Effect of the Neurolinguistic Approach on EFL Learners’ Implicit and Explicit Grammar Knowledge: The Present Perfect Tense in Focus

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Abstract

The neurolinguistic approach (NLA) is an intensive sentence-based pedagogy designed specifically for low-proficiency learners. It places a premium on orality and the development of both internal and external grammars through a project-based literacy loop. The present study employed a pretest–posttest control group design to investigate the effect of NLA on conveniently sampled pre-intermediate EFL learners’ implicit and explicit knowledge of the English present perfect tense. Treatment for the experimental group (EG; N=25) spanned three 1.5-h project-based sessions, with orality marking the beginning and end of each session and reading, rule induction, and writing as intermediary phases. The control group (CG; N=24), on the other hand, was exposed to tense-rich reading input, followed by rule explanation and follow-up communicative tasks. Implicit knowledge was measured through a timed grammaticality judgment test and an interview, and explicit knowledge was measured through an untimed grammaticality judgment test and a metalinguistic knowledge test. ANOVA results showed CG’s and EG’s comparable significant gains on explicit knowledge measures and only EG’s significant gain on implicit knowledge measures. The findings substantiate NLA’s potential for the development of both internal and external grammars and have implications for grammar instruction.

摘要

神經語言學教學法（NLA）是一種以句子為基礎的集中式教學法，專為低成就學習者設計。它透過一個以專題為基礎的識字循環，重視口語和內部及外部文法發展。本研究採用前後測的對照組設計，來研究NLA對便利抽樣初中級程度EFL學習者，英語現在完成式隱性跟顯性知識的影響。實驗組（EG; N=25）的
Keywords Explicit knowledge · Grammaticality judgment test · Implicit knowledge · Metalinguistic knowledge test · Neurolinguistic approach

Introduction

Language acquisition theory and research have long been under the auspices of cognitivism. The bond has been so strong that even with the social turn of the field in the mid-1990s (Ortega, 2013), the mental essence of second language acquisition (SLA) theories never left the stage. This is evident in burgeoning research on nativism, implicit/explicit L2 knowledge and learning, memory (declarative/procedural), attention, and awareness, as well as on skill acquisition, input processing, and usage-based approaches to explaining SLA (Ellis, 2008; VanPatten & Williams, 2015). Myles’s (Myles, 2010) delineation of the timeline of theoretical SLA also demonstrates the greater weight of the cognitive and neuroscience-grounded theoretical moves as compared with socially implicating ones. This is while the parallel analysis of the trends of language teaching methodology shows a pre- eminent concern with the social. Kim-Rivera’s (Kim-Rivera, 1998) mention of the theory–practice gap shortly after the field’s social turn still holds true. In his diachronic outlook on the post-1995 English language teaching (ELT), Waters (Waters, 2012) pointed to overriding social, rather than cognitive, concerns in the strong version of communicative language teaching (CLT), task-based language teaching, and Dogme ELT. Where cognitivism and neuroscience have informed ELT, the focus has been limited to facilitating such cognitive micro-processes as selective attention (as noticing) and awareness embodied in focus on form (FoF) and its pedagogical associations (e.g., collaborative dialoguing, input enhancement, and input flooding) (see Ellis (Ellis, 2008); VanPatten & Williams (VanPatten & Williams, 2015)). Against this backdrop, there was a conspicuous niche for a coherent L2 instructional approach grounded in the findings of neurolinguistic SLA research. Danesi and Mollica (cited in Mahmoodzadeh (Mahmoodzadeh, 2012)) proposed the bimodality language teaching construct in 1988, which was aimed at aiding the between-hemisphere information flow; however, this never turned into a formal language teaching approach. In fact, the bond between neurolinguistic theory and language teaching practice has not been clearly established (Nergis, 2011). The reason might be neurolinguistics’ apparent dissociation from the social. A more recent alternative neuroscience-based approach to
language teaching, with quite a precise mental-social procedure, is the neurolinguistic approach (NLA) (Netten & Germain, 2012).

NLA is a principled approach to foreign language instruction, resting on the findings of neuroscience in relation to memory, consciousness, and implicit/explicit knowledge dichotomy. It places a premium on oral production and the development of implicit and explicit competencies (internal and external grammars) in a sentence-based componential language pedagogy (Germain, 2013, 2017, 2018). Despite its articulated neuroscience underpinnings, NLA is not theoretically removed from major SLA tides. In line with functionalist SLA, it emphasizes communicative need as the driving force for syntacticization (see Mitchell & Myles (Mitchell & Myles, 2004)); in congruence with sociocultural SLA, it recognizes the vitality of the social to induce the cognitive (see Lantolf (Lantolf, 2000)); and in accord with the declarative/procedural model of SLA, it posits a demarcation between declarative and procedural memory systems (see Ullman (Ullman et al., 2015)). Practically, NLA shares with the strong version of CLT and Dogme ELT its emphasis on the provision of real-life communication opportunities and positive evidence, though it is a limited-focus sentential pedagogy. In addition, its emphasis on the provision of preferably implicit immediate feedback on learners’ productions of the targeted form binds it with FoF instruction. NLA needs to be distinguished from “neurolinguistic programming” (NLP) developed by Grinder and Bandler in the 1970s (cited in Hedayat, Raissi, & Azizzadeh Asl (Hedayat et al., 2020)). Unlike NLA, which is an approach to language teaching, NLP is principally “a humanistic philosophy that includes a set of notions used to inform individuals about their preferred learning styles and convince them that they are powerful and strong enough to take control of their affairs and reach excellence” ((Hedayat et al., 2020), p. 1146).

