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Impact of the Neurolinguistic Approach on English Language Learners' Implicit and Explicit Knowledge of English Articles

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Abstract

The neurolinguistic approach (NLA) nests the claim that both internal and external grammars (i.e., implicit and explicit grammar knowledge) develop through an intensive orality-based pedagogy. The present study put this claim to the test by focusing on Iranian English language learners' development of implicit and explicit knowledge of definite and indefinite English articles (EAs). Forty-three Iranian English language learners constituting two intact lower-intermediate classes were randomly assigned to a control group (CG; N = 20) and an experimental group (EG; N = 23). EG underwent four 1.5-hr project-based sessions of NLA-based instruction on definite and indefinite EAs. Each session began and ended with authentic oral practice of the structure under study. There was (a) a paragraph reading phase followed by rule induction and (b) a writing phase in between the two oral practice phases. CG was presented with reading texts (amply instantiating EAs), rule explanation, and communicative tasks. A timed grammaticality judgment test and an EA-focused oral proficiency interview were employed to estimate the participants' implicit knowledge, and an untimed grammaticality judgment test and a metalinguistic knowledge test were deployed to measure their explicit knowledge. ANOVA results showed (a) EG's development of implicit and explicit knowledge of EAs, but CG's development of only explicit knowledge of EAs, and (b) EG's significantly greater gain in both knowledge types. The findings reveal NLA's potential for the development of both types of knowledge concerning definite and indefinite EAs, and have implications for the intensive instruction of knotty structures for low proficiency L2 learners.

*Keywords***:** English articles; explicit knowledge; external grammar; implicit knowledge; internal grammar; neurolinguistic approach (NLA)

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INTRODUCTION

Cognitivism and neuroscience occupy a special position in the timeline of second language acquisition (SLA) theories. This is evident in such language acquisition theories as innatism, emergentism, connectionism, skill acquisition, and the declarative/procedural model (see Myles, 2010); however, cognitive theory has not as much implicated practically in language teaching as has social theory (see Ellis, 2008). In this context, effective instruction has been conceptualized as primarily social, with the cognitive having only a subsidiary function insofar as cognitive microprocesses are concerned. Against this background, it begs the question whether an approach based solely on neuroscience and cognitivism can induce the social, which has been hailed over the last two decades in such concepts as communicative competence and intercultural communicative competence, purportedly the ultimate aims of language learning (see VanPatten & Williams, 2015). About a decade ago, Nergis (2011) made the observation that language teaching methods and approaches had failed to embody neurolinguistics. Proof for this statement is (a) the paucity of neuroscientifically-founded approaches to language teaching, and (b) failure of the few existing attempts at initiating neuroscience-based language teaching practices to turn into full-fledged approaches (e.g., Danesi & Mollica's (1988) bimodality language teaching construct; cited in Mahmoodzadeh, 2012). To date, the only existing approach to language teaching characterized by a clear neurolinguistic modus operandi is NLA (Netten & Germain, 2012).

As a componential approach to language teaching for low proficiency learners, NLA adopts a thematic (project-based) orality-reading-writing-orality chain in its treatment of specific features of the L2. NLA proponents claim that this sequence, together with preferably implicit feedback, rule induction and repeated use of targeted features in various contexts, can induce both internal and external grammars. It borrows its theoretical justification from Paradis' (1994, 2004) propositions that internal and external grammars (i.e., implicit/explicit knowledge) are distinct, and that explicit knowledge does not transform into implicit knowledge. Accordingly, instruction should

begin in procedural memory for implicit knowledge to be in place. On the basis of this claim, rule explanation at the outset of instruction would lead learners to view the feature in focus as a grammatical phenomenon, which in turn obviates the development of implicit knowledge. The rationale for this comes from the inconclusive findings of research into approaches that inhere the binary implicit/explicit grammar knowledge distinction (e.g., focus on form (FoF) and focus on forms (FoFs) (see Norris & Ortega, 2006). Such research has mainly looked into each separately, and failed to pair them successively in one single treatment condition like NLA. Moreover, what binds NLA with major SLA trends is its recognition of the significance of social interaction, particularly for implementing the orality phases of instruction. Accordingly, NLA seems to be suited to the instruction of those L2 grammatical features that learners find particularly difficult to master, including those affected by parallel L1 structures (see Authors, 2023).

To date, there is only minimal empirical evidence for NLA's effectiveness in view of its claims (e.g., Authors, 2023), and studies have mainly addressed French as a second language (FSL) in intensive programs (e.g., Germain, 2013). The predominance of French as NLA research's targeted language could be attributed to the fact that the majority of publications on this approach exist in French, and FSL programs has been shown to be more aligned with neuroscience than their English counterparts (Germain, Lightbown, Netten, & Spada, 2004). Only recently did Authors (2023) show the potential of NLA for the development of implicit and explicit knowledge of the present perfect tense by Iranian EFL learners. To recapitulate, research into the potential of NLA for the development of implicit and explicit knowledge of the English language, particularly knowledge of its challenging grammatical structures, is rare. To extend this line of research, the present study targeted implicit and explicit knowledge of definite and indefinite EAs as a feature prone to interference from Farsi as the learners' L1 (Hassanzadeh & Shahbazi, 2021; Momenzade & Youhannaee, 2015), and therefore in need of special treatment. Such an exploration can have both theoretical and pedagogical implications. Theoretically, NLA marries FoF and FoFs in its

alternation of implicit and explicit instruction, and embeds social interaction opportunities as well. Therefore, it can be viewed as a socio-cognitive approach to second language acquisition. Pedagogically, this approach can provide a framework for the short-term treatment of knotty syntactic structures, including EAs. Given this background, the following research questions were posed:

1. Does NLA significantly affect Iranian EFL learners' implicit knowledge of English articles?
2. Does NLA significantly affect Iranian EFL learners' explicit knowledge of English articles?

