 7 p.m.
- at - on - in - until
- for - from - since
- 2) They always play tennis _____ *Saturday morning*. They start at 8 a.m.
- at - on - in - until
- for - from - since
- 3) Their wedding will be held _____ *November 14th*.
- at - on - in - until
- for - from - since
- 4) She comes home today _____ *6:00 p.m.*
- at - on - in - until
- for - from - since
- 5) I last saw Mary _____ *lunchtime*.
- at - on - in - until
- for - from - since
- 6) The store closes _____ *midnight*.
- at - on - in - until
- for - from - since
- 7) Sam was born _____ *1995*.
- at - on - in - until
- for - from - since
- 8) Our garden looks wonderful _____ *the spring*. April is a nice month to visit.
- at - on - in - until
- for - from - since
- 9) What do you normally do _____ *the evening after 8 p.m.?*
- at - on - in - until
- for - from - since
- 10) The traffic here is very bad _____ *night* because it gets so dark.
- at - on - in - until
- for - from - since
- 11) Yesterday, I woke up _____ *the night* feeling cold.
- at - on - in - until
- for - from - since
- 12) I will arrive home _____ *Christmas Eve*.
- at - on - in - until
- for - from - since
- 13) I stay with my family _____ *Christmas*. I love the holiday season.
- at - on - in - until
- for - from - since

- 14) I will finish the report _____ the weekend.
 - at - on - in - until
 - for - from - since
- 15) She has been learning to play the piano _____ 6 months.
 - at - on - in - until
 - for - from - since
- 16) Max worked _____ two years to earn a raise.
 - at - on - in - until
 - for - from - since
- 17) Mike usually rides his bicycle _____ two hours.
 - at - on - in - until
 - for - from - since
- 18) She left today, but she will be back _____ a week.
 - at - on - in - until
 - for - from - since
- 19) We need to leave for the airport _____ an hour. Prepare your luggage!
 - at - on - in - until
 - for - from - since
- 20) Summer vacation will begin _____ a week.
 - at - on - in - until
 - for - from - since
- 21) The factory has been here _____ the 1970s.
 - at - on - in - until
 - for - from - since
- 22) He's been acting strange _____ he returned from the party.
 - at - on - in - until
 - for - from - since
- 23) She has been here _____ 5 o'clock.
 - at - on - in - until
 - for - from - since
- 24) I am going to study _____ I get sleepy.
 - at - on - in - until
 - for - from - since
- 25) I'm staying in New York _____ Friday.
 - at - on - in - until
 - for - from - since
- 26) He read a book _____ his father came home.
 - at - on - in - until
 - for - from - since
- 27) He improved _____ when he got his first lesson to when he played in the concert.
 - at - on - in - until
 - for - from - since

28) The babies played in the playground _____ 1:00 p.m. to 3:00 p.m.

- at - on - in - until
- for - from - since

29) John worked at the same company _____ his graduation to his retirement.

- at - on - in - until
- for - from - since

Appendix B. Form B

For each of the following sentences, choose the most appropriate prepositions from the multiple choices.

1) There's a meeting _____ *Monday*. It starts at 10 a.m.

- at - on - in - until
- for - from - since

2) They always play football _____ *Thursday night*. They start at 7 p.m.

- at - on - in - until
- for - from - since

3) The ceremony will be held _____ *April 20th*.

- at - on - in - until
- for - from - since

4) He finishes work today _____ *10:00 p.m.*

- at - on - in - until
- for - from - since

5) I last saw Sam _____ *dinnertime*.

- at - on - in - until
- for - from - since

6) The office opens _____ *noon*.

- at - on - in - until
- for - from - since

7) Mary was born _____ *1998*.

- at - on - in - until
- for - from - since

8) The mountains look wonderful _____ *the winter*. January is a nice month to visit.

- at - on - in - until
- for - from - since

9) What do you normally do _____ *the morning after 6 a.m.?*

- at - on - in - until
- for - from - since

10) The desert is very calm here _____ *night* because it gets so dark.

- at - on - in - until
- for - from - since

11) Yesterday, my telephone rang _____ *the night*.

- at - on - in - until
 - for - from - since

12) I will reach the hotel _____ *Christmas Day*.

- at - on - in - until
 - for - from - since

13) I hang out with my friends _____ Christmas. I love the holiday season.

- at - on - in - until
 - for - from - since

14) She will start her new project _____ the weekend.

- at - on - in - until
 - for - from - since

15) John has been learning to drive _____ 2 weeks.

- at - on - in - until
 - for - from - since

16) John practiced _____ two weeks to win the grand prize.

- at - on - in - until
 - for - from - since

17) Sally often travels in the country _____ three days.

- at - on - in - until
 - for - from - since

18) Jack started the project today, and he will finish it _____ two days.

- at - on - in - until
 - for - from - since

19) Class starts _____ two minutes. Please find your seat!

- at - on - in - until
 - for - from - since

20) The World Cup will start _____ a month.

- at - on - in - until
 - for - from - since

21) I have been sick _____ last Tuesday.

- at - on - in - until
 - for - from - since

22) Tom has been performing _____ he was five years old.

- at - on - in - until
 - for - from - since

23) Jack has been here _____ the early morning.

- at - on - in - until
 - for - from - since

24) I am going to walk in the park _____ I get tired.

- at - on - in - until
 - for - from - since

25) She is working in the city _____ next year.

- at - on - in - until
- for - from - since

26) I baked cookies _____ my friends came over.

- at - on - in - until
- for - from - since

27) She got nervous _____ when she got up to speak to when she started to talk to the crowd.

- at - on - in - until
- for - from - since

28) Obama was the President of the United States _____ 2009 to 2017.

- at - on - in - until
- for - from - since

29) She visited her mother _____ her birthday to Thanksgiving.

- at - on - in - until
- for - from - since