NLA research has mostly targeted the learning of French as a foreign or second language and proved promising in a variety of contexts (see Germain (Germain, 2018)). This observation could be attributed to (a) the bulk of initial writings on NLA by its developers in French and (b) the more conspicuous alignment of existing intensive French (IF) programs, as compared with intensive English (IE) programs, with neuroscience and NLA’s principles. Regarding the latter point, Germain et al. (Germain et al., 2004) found IF’s comparably greater emphasis on the simultaneous development of accuracy and fluency, and reading and writing. However, the potential of NLA for learning English as a foreign language (EFL) has not been investigated. As such, most of NLA’s claims stand in need of research evidence. The present study was designed to test NLA’s potential promises for the development of implicit and explicit L2 grammar knowledge. It specifically focused on the present perfect tense as a grammar feature requiring special attention for Iranian EFL learners. Accordingly, it posed the question of whether NLA would facilitate the development of implicit and explicit knowledge of the English present perfect tense by adult EFL learners.

**Literature Review**

As an approach to language teaching, NLA was developed by Netten and Germain (Netten & Germain, 2012) for low-proficiency learners based on neuroscientific research evidence (e.g., (Ellis, 2005a; Paradis, 2004; Paradis & Ellis, 1994)). It dismisses the Chomskyan notion of an innate language acquisition device and instead accords language learning success with the activation of the limbic system to induce the desire and motivation to communicate in the target
language (Germain, 2017). On the basis of NLA, this can be achieved not through mere explicit instruction, but through the affordances of a sustained L2 learning context similar to use contexts, replete with real social interaction opportunities in an intensive course of study. As such, it nests projects, made up of successive constituent tasks spanning whole sessions. Theoretically, contextual learning-use similarities can facilitate L2 learning based on Segalowitz’s (Segalowitz, 2010) “transfer appropriate processing” (TAP); moreover, social interaction is valued in NLA for its individual cognitive benefits and facilitation of the input-to-intake transformation. NLA principally borrows from N. Ellis (Ellis, 2005a) and Paradis (Paradis, 2004) its demarcation between declarative and procedural memories as two distinct systems, with the former not transformable into the latter. Accordingly, it goes against skill acquisition SLA theories, which assume the possibility of proceduralization and automatization of metalinguistic information provided explicitly at an earlier phase of instruction (see Ellis (Ellis, 2008)). In this regard, NLA draws a distinction between implicit and explicit L2 knowledge (internal and external grammars), with the former denoting grammar-meaning connections and the latter sound-meaning connections. Drawing on neuroscientific findings from Paradis (Paradis, 2004; Paradis & Ellis, 1994), Ellis (Ellis, 2005a), and Segalowitz (Segalowitz, 2010), as well as the sociocultural theory, Germain (Germain, 2018) enumerated NLA’s five main principles as follows:

1. Internal and external grammars are distinguishable, and contrary to Krashen’s (Krashen, 1985) claims, the former is acquirable in the classroom setting.
2. Orality and a sentential pedagogy should be set as the springboard of L2 learning. As such, the L2 literacy loop should proceed from speaking to reading, and then to writing and follow-up speaking in order for patterns and pathways to take shape in the learners’ minds. Accordingly, it is a material-free approach to L2 learning and dismisses the notion of L2 acquisition orders.
3. Learning should be project-based as project accomplishment guarantees focus on meaning rather than form. Every intensive teaching unit should consist of three to four mini-projects culminating in a final project.
4. Learning ensues from authentic communication as it leads to the activation of the limbic system. This in turn lies behind self-esteem and learning motivation. On the other hand, drills, role plays, simulations, and other inauthentic constituents of focus on form (FoF) instruction are not recommended since they fail to activate the limbic system, and are thus not sufficiently motivating.
5. Social interaction embodied in group work leads to authentic communication and works to the anchoring of frequent neuronal connections. Input is limited, rather than rich and varied; output is necessary; and all errors must be corrected (either immediately or with a delay, implicitly or explicitly depending on the contingencies of the situation) for implicit competence to be in place.

Theoretically, the tenets of NLA-based grammar instruction could be put forth as follows:

1. Internal grammar can be acquired through speaking, and external grammar can be learned through reading and writing.
2. Repeated use is essential for the formation of form regularities processed in pro-
cedural memory.
3. Explicit grammar knowledge (processed by declarative memory) cannot transform
into implicit grammar knowledge.
4. Retention is ensured through periodic returns into already studied themes to facili-
tate the reuse of intended forms in new contexts.

Practically, NLA-based grammar instruction begins with an orality phase, involving eight strategies. The first five strategies are implemented consecutively, and the last three are attended to while implementing each of the first five. These are as follows:

1. Teacher modeling of the form at issue through realia
2. A teacher-student question-and-answer phase involving the use of the form at issue
3. A student–student question-and-answer phase by a few pairs
4. A student–student question-and-answer phase by all the learners
5. A teacher questioning phase, targeting paired interactions’ themes
6. Fluency work involving the elicitation of complete form-housing sentences
7. Accuracy work involving the teacher’s remodeling of erroneous sentences and
re-asking to urge students’ uptake and repair
8. Purposeful listening involving posing questions to students about their classmates’
answers to teacher-posed questions

Then and only then is explicit knowledge of the structure at issue triggered through
reading-based induction and writing. It should be noted that L1 use is limited to the
explanation of NLA’s modus operandi in the introductory session. According to Ger-
main [12, p. 64], reading at the onset of instruction “creates a long detour, because it
makes learners call on declarative rather than procedural memory first.”