LITERATURE REVIEW

Cognitive and social approaches to explaining second language acquisition have left their mark on language teaching practices, though in two parallel, rather than conjoining, strands. Going against innatism and subscribing to usage-based approaches to language acquisition, Netten and Germain's (2012) NLA brings the cognitive and the social together in a single approach. In accord with Paradis' (1994, 2004), NLA has the following theoretical tenets:

1. The existence of an innate language faculty is a myth, and language acquisition can be fully explained as a token of usage-based cognitive development. It follows that it camps with anti-Chomskyan accounts of SLA.
2. Internal and external grammars (implicit and explicit knowledge) are distinct, but also associated, and processed separately in procedural and declarative memories. This resonates with Ullman's (2015) declarative/procedural model of SLA.
3. External grammar induced by explicit instruction cannot be transformed into internal grammar. Therefore, it goes against skill acquisition explanations of SLA.

4. Language use that is driven by one's needs in the course of social interaction activates language learners' limbic system and is motivating. Accordingly, NLA attributes the potential for cognitive malleability to social interaction.

5. Repeated use of newly learnt structures in various contexts works to strengthen their associated cognitive patterns.

These propositions bring to the forefront NLA's interrelated instructional constituents, namely (a) initial implicit instruction, (b) authentic limited-focus interaction, (c) teacher's immediate feedback, (d) full-session skill-based projects as, and (d) consolidation of neuronal connections through social interaction (Germain, 2018). To elaborate, NLA initiators have it that in order for implicit L2 knowledge to develop, instruction of L2 components and features should initially be implicit. This would obviate viewing targeted components as rule-based grammatical phenomena, which explicit instruction induces. The hailed implicit instruction in NLA embeds authentic communication opportunities in teacher-led interaction episodes. This can involve FoF in the form of teacher's immediate (preferably) implicit feedback on learners' erroneous utterances. Authenticity is by nature motivating for its stimulating effect on the limbic system, and this motivational element receives weightage in full-session projects.

Projects, in NLA terms, involve single-session four-phase treatment of a theme that is of personal relevance to learners. Projects begin and end with authentic orality practice. The first orality phase involves opportunities for producing sentential output containing the feature at issue and receiving feedback, not only on the project's theme, but also on similar themes. Following are (a) a feature-rich paragraph reading and rule induction phase aimed at introducing the feature as a grammatical phenomenon, (b) a paragraph writing and peer retelling phase aimed at providing extended use opportunities, and (c) an orality phase aimed at the consolidation of implicit and explicit grammars developed earlier. Implementation of a sentential project-based pedagogy would by nature lead to opportunities for social interaction, which NLA proponents advocate for its potential to settle implicit

and explicit neuronal connections formed in the process of project completion (Authors, 2023).

Insofar as NLA-based grammar instruction is concerned, the just-mentioned theoretical and practical premises can be translated into a multi-phase instructional procedure. The initial orality-based stage of the procedure involves the teacher's realia-based modelling of the form, followed by teacher-student and student-student question-and-answer (Q&A) phases wherein questions elicit the targeted form in complete sentences. The teacher will then run a questioning phase on the themes of paired interactions. This will provide the ground for attentive listening, which is believed to be one of the main triggers behind the formation of neuronal form-function-context connections. Emphasis on the production of full-formed sentences nesting the form at issue engages NLA's concern with fluency development. This is while accuracy is induced by the teacher urging learners to repair their erroneous utterances through immediate implicit feedback. Once implicit knowledge of the form is in place through this orality-based practice, learners are geared to form-housing reading comprehension and writing to develop its accorded explicit knowledge. A subsequent orality phase in which learners read and retell each other's writing content would wrap the literacy loop up. Was this literacy loop implemented in reverse order (from reading and writing to orality), implicit knowledge of the form would not be pertinently in place.

Most of the premises of NLA find theoretical and empirical support in the existing literature. The two desirable outcomes of grammar instruction put forth by Ellis (2005), namely explicit knowledge of the form and implicit use-related ability, are both attended to in NLA, the former through reading and writing, and the latter through orality. In line with NLA's opposition to Krashen's (1985) claims, Ellis (2002) showed viability of classroom grammar instruction for inducing both learnt and acquired grammar knowledge (internal and external grammars in NLA terms), and Long (1996) provided evidence for the similarity of learning routes in classroom and naturalistic settings. There is also counterevidence to these two claims (e.g., Genesee, 1987); however, as Authors (2023, p. 5) put it, such evidence "rests solely on

measures of explicit grammar knowledge and sentence-level items (including short-response items) rather than measures of implicit grammar knowledge (including productive task items)."

The distinctiveness of internal and external grammars, which NLA initiators posit (see Germain, 2018), would tell it apart from processing instruction (PI) (see VanPatten & Cadierno, 1993) or incidental FoF (see Ellis, 2008) which do not attribute due weightage to either. While also a sentential approach to grammar instruction, PI proceeds from explicit instruction to structured-input tasks, almost leaving internal grammar out of the equation (Hassanzadeh & Shahbazi, 2021; Patra et al., 2022). On the other hand, incidental FoF fails to treat external grammar thoroughly. Comparatively, NLA can be conceptualized as a form of planned FoF with an intermediate FoFs phase, in which learners induce grammar rules based on form-rich reading input. This combined focus is fortified in the intensiveness of NLA-based grammar instruction. Spada and Lightbown (1999) commend intensive grammar instruction for its plentiful practice opportunities facilitating understanding and use. On top of this, NLA can be envisioned as a great venue for providing what is acknowledged as the main benefit of extensive grammar instruction, i.e., exposition of real-time error feedback (see Spada & Lightbown, 1999), owing to theme-based projects and authentic communication opportunities it nests. In other words, despite its intensity, NLA-based instruction makes space for extensive instruction's purported advantage. Consciousness raising instruction (CRI) (Rutherford & Sharwood Smith, 1985) would also place a premium on external grammar through guided discovery, among others. While induction constitutes a main aspect of NLA-based, it accommodates it only after an orality phase aiming to induce internal grammar. NLA, however, goes against the hypothesis of transformability of external grammar to internal grammar, hence deeming approaches that house this presumption ineffective for bringing about implicit grammar knowledge. This is evidenced in Hassanzadeh & Shahbazi's (2021) study, which is suggestive of PI and CRI's no significant effect on the

participants' acquisition of the EAs. The measures in their study included both receptive and productive response items.

In line with NLA's claim, whether external grammar developed at an earlier phase of instruction could be transfigured into internal grammar through communicative tasks begs the question in Ullman's (2015) declarative/procedural model. The model, put forth to explain SLA from a psycholinguistic perspective, similarly posits a non-interface position. Pointing to the dissociable nature of internal and external grammars, Germain (2018) deems it necessary for language instruction to induce both grammar types, and this proposition explains NLA's iterative treatment of both in its project-based multiphase procedure.

Research into NLA's effect on language learning is scarce. Studies have mainly targeted French, rather than English, and involved a general focus approach, rather than the specific treatment of a particular language skill or component (see Germain (2018) for reports of the promising results of applying NLA in Japan and Taiwan for French instruction). Germain, Liang, & Ricordel (2015) showed how NLA could aid the oral proficiency and writing development of Chinese learners of French. Apart from studies done by the initiators of the approach, empirical research has operationalized NLA on the basis of distorted interpretations of its procedure. To exemplify, Mohammadi, Gashmardi, Rahmatian, and Shairi (2019) probed the viability of NLA in terms of its effect on Iranian French as a foreign language (FFL) learners' oral proficiency. They, however, introduced NLA as a totally implicit approach to language teaching, and failed to include rule induction in their treatment. This is while NLA initiators are insistent on facilitating learners' development of both implicit and explicit knowledge of the language skill or component at issue. Their experimentation proved to reduce the rate of interlanguage transfer and urge learners to engage in a higher number of self-repair episodes. More recently, as an antecedent to the present study, authors (2023) set out to investigate whether NLA could induce implicit and explicit knowledge of the present perfect tense by Iranian pre-intermediate EFL learners. Treatment to the experimental group involved an

orality-reading-writing-orality chain in three consecutive project-based sessions. The project themes (virtual camping, party planning and cooking) were designated in a way to amply elicit variants of the tense. Results of combined measures of implicit and explicit knowledge showed the procedure's positive effect on both knowledge types.

To extend this line of research, the present study targeted EAs as they have been shown to pose a challenge to English language learners, irrespective of whether their L1 lacks or represents a parallel feature (Chan, 2019; Zhao & MacWhinney, 2018); however, as Hassanzadeh and Shahbazi (2021) put it, EAs do not receive mindful attention by learners as do other morpho-syntactic features owing to (a) low imposition involved in their misuse in communication and (b) their low-key occurrence in L2 input. To these, one can add the multiple form-meaning associations involved in the use of the definite article (see Lopez, 2019), which is literally absent in the use of generic nouns and specific entities (e.g., rivers and specific countries) in Farsi, and the resultant complications involved in its use (see Momenzade & Youhannaee, 2015; Rezai & Jabbari, 2010). Rezai and Jabbari point to the inconsistency evidenced in Iranian EFL learners' use of EAs, which they ascribe to L1-induced difficulty involved in their identification and analysis in the L2 input they receive. Their observation could also be attributed to the fact that indexicals (used with both singular and plural nouns) and the suffixed enclitic –e (used only with singular nouns, with or without a noun-preceding indexical) would function as the definite article on a conceptual level in Farsi. Accordingly, the concept of definiteness/indefiniteness exists in both Farsi and English, but it is phonologically realized differently across the two languages causing the just-discussed noticing and learning difficulty. Studies have mainly addressed the effect of explicit instruction on the learning of EAs (e.g., Snape & Yusa, 2013; Umeda, Snape, Yusa, & Wiltshier, 2019). Umeda et al. (2019) investigated the effect of explicit instruction on the genericity aspect of the use of EAs by Japanese English language learners, and found only a transient effect. They admitted the unproductivity of explicit instruction for bringing about in learners implicit knowledge of the targeted