One can locate evidence for the effectiveness of different aspects of NLA-based
grammar instruction in mainstream SLA research. Ellis (Ellis, 2005b) conceptu-
alizes grammar instruction as the direct or indirect instructional treatment of spe-
cific grammatical structures for the purpose of inducing metalinguistic understand-
ing and/or comprehension/production processing ability. NLA prioritizes the latter
aim in its appreciation of the primacy of orality and spares space for the former in
its inclusion of project-related reading and writing. Moreover, NLA concurs with
Ellis’s (Ellis, 2002) evidence-based conclusion that, unlike Krashen’s (Krashen,
1985) claims, grammar instruction can lead to both learned (external) and acquired
(internal) grammar knowledge. In line with NLA’s rejection of an acquisition order
for grammar learning, there is research evidence on roughly similar learning pro-
cesses and acquisition orders for instructed and naturalistic learners (Long et al.,
1996). On the other hand, contrary to NLA’s claim, research has shown the failure
of natural classroom interactions to induce high levels of grammatical competence
(Genesee, 1987). Such evidence, however, rests solely on measures of explicit gram-
mar knowledge and sentence-level items (including short-response items) rather
than measures of implicit grammar knowledge (including productive task items)
(see Ellis (Ellis, 2006) and Norris & Ortega (Norris & Ortega, 2000)).
In relation to NLA’s authenticity and naturalness concerns, FoF instruction, with its emphasis on communication-embedded form-meaning connections, has now replaced structural linguistics-based FoFs (Schruz & Coumel, 2020; Waters, 2012; Wong & VanPatten, 2004). In addition, NLA endorses the intensive limited-focus, rather than extensive multistructural, treatment of grammar, which enjoys ample research support (see Ellis (Ellis, 2005b) for a review). There is evidence in favor of intensive instruction of selected grammatical structures since it would provide learners with ample practice opportunities via drills and tasks and induce a thorough understanding of the structure at issue to the point of its correct use in communication (see Ellis (Ellis, 2005b)). Spada and Lightbown (Spada & Lightbown, 1999) pointed to the advantage intensive grammar instruction offers in terms of helping learners progress more smoothly along related acquisitional stages, irrespective of their developmental readiness. This is while extensive/incidental grammar instruction allows for the provision of real-time feedback on learners’ errors in situ (Ellis, 2005b). NLA can be said to offer this advantage, too, owing to its context-contingent and project-based nature. As an intensive sentential approach, NLA-based grammar instruction can be envisioned as mainly featuring planned FoF (see Ellis (Ellis, 2002)), with an intermediary inductive explicit instruction (FoF) phase. Accordingly, it can be investigated in terms of the extent to which it facilitates the development of internalized (implicit) and analyzed/metalinguistic (explicit) knowledge of L2 structures.

The distinction between explicit and implicit knowledge lies in their learnability, verbalizability, processing control, availability for use, and consciousness. While explicit knowledge is conscious, learnable, and verbalizable, implicit knowledge is unconscious and available for rapid access in communication (Ellis, 2002, 2006, 2008). NLA distinguishes between internal and external grammars, and marries implicit and explicit grammar instruction in its practicum. Its developers support their stance in this regard by stating that explicit grammar instruction alone, though facilitating the formulation and monitoring of messages (see Ellis (Ellis, 2005b) for a review), is ineffective owing to its failure to induce implicit grammar knowledge and ignorance of the necessity of inducing grammar learning motivation (Godfroid et al., 2015; Wong & VanPatten, 2004).

A related issue is the transformability of explicit knowledge into implicit knowledge. This has been investigated in a) the non-interface model ((Krashen, 1985; Paradis, 2004)), which posits the distinctiveness of these two knowledge systems and their associated processing venues; (b) the interface model (DeKeyser et al., 1998), which places emphasis on practice as the key to transformability; and (c) the weak interface model (Ellis, 2002), which brings to the forefront learners’ developmental readiness and noticing-the-gap ability as the preconditions of transformability. This last position is endorsed by Ellis ((Ellis, 2005a), p. 305), who describes implicit and explicit cognitions as “dissociable but cooperative.” NLA can be said to endorse the non-interface position, owing to its posited distinctiveness of internal and external grammars. This explains why provision has been made to induce both knowledge systems. The developers of the approach explicitly express their concern with implicit grammar knowledge; however, they explain that “it is necessary to have the learner acquire/learn not
ONE but TWO grammars: an internal grammar (in the form of an implicit competence) and an external grammar (in the form of explicit knowledge)” ((Germain, 2018), p. 18).

There are only few studies on NLA’s effectiveness for language learning, and even these have only targeted the learning of French as a foreign or second language. In one study, NLA was investigated by Mohammadi et al. (Mohammadi et al., 2019) in terms of its effect on Iranian French as a foreign language (FFL) learners’ oral proficiency, though rule induction was not part of the treatment condition. The approach proved to result in a lower rate of L1 transfer and overgeneralization, and a higher rate of while-task self-repair. In a similar vein, Germain et al. (Germain et al., 2015) showed the effectiveness of NLA for the oral proficiency and writing development of Chinese university students/learners of French as a second language in comparison with the traditional Chinese instructional approach. Likewise, Germain (Germain, 2018) points to the successful application of NLA in Japan and Taiwan. Studies, however, have been mainly general-focus, spanning a matter of months.

To test NLA’s claim as to its potential to induce both internal and external grammars, the present study focused on the present perfect tense mainly owing to its inherent cognitive difficulty in terms of internalization (see Ellis (Ellis, 2005b)), frequency in the input and utility to learners, difference with its functionally equivalent Persian tense, and L1 Farsi-speaking learners’ common errors with this tense. The selection of NLA for the instruction of this problematic tense is also because Iranian EFL learners tend to value explicit grammar instruction over its implicit counterpart (see Mohammadi & Yousefi (Mohammadi & Yousefi, 2019)). Moreover, Shakhsi Dastgahian (Shakhsi Dastgahian, 2021) showed Iranian EFL teachers’ “strong beliefs in the importance of accuracy, enhanced by their students’ low English proficiency and parental expectation, continued to guide lessons with an initial explicit grammar teaching” (p. 1). Using two measures of implicit knowledge and two measures of explicit knowledge, this study involved the investigation of NLA’s effect on EFL learners’ implicit and explicit knowledge of the present perfect tense.

Methodology

Participants

In order to meet the study’s purpose, 49 male (N=13) and female (N=36) Iranian pre-intermediate EFL learners, as members of two intact 30-member classes at a private English language institution, participated in the study. They all filled out a participation consent form and were randomly assigned into an experimental group (EG) (N=25) and a control group (CG) (N=24). Owing to the Covid-19 pandemic, they met online on the Skyroom platform three times a week and were taught by the same teacher. Proficiency level check was made through the computerized version of the Oxford Placement Test (to include only pre-intermediate level learners). This measure was taken to ensure the participants did not have a grounded knowledge of the present perfect tense, which was the target of the study.
Instruments

For the purpose of the present study, five instruments were used, which are described in this section.

Oxford Placement Test  In order to include only pre-intermediate proficiency learners in the study, the computerized version of Oxford Placement Test, developed jointly by Oxford University Press and the Syndicate of Cambridge ESOL Examinations, was used. The test comprises 60 receptive-response reading comprehension, vocabulary, and grammar items, and its results can be reported along Association of Language Testers in Europe (ALTE) levels from beginner to very advanced. The test took 40 min to complete online. The two groups’ homogeneity was ensured by including learners scoring within the range of 30–39.

One-to-one Present Perfect–Focused Interview  As one of the two measures of the participants’ implicit grammar knowledge, pretest and posttest semi-structured interviews were conducted by one of the researchers to elicit instances of the present perfect tense in their three variants (life experiences (e.g., I have never been to the US), completed actions (I have not had lunch, yet), and sign-inducing actions (e.g., My eyes are red because I have cried)) in the course of talk-in-interaction, without the learners being aware of the interview focus. The interview guide comprised probes on learners’ educational and other life experiences, picture description, and arrangements for an important upcoming plan or a resolution. Several follow-up probes were posed in a way to elicit the tense, but also not to give away the limited focus of the interview. Each interview was carried out online through WhatsApp’s “video call” option to the extent that at least ten instances of the tense would have to be used in connected speech (rather than as sentence-level production), including all its three uses. All the interviews were screen-recorded and further analyzed for the correct and appropriate use of the tense. Scores ranged from 0 to 10, and the interviews took between 18 and 32 min. Regarding validity, the interview guide was subjected to expert review by two applied linguistics professors for gauging the adequacy of the probes and setting the conditions of acceptance of instances of use as an indication of implicit knowledge. Based on expert review results, instances of use were not taken as an indication of implicit knowledge of the tense in cases where they were (a) preceded or mediated by pauses indicating the participant’s reflection over the formal and semantic appropriateness of the verb before producing it and/or (b) marked by shifts from one tense to another before producing the final form. The probes were further piloted with three pre-intermediate learners at the same institution where the study was implemented to make sure they were appropriate for the elicitation of the tense at issue. As for reliability, all interviews were scored by both researchers, and a Cronbach’s alpha coefficient of 0.87 indicated high inter-rater reliability.

Timed and Untimed Grammaticality Judgment Tests  Four parallel 20-item GJTs, two with time pressure and two without, were given as pretest and posttest measures of implicit and explicit present perfect knowledge, respectively. An initial pool of 125 sentences was extracted from various grammar books, among which 80 were
selected (based on such considerations as length and level suitability). They were first piloted with three pre-intermediate EFL learners and two teachers of the level for level appropriateness, and subsequently on 25 learners. Similar means in a one-way ANOVA indicated parallelness ($F = 0.54$, $p > 0.05$). Each test consisted of 15 sentences containing the present perfect tense (five grammatically correct and ten grammatically incorrect), five on each of the tense’s three uses, and five (simple present and simple past) distractor sentences, which were not considered while scoring the tests. The rationale for including the distractor items was to avoid giving away the focus of the interview, which would otherwise pose a threat to its validity as a measure of implicit knowledge. Both timed grammaticality judgment test (TGJT) and untimed grammaticality judgment test (UGJT) were given online. The only difference between them was their time condition. UGJT involved the presentation of all the 20 sentences in one slide, and test takers could determine their un/grammaticality at their leisure (1 min for each sentence, totaling 20 min). On the other hand, TGJT presented each sentence in a separate slide for 5 s, and once passed, no regression was possible. All the four tests were scored from 0 to 15, assigning one mark to each correct answer. The reliability of pretest TGJT, pretest UGJT, posttest TGJT, and posttest TGJT were ensured in four acceptable KR-21 indices (0.81, 0.89, 0.73, 0.85, respectively). There is comparably more evidence for the validity of TGJTs and UGJTs as measures of implicit and explicit knowledge than against it (see Ellis (Ellis, 2008; Ellis et al., 2009)). More specifically, time pressure has been generally shown to mediate rule or form retrieval from one’s declarative or procedural memory systems, i.e., through controlled or automatic processing; there is both psychometric and psycholinguistic evidence on the distinctiveness of constructs underlying TGJTs and UGJTs. In Ellis’s study (Ellis, 2005b), timed and untimed items loaded on two different factors along with a number of other measures known to measure implicit and explicit grammar knowledge. From a psycholinguistic perspective, Godfroid et al. (Godfroid et al., 2015) found time pressure in TGJTs to suppress eye regressions in non-native speakers, but lack of time pressure in UGJTs to involve more eye regressions by both native and non-native speakers. This was taken to imply they measured implicit and explicit knowledge of grammar, respectively. There is also some counterevidence, though rare, to this effect. The study of Vafaee et al. (Vafaee et al., 2017) casts doubts on the validity of GJTs for measuring implicit knowledge. Along the same lines, Gutiérrez (Gutiérrez, 2013) showed ungrammaticality, rather than lack of time pressure, could evoke explicit knowledge. Given this, the researchers in this study triangulated the results with those of the interview and the metalinguistic knowledge test to obtain aggregate measures of the two knowledge systems.

**Metalinguistic Knowledge Test** As the second measure of explicit knowledge, a 20-item metalinguistic knowledge test (MKT), comprising (present simple and past simple) grammatical ($N = 3$) and ungrammatical ($N = 2$) distractor sentences, grammatical present perfect sentences ($N = 5$), and ungrammatical present perfect sentences ($N = 10$). Metalanguage has been shown to be an indicator of controlled and analyzed, i.e., explicit, knowledge (see Ellis (Ellis, 2005b); Gutiérrez (Gutiérrez, 2013)). The participants had to indicate un/grammaticality, and write down their
reason for those they marked as “incorrect.” It should be noted that ungrammaticality was related mainly to the function, rather than form, of the tense (e.g., *I never travelled abroad in my life*). The test was scored from 0 to 10, and only ungrammatical sentences were included in scoring. This decision was made with reference to Gutiérrez (Gutiérrez, 2013), who found ungrammaticality to invoke explicit knowledge. KR-21 values of 0.80 and 0.81 showed the reliability of the pretest MKT and posttest MKT, respectively.