form. This finding is corroborated in Lopez' (2019) study, which showed explicit instruction would not have a significant effect on the learning of definiteness and specificity by Chinese English language learners. Given the precedence of explicit instruction of EAs over other instructional approaches in the existing literature, NLA could contribute to this line of research through marrying implicit and explicit instruction in a single approach with the aim of inducing both implicit and explicit knowledge of EAs.

PURPOSE OF THE STUDY

The learning of EAs has always posed a challenge to Farsi-speaking learners. This, along with the apparent inefficacy of the frequently investigated explicit instruction of them (see Umeda et al., 2019) justifies probing the effect of alternative instructional approaches like NLA. What distinguishes NLA from the already tried-out implicit or explicit approaches to instructing EAs is (a) its consecutive implicit-explicit-implicit cycle, and (b) its limited focus. The former feature could potentially help learners develop both implicit and explicit knowledge of EAs, and the latter would make it suitable for the exclusive treatment of EAs, as particularly challenging features to learn, in an instructional course. Accordingly, this study was designed to investigate the effectiveness of NLA for the learning of EAs by Iranian (Farsi-speaking) EFL learners. Instruction targeted the three dimensions of definiteness/specificity, genericity, and categorical dimensions of articles' use in English (see Procedure).

METHOD

Participants

For the purpose of the present study, 43 Iranian female English language learners, as members of two adult classes at a language institute in Tehran, Iran, ranging in age from 19 to 24 were selected through a convenience sampling procedure, and randomly assigned into an experimental group (EG;

N = 23) and a control group (CG; N = 20). The two intact classes had 28 and 26 students, but only data from pre-intermediate proficiency level learners as indicated in scores on Oxford Placement Test (OPT; see Instruments) were included in the analyses. Consent of the institute's supervisor and the teacher, teaching both classes, was obtained, and the participants, too, filled out an official consent form, expressing approval to receive instruction in four consecutive online 1.5-hr sessions under the conditions of anonymity and data confidentiality. They had not been exposed to an in-depth instructional treatment of EAs, apart from the superficial treatment of this morpho-syntactic feature in high school textbooks only regarding its specificity dimension (see Procedure).

Instruments

Implicit knowledge of EAs was measured through a timed grammaticality judgment test (TGJT) and an EAs-focused oral proficiency interview (OPI), while explicit knowledge was measured through an untimed grammaticality judgment test (UGJT) and a metalinguistic knowledge test (MKT). The decision to use two measures for each of the implicit and explicit knowledge types was made in view of the prevailing challenge faced by researchers regarding their measurement. In other words, triangulation of data obtained through two instruments for each was done with the purpose of enhancing the credibility and validity of the findings. OPT was also used as a measure of the participants' proficiency level. These are described in this section.

OPT

Scores on the computerized version of OPT (falling within the range of 30-39) were used to obtain a homogeneous sample of pre-intermediate proficiency participants. The test, developed by Oxford University Press and Syndicate of Cambridge ESOL Examinations Syndicate includes, 60 receptive-response items on reading, grammar, and vocabulary (see Geranpayeh, 2003), and was completed online in 40 minutes by the participants.

TGJT and UGJT

Four parallel 25-item tests (a pretest TGJT and a posttest TGJT involving a 5-second time pressure for each sentence for implicit knowledge; a pretest UGJT and a posttest UGJT involving no time pressure for explicit knowledge) were developed by the researcher. Each comprised 20 sentences of a similar length and difficulty level and five distractors (included not to give away OPI's focus, but excluded from data analysis; see EA-Focused OPI and Procedure). The participants were required to indicate the un/grammaticality of the items, which were all single-focused, in an online session one week prior to the onset of the treatment period. EA items targeted definiteness/specificity (e.g., *I ate all the bananas that you bought*; N = 5), genericity (e.g., *I read somewhere that the apples are very good for you*; N = 5), and use with specific noun categories (e.g., *The river Thames is really beautiful*; N = 10). The higher number of the third category was intentional due to the greater difficulty the participants were found to experience in its learning. There were 10 correct and 10 incorrect items in each of the four tests, and each item was assigned one mark totaling 20. Distractors involved no nouns to obviate EAs' use necessity (e.g., *She slept before I did*.), and all items were put forth in simple present and simple past tenses, which the participants had already been instructed on; however, despite the participants' proficiency level, "specificity" items were put forth as compound or complex sentences to provide sufficient contextual information. Finally, level suitability was checked in a pilot study involving evaluation by three expert reviewers. Parallelism of the four variants of the test was also ensured through their simultaneous administration (without time pressure) to 28 non-participants in an intact pre-intermediate class at the same institute. An insignificant F statistic in a one-way ANOVA indicated parallelism (F = .79; *p* > .05). Reliability of pretest TGJT, posttest TGJT, pretest UGJT, and posttest UGJT was also respectively indicated in KR-21 values of .83, .76, .77, and .79.