**Procedure**

Upon the convenience sampling of two 30-member intact online classes and their online consent form completion, the computerized version of the Oxford Placement Test was administered to include only pre-intermediate proficiency learners. Subsequent to their random assignment into EG and CG ($N_{EG} = 25; N_{CG} = 24$), the participants were given the four pretests (i.e., TGJT, UGJT, MKT, and interview). EG was instructed through NLA, and CG through the institution’s regular syllabus for three weekly 1.5-h sessions. Treatment to EG involved three projects designed around the three uses of the present perfect tense: life experiences (deciding about where and how of virtual camping based on the student’s experiences), unfinished actions (arranging a party), and actions inducing present signs or results (looking at a chef’s dish, and talking about what s/he has done, in order to regenerate it in the class).

EG was provided with a description of the aims and modus operandi of NLA in Farsi in the first session. Each EG treatment session began and ended with spoken language. It began with the teacher’s elaboration on the project, followed by a couple of oral model sentences related to the theme of the project (e.g., *I have never been to the USA; I have prepared some items for the birthday party as you can see; I guess the chef has added a lot of tomato sauce as the dish is extra red*). This involved no questioning and no board writing, but the use of such realia as maps, party items, and pictures. This was followed by the teacher asking a few students questions to elicit theme-related present perfect–containing complete sentences, providing words were needed. Subsequently, a similar question-and-answer phase was carried by three pairs in front of the class. This was then repeated simultaneously for all the students, followed by teacher questioning. Pairs were reassigned, and the last two phases were repeated. Fluency was emphasized by requiring full sentences; accuracy was emphasized by the immediate remodeling of erroneous utterances and asking questions again; and purposeful listening was emphasized by the teacher asking what other learners had said. This was followed by a final activity requiring the use of the structure in a new related situation. Errors were immediately (or following interactions) explicitly or implicitly corrected (mainly involving recasting and meaningful questions for further production). Subsequently, learners were presented with an authentic similar-theme short reading text replete with instances of the uses of the tense for the function at issue. It was only here that they observed the tense as a grammatical phenomenon. At this stage, the function-based explanation of the specific use of the tense was induced and written down by learners making reference to the examples in the text. Finally, learners were required to write a similar text for
a similar project followed by teacher-students’ jointly constructed model paragraph put down on the board (supposed to automate application, rather than knowledge, of the rule), read each other’s texts, and retell what they had read to the class while the teacher provided them with feedback. Accordingly, there was a 30-min speaking phase, followed by a 1-h reading and writing phase, wherein the present perfect tense was intensively treated. CG, on the other hand, was presented with a reading text replete with present perfect tense instances related to its three functions. They were then exposed to the teacher’s story-based modeling of the form and questioning about its construction, where learners were required to induce the rule. The teacher proceeded to rule explanation using the board (which based on NLA creates explicit knowledge prematurely and activates different neural networks than those related to the auditory system). No L1 was used. Students were then presented with two communicative tasks for each function. Treatment to CG was offered intensively in order to ensure the comparability of both EG and CG conditions in terms of their being intensive.

Data Analysis Results

In order to find out if NLA differed from the control condition in terms of its effect on the participants’ implicit and explicit knowledge of the present perfect tense, the participants’ scores on six pretest/posttest measures were obtained: (a) TGJT, (b) interview, (c) aggregate implicit measures (AIKMs) (defined as the combined score on TGJT and interview, based on equal weights), (d) UGJT, (e) MKT, and (f) aggregate explicit knowledge measures (AEKMs) (defined as the combined score on UGJT and MKT, based on equal weights). Table 1 shows the descriptive statistics for each of the six pretest score sets and six posttest score sets for each group separately. Ratios of skewness and kurtosis to their associated standard error estimates within the range of ± 1.96 indicated univariate normality of all the 24 distributions. An inspection of mean scores showed the ignorable rise of CG’s implicit mean score, while the rise of EG’s implicit and explicit mean scores as well as that of CG’s explicit mean score was clearly visible.

Two one-way ANOVAs (one on pretest scores and one on posttest and explicit gain scores) were conducted. MANOVA would provide a stronger effect estimate. An inspection of the bivariate correlation matrix showed several instances of very low or very high bivariate correlations even after mixing highly correlated variables into single variables; this is while MANOVA works best with moderate correlations (Field, 2009); multicollinearity was also expected given the tests’ similarity and relatedness of the two knowledge constructs. Prior to running the test, ANOVA’s assumptions were checked. Having checked univariate normality, tests of homogeneity of variances were in order. Levene’s statistic for 47 degrees of freedom was insignifiant for all the pretest score sets. Insignificant $F$ statistics for all the six pretest datasets showed the two groups’ pre-treatment homogeneity in terms of implicit and explicit knowledge of the present perfect tense ($F_{\text{TGJT}}(1) = 1.52, p > 0.05$; $F_{\text{Interview}}(1, 47) = 0.08, p > 0.05$; $F_{\text{AIKMs}}(1, 47) = 0.56, p > 0.05$; $F_{\text{UGJT}}(1, 47) = 2.82, p > 0.10$; $F_{\text{MKT}}(1, 47) = 3.45, p > 0.05$; $F_{\text{AEKMs}}(1, 47) = 0.07, p > 0.05$) (see Table 2).
A second one-way ANOVA was conducted on (a) posttest TGJT, (b) posttest interview, (c) posttest AIKMs, (d) posttest UGJT, (e) posttest MKT, (f) posttest AEKMs, (g) TGJT gain scores, (h) interview gain scores, (i) AIKMs gain scores,