Measures of implicit and explicit knowledge have involved some controversy in research; however, time pressure, as the distinguishing feature of TGJTs and UGJTs, has been evidenced in several studies (see Ellis, 2006, 2008). From a psycholinguistic perspective, the presence of time pressure invokes automatic processing in procedural memory, while lack of time pressure compels controlled processing in declarative memory. Evidence comes from Godfroid et al.'s (2015) study, which revealed more frequent eye regressions in the absence of time pressure. Ellis (2005) also provided psychometric evidence for this claim showing the comparability of TGJT and UGJT with other known measures of implicit and explicit grammar knowledge in terms of their factorial structure; he conducted principal component factor analysis on five tests designed to measure implicit and explicit knowledge of English morphology and syntax: TGJT, UGJT, MKT, an oral narrative test, and an elicited imitation test. He showed TGJT to load with the oral narrative and oral imitation tests on one factor, and UGJT to load with MKT on another; he concluded the first factor encompassed measures of implicit knowledge and the second factor contained measures of explicit knowledge; however, there exists some counterevidence (though in far fewer studies, by comparison) for the viability of GJTs as measures of implicit knowledge (e.g., Vafaee, Suzuki, & Kachinske, 2017) and also for time pressure as an adequate measure of implicitness/explicitness (e.g., Gutiérrez, 2013). Accordingly, TGJT and UGJT results in this study were triangulated with those of two other measures of implicit and explicit knowledge, namely "EA-focused OPI" and "MKT," respectively.

MKT

Paired with the UGJTs, MKT was used to provide an indication of explicit knowledge of EAs. Used in two parallel forms, the test comprised 20 items: five distractors and 15 EAs-focused single-target items ($N_{specificity} = 5$; $N_{genericity} = 5$; $N_{categorical} = 5$). Each item required the learner to indicate un/grammaticality and provide an explanation (viz. metalanguage) for their

response in cases of ungrammaticality. As far as psychometric validity evidence is concerned, Ellis' (2005) principal component factor analysis showed MKT to be a measure of explicit linguistic knowledge as it loaded along with UGJT on one factor. He explained this finding in terms of the contingencies of successful performance on MKT: conscious awareness, controlled processing, accessability of knowledge in the declarative memory, and verbalizability of targeted morphological and syntactic rules. In the MKT in this study, there were 12 ungrammatical items (e.g., *We went to movies yesterday*), and only these were included in scoring and data analysis. The rationale was research evidence as to the potential of metalanguage and ungrammaticality to call into use the explicit grammar knowledge (Ellis, 2005; Gutiérrez, 2013). Reliability of pretest and posttest MKTs was shown in KR-21 values of .78 and .82. As for content validity, both tests were reviewed by two PhD holders of applied linguistics to ensure that their content adequately represented the three conditional structures under investigation and that they were suited to the proficiency level of the participants.

EAs-Focused OPI

As the second measure of implicit knowledge of EAs, a semi-structured EA-focused OPI interview was conducted and screen-recorded by the teacher with each of the participants at pre-treatment and post-treatment phases. Regarding construct validity, OPI is a variant of Ellis' (2005) oral narrative test, which was shown in a principal component analysis to measure implicit linguistic knowledge. Like the oral narrative test, successful performance in OPI as operationalized in this study was contingent on intuitive awareness of EAs, their automatic processing in procedural memory, and their accessibility during fluent performance. Each OPI, held online through WhatsApp's video call option, aimed at eliciting at least 12 uses of EAs (on specificity, genericity, and specific noun categories dimensions), while not giving away its focus to the interviewees. This last measure was taken to ensure the learners' produced utterances in the course of talk-in-interaction were processed in their procedural memory and therefore indicated their implicit

knowledge. Conditions of acceptance of instances of EAs' use as indications of implicit knowledge were set in the pre-treatment phase, and the teacher was debriefed on them. Following Authors (2023), instances of EAs' use were not counted as indications of implicit knowledge where they were mediated by reflective pauses, regressions, and/or shifts between definite and indefinite EAs or their use and nonuse. The OPI guide posed three main questions on one's last travel (to elicit EAs on specificity), health food (to elicit EAs on genericity), and hobbies (to elicit EAs on specific noun categories). Further probes were improvised with an eye to the three dimensions of EAs. OPIs lasted between 8 to 14 minutes, and data were analyzed jointly by the teacher/interviewer and researcher. Scores were assigned out of a total 12, and inter-rater reliability was ensured in Alpha coefficients of .83 on pretest OPIs and .75 on posttest OPIs.

Data Collection Procedure

The study began with the convenient sampling of EG and CG, and their proficiency level homogenization through OPT. Four pretests (TGJT and EA-focused OPI as measures of implicit knowledge, and UGJT and MKT as measures of explicit knowledge) were subsequently administered to both groups. Within one week, treatment and control conditions were implemented online through Google Meet over four 1.5-hr sessions in two weeks. Instruction to both groups targeted three dimensions of EAs' use: definiteness/specificity (i.e., use of definite and indefinite EAs to designate known and unknown entities), genericity (i.e., use of the indefinite EA with singular generic nouns and nonuse of the definite EA with plural generic nouns), and specific nominal categories (i.e., use/nonuse of the definite article with such nominal entities as rivers, magazines, musical instruments, etc.) (see Snape & Yusa, 2013).