### Table 1  Descriptive statistics of experimental and control groups’ pretest and posttest scores

| Group          | Test  | Min | Max | Mean  | SD   | Skewness | Kurtosis |
|----------------|-------|-----|-----|-------|------|----------|----------|
|                |       |     |     |       |      | Statistic| SE       |
|                |       |     |     |       |      | Statistic| SE       |
| Experimental   | Pretest| 3  | 8  | 4.80  | 1.58 | 0.63     | 0.46     | −0.58   | 0.90   |
| Group          | TGJT  | 1  | 4  | 2.24  | 0.92 | 0.16     | 0.46     | −0.78   | 0.90   |
|                | AIKMs | 3  | 7  | 7.33  | 5.44 | 1.07     | −0.38    | 0.46    | −0.14   | 0.90   |
|                | UGJT  | 3  | 7  | 4.92  | 1.49 | 0.14     | 0.46     | −1.29   | 0.90   |
|                | MKT   | 3  | 7  | 4.68  | 1.14 | 0.51     | 0.46     | −0.41   | 0.90   |
|                | AEKMs | 6  | 14 | 9.60  | 2.39 | 0.47     | 0.46     | −0.69   | 0.90   |
|                |       | 6  | 13 | 10   | 1.77 | −0.09    | 0.46     | −0.44   | 0.90   |
|                |       | 3  | 8  | 5.76  | 1.09 | −0.31    | 0.46     | 0.64    | 0.90   |
|                |       | 9  | 16 | 12.42 | 1.82 | 0.14     | 0.46     | 0.04    | 0.90   |
|                |       | 5  | 13 | 9.68  | 1.93 | −0.18    | 0.46     | −0.08   | 0.90   |
|                |       | 7  | 13 | 10.24 | 1.39 | −0.16    | 0.46     | 0.07    | 0.90   |
|                |       | 15 | 25 | 19.92 | 2.76 | −0.02    | 0.46     | −0.81   | 0.90   |
|                | Posttest | 6  | 8  | 5.33  | 1.43 | −0.06    | 0.47     | −0.87   | 0.91   |
|                |       | 3  | 8  | 5.76  | 1.06 | 0.52     | 0.47     | −0.02   | 0.91   |
|                |       | 3  | 8  | 5.52  | 1.53 | 0.01     | 0.47     | −0.01   | 0.91   |
|                |       | 3  | 8  | 5.58  | 1.24 | −0.13    | 0.47     | −0.53   | 0.91   |
|                |       | 2  | 7  | 5.29  | 1.16 | −0.81    | 0.47     | 1.43    | 0.91   |
|                |       | 5  | 15 | 10.87 | 2.13 | −0.49    | 0.47     | 1.49    | 0.91   |
| Control group  | Pretest| 3  | 8  | 5.33  | 1.43 | −0.06    | 0.47     | −0.87   | 0.91   |
|                |       | 3  | 4  | 2.16  | 0.86 | 0.52     | 0.47     | −0.02   | 0.91   |
|                |       | 3  | 8  | 5.72  | 1.53 | 0.01     | 0.47     | −0.01   | 0.91   |
|                |       | 3  | 8  | 5.58  | 1.24 | −0.13    | 0.47     | −0.53   | 0.91   |
|                |       | 2  | 7  | 5.29  | 1.16 | −0.81    | 0.47     | 1.43    | 0.91   |
|                |       | 5  | 15 | 10.87 | 2.13 | −0.49    | 0.47     | 1.49    | 0.91   |
|                | Posttest | 3  | 8  | 5.45  | 1.38 | 0.04     | 0.47     | −0.46   | 0.91   |
|                |       | 0  | 4  | 2.45  | 0.97 | −0.48    | 0.47     | 0.51    | 0.91   |
|                |       | 4  | 8  | 6.09  | 1.13 | 0.03     | 0.47     | −0.56   | 0.91   |
|                |       | 5  | 13 | 9.66  | 1.85 | −0.75    | 0.47     | 0.89    | 0.91   |
|                |       | 7  | 12 | 10.45 | 1.38 | −0.71    | 0.47     | 0.173   | 0.91   |
|                |       | 16 | 24 | 20.12 | 2.29 | −0.64    | 0.47     | −0.58   | 0.91   |

### Table 2  Levene’s test and between-groups ANOVA results for pretest scores

| Pretest   | Levene’s test                  | Between-groups ANOVA results |
|-----------|--------------------------------|------------------------------|
|           | Statistic | Sig | Sum of squares | df | Mean square | F | Sig |
| Implicit  | TGT       | 0.26 | 0.60 | 3.48 | 1 | 3.48 | 1.52 | 0.22 |
|           | Interview | 0.59 | 0.44 | 0.06 | 1 | 0.06 | 0.08 | 0.77 |
|           | AIKMs     | 1.62 | 0.20 | 0.97 | 1 | 0.97 | 0.56 | 0.45 |
| Explicit  | UGJT      | 0.7  | 0.40 | 5.38 | 1 | 5.38 | 2.82 | 0.10 |
|           | MKT       | 0.06 | 0.80 | 4.58 | 1 | 4.5  | 3.45 | 0.06 |
|           | AEKMs     | 0.80 | 0.37 | 0.51 | 1 | 0.515| 0.07 | 0.77 |
(j) UGJT gain scores, (k) MKT gain scores, and (l) AEKMs gain scores. Table 3 shows the Levene’s test results for variance homogeneity and between-groups comparison results. Levene’s statistic was insignificant for most posttest and gain score sets except in three cases (i.e., posttest AIKMs, gain AIKMs, gain UGJT, and gain AEKMs). Accordingly, Welch’s test, which adjusts degrees of freedom in cases of lack of variance homogeneity, was used to test the significance of between-groups differences. As shown in Table 3, Welch’s statistic (featuring in the asymptotic F distribution) was significant for all three implicit measures with larger than medium effect sizes (see Sullivan & Fein, 2012) ($F_{TGJT}(1, 45.07) = 99.98, p < 0.05$, Cohen’s $d = 0.67$; $F_{Interview}(1, 46.78) = 124.75, p < 0.05$, Cohen’s $d = 0.72$; $F_{AIKMs}(1, 40.35) = 215.25, p < 0.05$, Cohen’s $d = 0.81$) as well as for gain scores on them ($F_{TGJT}(1, 45.79) = 142.87, p < 0.05$, Cohen’s $d = 0.75$; $F_{Interview}(1, 42.04) = 96.43, p < 0.05$, Cohen’s $d = 0.66$; $F_{AIKMs}(1, 36.14) = 245.34, p < 0.05$, Cohen’s $d = 0.83$).