NLA-based treatment of EAs offered to EG involved four 1.5-hr sessions of theme-based projects, each spanning a consecutive orality, reading, writing, and orality loop:

1. *describing one's house or workplace*; focus: EAs' use to indicate definiteness/specificity; example sentence: "I always put *the* flowers in *a pot*."

2. *discussing health food for common conditions like diabetes*; focus: EAs' use to indicate genericity; example sentence: "*Apples* are known to lower your blood pressure."

3. *talking about one's favorites* (1 & 2); focus: definite article's use/nonuse with specific noun categories; example sentence: "*Time magazine* is one of my favorites."

Themes were selected in a way to optimally elicit instances of EAs' dimension in focus. The first orality phase lasted for about 30 minutes. Following the explanation of the procedure in Farsi, the teacher modelled the use of the EAs' dimension in a couple of sentences through such realia as the pictures of her house, fruits, and other entities like magazines. Modelling was followed by the teacher eliciting complete EA-containing sentences from a few learners. This Q&A phase was then repeated by a few learner pairs in front of the class, and subsequently by all learners in their seats. Words were provided upon learners' request, and teacher questioning, pairs' reassignment, and elicitation of instances of EAs' dimension in focus in a similar situation followed. All through this phase, the teacher emphasized (a) "fluency" by eliciting complete sentences, (b) "accuracy" by providing immediate corrective feedback (preferably implicit) on learner errors and ensuring uptake, and (c) "purposeful listening" in Q&A episodes. Following this initial orality phase, which involved no board writing, a 1-hr reading, writing, and orality loop was implemented. Learners were initially presented with an authentic one-paragraph text, representing the session's theme ("room description," "health food to prevent cancer," and "favorite hobbies"). The texts amply instantiated EAs' use dimension at issue in each session. This was the first written presentation of EAs in order to guide learners to begin to view this morpho-syntactic feature as a rule-based grammar feature.

Learners were required to read the text in pairs, and induce and put down rules of EAs' use making reference to text-contained examples. Following

was a whole class function-based discussion of the rule. Subsequently, in order to facilitate rule application and shift learning efforts to procedural processing again, the teacher and learners jointly composed a theme-based paragraph (put down on the board by the teacher). Learners were then required to write a similar theme-based paragraph, read each other's texts in pairs, and in a final orality phase retell their partner's paragraph content while receiving immediate feedback from the teacher. The control condition, on the other hand, proceeded from EAs-containing text presentation to learners' rule induction and the teacher's subsequent rule explanation involving board writing and exemplification. Two communicative tasks requiring the use of EAs dimension in focus were then presented. In other words, CG was guided to view EAs' use as a grammatical phenomenon on the presumption that the induced explicit knowledge would transform into implicit knowledge in the course of accomplishing communicative tasks. NLA proponents view this succession as premature development of explicit knowledge obviating the activation of neural networks necessary for the development of implicit knowledge. It needs to be noted that treatment to CG was offered online over four 1.5-hr sessions in two weeks to yield comparability with EG in terms of mode of presentation and intensity. Finally, EG and CG's pretest, posttest and gain scores were compared through three one-way ANOVAs.

Data Analysis

In order to answer the research questions, each participant was assigned pretest, posttest, and gain scores on the following measures:

  (a) TGJT [score range: 0-20]
  (b) EA-focused OPI [score range: 0-12]
  (c) aggregate implicit knowledge measures (AIKMs; defined as an equally weighed combined score on both TGJT and OPI) [score range: 0-24]
  (d) UGJT [score range: 0-20]
  (e) MKT [score range: 0-12]

(f) aggregate explicit knowledge measures (AEKMs; defined as an equally weighed combined score on UGJT and MKT) [score range: 0-24]

Subsequently, three one-way ANOVAs were conducted to compare (a) pretest scores, (b) posttest scores, and (c) gain scores of the two groups. It should be noted that multicolinearity, as observed in the bivariate correlations' matrix, obviated the use of MANOVA, which would otherwise provide a more accurate measure of between-groups differences.

RESULTS

This study addressed the question of whether NLA had a significant effect on EFL learners' implicit and explicit knowledge of EAs. Table 1 presents the descriptive statistics of the six pretest and posttest measures explicated in the data analysis section separately (i.e., TGJT, EA-focused OPI, AIKMs, UGJT, MKT, and AEKMs). Ratios of skewness and kurtosis to their related standard error values fell within the range of ± 2, denoting the univariate normality of all the score sets (Field, 2009). EG's greater rise of mean scores on implicit and explicit measures from pretreatment to posttreatment phase is observable.

Table 1: Descriptive statistics of EG and CG's pretest and posttest score sets

Group	Test		Min	Max	Mean	SD	Skewness Statistic	SE	Kurtosis Statistic	SE
Experimental Group	Pretest	TGJT	4	8	5.52	.99	.54	.48	.48	.93
		OPI	2	6	3.30	1.01	.72	.48	.81	.93
		AIKMs	4.40	9.19	6.61	1.29	.47	.48	-.38	.93
		UGJT	3	7	4.60	1.11	.23	.48	-.56	.93
		MKT	1	5	3.04	.92	-.09	.48	.00	.93
		AEKMs	2.80	7.59	5.80	1.08	-.96	.48	1.39	.93
	Posttest	TGJT	5	17	10.60	2.96	.07	.48	-.11	.93
		OPI	4	10	6.73	1.54	.23	.48	-.52	.93
		AIKMs	9.59	19.18	13.09	2.37	.54	.48	.28	.93
		UGJT	7	18	12.17	2.90	.09	.48	-.43	.93
		MKT	7	12	9.13	1.45	.43	.48	-.36	.93
		AEKMs	11.19	22.78	16.42	2.87	.33	.48	.38	.93

	Gain	TGJT	0	9	5.08	2.46	-.36	.48	-.34	.93
		OPI	0	6	3.43	1.64	-.10	.48	-.43	.93
		AIKMs	3	10.79	6.48	2.17	.34	.48	-.69	.93
		UGJT	2	13	7.56	2.59	.03	.48	.09	.93
		MKT	4	9	6.08	1.37	.05	.48	-.43	.93
		AEKMs	6.20	15.78	10.61	2.32	.13	.48	.26	.93
Control Group	Pretest	TGJT	3	9	5.40	1.50	.78	.51	.44	.99
		OPI	2	5	3.40	.75	-.03	.51	-.07	.99
		AIKMs	5.40	9.39	6.63	1.02	1.02	.51	1.38	.99
		UGJT	3	5	4.15	.74	-.25	.51	-1.04	.99
		MKT	1	4	2.80	.83	-.19	.51	-.35	.99
		AEKMs	2.80	6.99	5.28	.99	-.69	.51	.68	.99
	Posttest	TGJT	4	10	6.00	1.45	1.01	.51	1.80	.99
		OPI	3	6	3.75	.96	.99	.51	1.17	.99
		AIKMs	5.99	8.99	7.34	1.02	.31	.51	-1.25	.99
		UGJT	4	10	6.15	1.89	.83	.51	-.13	.99
		MKT	2	7	4.45	1.39	-.14	.51	-.64	.99
		AEKMs	4.99	12.99	8.13	2.04	.66	.51	-.00	.99
	Gain	TGJT	-1	3	.60	1.14	.19	.51	-.49	.99
		OPI	-1	3	.35	.98	1.01	.51	1.59	.99
		AIKMs	-.6	3	.70	1.11	.35	.51	-1.01	.99
		UGJT	-1	6	2.25	1.91	.35	.51	-.76	.99
		MKT	0	5	1.65	1.22	.94	.51	1.56	.99
		AEKMs	0	7.99	2.84	1.97	.92	.51	1.13	.99

To answer the research questions, three one-way ANOVAs were conducted on pretest, posttest, and gain scores. Regarding pretest scores, Levene's statistic was insignificant for all the score sets indicating variance homogeneity, except for UGJT scores (see Table 2). Accordingly, to adjust for this observed lack of variance homogeneity, Welch's statistic, as a more robust measure of means' equality featuring in the asymptotic F distribution, was used (see Sullivan & Fein, 2012). Adjusting for degrees of freedom, this statistic was not significant for any of the six pretest score sets, showing EG and CG's pretreatment homogeneity in terms of implicit and explicit knowledge of EAs [$F_{TGJT}(1, 32.21) = .09$, $p > .05$; $F_{OPI}(1, 40.03) = .12$, $p >$

.05; $F_{AIKMs}(1, 40.64) = .00$, $p > .05$; $F_{UGJT}(1, 38.57) = 2.56$, $p > .05$; $F_{MKT}(1, 40.94) = .82$, $p > .05$; $F_{AEKMs}(1, 40.83) = 2.67$, $p > .05$].

Table 2: Welch results for pretest implicit and explicit score sets

Pretest		Levene's Test		Between-Groups Welch Results			
		Statistic	Sig.	Statistic	df1	df2	Sig.
Implicit	TGJT	2.82	.10	.09	1	32.21	.76
	OPI	2.56	.11	.12	1	40.03	.72
	AIKMs	1.70	.19	.00	1	40.64	.94
Explicit	UGJT	4.45	.04*	2.56	1	38.57	.11
	MKT	.00	.95	.82	1	40.94	.37
	AEKMs	.03	.86	2.67	1	40.83	.11