On the other hand, no significant difference was observed for the three explicit measures ($F_{UGJT}(1, 47) = 0.001, p > 0.05$; $F_{MKT}(1, 46.94) = 0.30, p > 0.05$; $F_{AEKMs}(1, 46.01) = 0.08, p > 0.05$) and for gain scores on them ($F_{UGJT}(1, 34.81) = 1.32, p > 0.05$; $F_{MKT}(1, 45.26) = 1.06, p > 0.05$; $F_{AEKMs}(1, 36.47) = 2.04, p > 0.05$). It should be noted that cases of variance homogeneity were also checked in the F distribution for 47 degrees of freedom, and similar results in terms of the significance of mean differences as those produced in Welch were obtained. Accordingly, EG made significant gains over CG in all posttest implicit measures; however, there was no significant difference between EG and CG in terms of their posttest and gain explicit knowledge scores.

In order to map each group’s pretest–posttest differences for each of the implicit and explicit measures, separate paired samples $t$ tests were run. To adjust for multiple comparisons, the significance level was set at 0.01. As shown in Table 4, EG made significant gains in all the implicit and explicit measures with very large

### Table 3: Levene’s test and between-groups ANOVA (Welch) results for posttest and gain scores

| Test       | Levene’s test | Between-groups Welch results |
|------------|---------------|-----------------------------|
|            | Statistic     | Sig | Statistic | $Df_1$ | $Df_2$ | Sig  |
| Posttest   |               |     |           |       |       |
| TGJT       | 1.51          | 0.22 | 99.98 | 1 | 45.07 | 0.00* |
| Interview  | 0.10          | 0.74 | 124.75 | 1 | 46.78 | 0.00* |
| AIKMs      | 4.57          | 0.03* | 215.25 | 1 | 40.35 | 0.00* |
| UGJT       | 0.27          | 0.60 | 0.001 | 1 | 47.00 | 0.98  |
| MKT        | 0.26          | 0.87 | 0.30 | 1 | 46.94 | 0.58  |
| AEKMs      | 1.40          | 0.24 | 0.08 | 1 | 46.01 | 0.77  |
| Gain scores|               |     |           |       |       |
| TGJT       | 0.00          | 0.95 | 142.87 | 1 | 45.79 | 0.00* |
| Interview  | 2.35          | 0.13 | 96.43 | 1 | 42.04 | 0.00* |
| AIKMs      | 5.2           | 0.02* | 245.34 | 1 | 36.14 | 0.00* |
| UGJT       | 4.38          | 0.04* | 1.32 | 1 | 34.81 | 0.25  |
| MKT        | 0.11          | 0.73 | 1.06 | 1 | 45.26 | 0.30  |
| AEKMs      | 4.58          | 0.03* | 2.04 | 1 | 36.47 | 0.16  |

*Significant at 0.05 level
effect sizes ($T_{\text{TGJT}}(24) = -15.92, p < 0.01, \text{Cohen's } d = 3.19$; $T_{\text{Interview}}(24) = -12.96, p < 0.01, \text{Cohen's } d = 3.75$; $T_{\text{TGJT}}(24) = -17.46, p < 0.01, \text{Cohen's } d = 4.55$; $T_{\text{UGJT}}(24) = -17.46, p < 0.01, \text{Cohen's } d = 3.77$; $T_{\text{MKT}}(24) = -22.64, p < 0.01, \text{Cohen's } d = 4.55$; $T_{\text{AEKMs}}(24) = -28.01, p < 0.01, \text{Cohen's } d = 5.60$), while CG's gain was significant for only explicit measures ($T_{\text{TGJT}}(23) = -0.46, p > 0.01$; $T_{\text{Interview}}(23) = -1.57, p > 0.01$; $T_{\text{AIKMs}}(23) = -1.91, p > 0.01$; $T_{\text{UGJT}}(23) = -7.83, p < 0.01, \text{Cohen's } d = 4.55$; $T_{\text{MKT}}(23) = -17.64, p < 0.01, \text{Cohen's } d = 4.55$; $T_{\text{AEKMs}}(23) = -14.19, p < 0.01, \text{Cohen's } d = 4.55$).

To sum up, EG made significant gains on both implicit and explicit measures, but CG's gain was significant only for explicit measures; moreover, EG's posttest and gain scores on implicit measures were significantly greater than CG's, while no between-groups significant differences were detected in terms of explicit knowledge scores.

**Discussion**

The present study was designed to investigate the effect of NLA on EFL learners' development of implicit and explicit knowledge of the present perfect tense. The results showed that while both EG and CG made comparable significant gains in their explicit knowledge, only EG made significant gains on measures of implicit knowledge. That CG failed to gain implicit knowledge, but NLA induced both knowledge systems alludes to the distinctiveness of implicit and explicit knowledge systems, sparing NLA’s subscription to the non-interface position. This finds neuroscientific support in Paradis (Paradis & Ellis, 1994), who discussed the distinctness and non-transformability of declarative and procedural memories, while also appreciating their partial interaction with each other. Likewise, pointing to the two memory systems as distinct, Ullman (Ullman et al., 2015) referred to the significance of learning context (more specifically, the presence or absence of explicit instruction) and rule/pattern
complexity, among others, for reliance on either. The present perfect tense seems to present Persian-speaking EFL learners with one of the most complex multifunctional tenses. Accordingly, it will seemingly be learned best through shifting learning to the procedural memory. This standpoint goes against the declarative-to-procedural memory transformability claim underlying skill acquisition theories of second language learning (see Ellis (Ellis, 2008)). Language teaching approaches and methods rooted in skill acquisition theories (e.g., audiolingualism and even the weak version of CLT as the control condition in this study) share with NLA their subscription to neuroeducation and more specifically the neurodidactics of language (a term coined by Huc and Smith (cited in Germain (Germain, 2018), p. 28)); however, they diverge from NLA in their initial reliance on declarative memory, which is, from a neuroscientific perspective, demotivating owing to its failure to trigger the limbic system.

To support procedural memory–housed learning, Thierry and Rebuschat ((Thierry & Rebuschat, 2020), p. 5) cogently maintained that a great deal of language learning “happens outside conscious awareness, that is, without the learner relying on explicit processes involving declarative memory or metacognitive awareness.” As for this study, (a) the memory alternation intended in NLA (i.e., from procedural memory in the initial oral phase to declarative memory in the intermediary reading and writing phase, and back again to procedural memory in the final oral phase), (b) the sustained project accomplishment goal, (c) continued social interaction with its embedded dialoguing opportunities, and (d) the intensity of instruction seem to have collectively led to limbic system stimulation even in the treatment of the grammatical point as a grammatical phenomenon.

Regarding the role of input, unlike emergentist SLA theories and Krashen’s (Krashen, 1985) “comprehensible input hypothesis,” NLA’s claims to effectiveness do not rest as much on input type or frequency as on output and social interaction for strengthening emerging neural connections in relation to form-function-context mappings. In other words, NLA places a premium on pattern-based learning in procedural memory and further complements such learning with declarative memory–housed rule processing. This might have led to EG’s development of both implicit and explicit knowledge of the tense under investigation.

CG’s explicit knowledge gain with a large effect size can be attributed to the fact that the condition involved the first formal treatment of the tense; however, since instruction began with reading and involved rule explanation, learners began to view the tense as a grammatical, rather than communicative, phenomenon and processed it in declarative memory. Accordingly, this primary processing venue might have persisted even while they were engaged in communicative tasks following rule presentation.

The findings are congruent with those of Mohammadi et al. (Mohammadi et al., 2019), who substantiated NLA’s potential for the development of French oral proficiency in the Iranian FFL context; however, their 120-h treatment did not involve rule induction and memory alternation, and only brought orality to the forefront. Moreover, a clear account of the procedure is missing in the article. The reliance of NLA on the language of communication and contextualized teaching of various language skills and components corroborates grammar instruction research with its emphasis on meaningful learning experiences and communicative work (e.g., (Underwood, 2017; Wong & VanPatten, 2004)).
Conclusion and Implications

Grammar instruction approaches have been specified in the literature in terms of the availability and type of input and of output opportunities (see Ellis (Ellis, 2006)), as well as their being implicit or explicit; however, facilitating both implicit and explicit grammar knowledge in one coherent grammar instruction approach with social underpinnings has not been adequately researched. NLA, as an interactive approach, seems to have the potential to induce both implicit and explicit grammar knowledge. This approach goes against the mere provision of FoFs and explicit grammar instruction as this would preoccupy learners’ attention with one of the grammatical properties (morphosyntax, lexicon, phonology) at the cost of ignoring others. Instead, it rests on the assumption that both implicit and explicit grammar knowledge should result from instruction through a seriation of modality-specific instructional techniques (orality-reading-writing-orality) for procedural-declarative-procedural memory alternations, and preferably implicit immediate feedback. Theoretically, the study shows NLA can serve as a sound neuroscientifically founded approach to grammar instruction. The advantage of NLA lies in its marrying internal and external grammars in one approach, while placing a premium on orality and communicative language use; the distinctness of the two memory systems (as shown in CG’s failure to develop implicit knowledge) is also supported by the findings.

Practically, the findings illuminate the ineffectiveness of FoFs (as implemented with the CG) for inducing implicit grammar knowledge. This is while teachers, learners, and other stakeholders in Iran are obsessed with explicit grammar instruction (Shakhsi Dastgahian, 2021). In this regard, NLA can be said to have the potential to satisfy stakeholders’ preference for explicit grammar instruction through its intermediary rule induction phase. Additionally, by virtue of its being intensive, NLA can be thought of as effective for teaching grammar features, which learners find specifically difficult to master even after long study periods. Development of both implicit and explicit knowledge of the form would be facilitated through this approach, given its concurrent treatment of the four skills with an eye to both accuracy and fluency. Finally, language teacher education programs could also be designed to raise student-teachers’ awareness of NLA’s principles and its operationalization procedure in the classroom. The resultant awareness could not only sensitize would-be teachers to the distinctiveness of the two memory systems, but also to the significance of attending to both in a unified approach as NLA. This is a much-needed awareness in a context where most teacher education programs tend to overemphasize the social at the cost of the cognitive.

NLA was primarily designed for later-grade beginners. Accordingly, whether it can serve high proficiency learners should be investigated in further research. Additionally, one can claim that founding instruction solely on neuroscientific findings can be on a par with recourse to the methods era. NLA’s emphasis on sentence-level production for fluency (as the 6th strategy), L1 use ban, and the mandatory immediate or delayed corrective feedback renders it method-like, despite its proponents’ claims as to the primacy of “the language of communication” (Germain, 2018).
Empirically, there are only a few studies which have implemented NLA in the language classroom. In addition, research has essentially addressed NLA’s effectiveness for the learning of French as a foreign or second language (e.g., (Mohammadi et al., 2019)). It remains to be seen if this new language teaching paradigm can also facilitate the learning of other languages, including English as a foreign or second language. Last but not least, it should be admitted that “test wisdom” (i.e., the carryover from the pretests to the posttests) was an indispensable threat to this study’s validity. Studies with different implicit and explicit knowledge measures would work to provide additional evidence (or counterevidence) for this study’s findings.

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Data Availability  The data and instructional materials will be available upon request.

Code Availability  Not applicable.

Declarations

Competing Interests  The authors declare no competing interests.

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