*Significant at .05 level

Subsequent to showing EG and CG's pretreatment homogeneity, differences between their posttest scores and gain scores on all the six implicit and explicit measures (TGJT, OPI, AIKMs, UGJT, MKT, and AEKMs) were probed through two further one-way ANOVA tests (see Tables 3 & 4). As shown in Table 3, the more conservative Welch's statistic was reported owing to lack of variance homogeneity in the case of implicit knowledge score sets. This statistic was found to be significant in all the score sets, indicating EG's significantly greater posttest scores on both implicit and explicit measures [$F_{TGJT}(1,32.89) = 43.55$, $p < .05$; $F_{OPI}(1, 37.48) = 59.43$, $p < .05$; $F_{AIKMs}(1, 30.87) = 111.06$, $p < .05$; $F_{UGJT}(1, 38.26) = 66.38$, $p < .05$; $F_{MKT}(1, 40.59) = 115.69$, $p < .05$; $F_{AEKMs}(1, 39.51) = 121.01$, $p < .05$]. Similar results were obtained for gain scores. Lack of variance homogeneity in the case of implicit knowledge gain score sets necessitated the use of Welch's test as a robust measure of means equality. Welch's statistic in all the six gain score sets was significant, showing EG's significantly greater improvement from the pretest to the posttest on all implicit and explicit measures [$F_{TGJT}(1,31.94) = 61.05$, $p < .05$; $F_{OPI}(1, 36.70) = 57.08$, $p < .05$; $F_{AIKMs}(1, 33.72) = 124.26$, $p < .05$; $F_{UGJT}(1, 40.03) = 59.43$, $p < .05$; $F_{MKT}(1, 40.97) = 124.76$, $p < .05$; $F_{AEKMs}(1, 40.98) = 140.88$, $p < .05$].

Table 3: Welch results for posttest implicit and explicit score sets

Pretest		Levene's Test		Between-Groups Welch Results			
		Statistic	Sig.	Statistic	df1	df2	Sig.
Implicit	TGJT	9.88	.00*	43.55	1	32.89	.00*
	OPI	4.81	.03*	59.43	1	37.48	.00*
	AIKMs	12.68	.00*	111.06	1	30.87	.00*
Explicit	UGJT	2.33	.13	66.38	1	38.26	.00*
	MKT	.00	.92	115.69	1	40.59	.00*
	AEKMs	.68	.41	121.01	1	39.51	.00*

*Significant at .05 level

Table 4: Welch results for implicit and explicit gain score sets

Gain scores		Levene's Test		Between-Groups Welch Results			
		Statistic	Sig.	Statistic	df1	df2	Sig.
Implicit	TGJT	7.41	.00*	61.05	1	31.94	.00*
	OPI	4.99	.03*	57.08	1	36.70	.00*
	AIKMs	7.92	.00*	124.26	1	33.72	.00*
Explicit	UGJT	.83	.36	59.43	1	40.03	.00*
	MKT	.21	.64	124.76	1	40.97	.00*
	AEKMs	.65	.42	140.88	1	40.98	.00*

*Significant at .05 level

Finally, group-specific pretest-posttest differences for both implicit and explicit knowledge measures were tested for significance through a series paired samples t tests, setting a conservative .01 significance level for multiple comparisons. As shown in Table 5, differences were significant on all the measures for EG [$T_{TGJT}(22) = -9.89$, $p < .01$; $T_{OPI}(22) = -10.00$, $p < .01$; $T_{AIKMs}(22) = -14.28$, $p < .01$; $T_{UGJT}(22) = -14.00$, $p < .01$; $T_{MKT}(22) = -21.17$, $p < .01$; $T_{AEKMs}(22) = -21.93$, $p < .01$]. Differences were also significant for CG on explicit but not on implicit knowledge measures [$T_{TGJT}(19) = -2.34$, $p > .01$; $T_{OPI}(19) = -1.58$, $p > .01$; $T_{AIKMs}(19) = -2.84$, $p > .01$; $T_{UGJT}(19) = -5.21$, $p < .01$; $T_{MKT}(19) = -6.02$, $p < .01$; $T_{AEKMs}(19) = -6.64$, $p < .01$].

Table 5: EG and CG's paired samples t test results for implicit and explicit measures

Group	Pretest-Posttest Pairs	Mean Difference	SD	SE	t	Sig.
EG	TJGT	-5.08	2.46	.51	-9.89	.00*
	OPI	-3.43	1.64	.34	-10.00	.00*
	AIKMs	-6.48	2.17	.45	-14.28	.00*
	UGJT	-7.56	2.59	.54	-14.00	.00*
	MKT	-6.08	1.37	.28	-21.17	.00*
	AEKMs	-10.61	2.32	.48	-21.93	.00*
CG	TJGT	-.60	1.14	.25	-2.34	.06
	OPI	-.35	.98	.22	-1.58	.13
	AIKMs	-.70	1.11	.24	-2.84	.02
	UGJT	-2.00	1.71	.38	-5.21	.00*
	MKT	-1.65	1.22	.27	-6.02	.00*
	AEKMs	-2.84	1.97	.44	-6.64	.00*

*Significant at .01 level

To sum up, Both EG and CG made a significant improvement on explicit knowledge measures, but only EG's improvement was significant on implicit knowledge measures, too. Moreover, despite initial between-groups homogeneity, EG's posttest scores and gain scores for both implicit and explicit knowledge measures were significantly greater.

DISCUSSION

In this study, NLA was shown to induce both implicit and explicit knowledge of EAs. Accordingly, both research questions were answered in the affirmative. On the other hand, the control condition, which featured an explicit inductive-deductive approach, exerted a positive influence on only the participants' explicit knowledge of EAs. In addition, this effect was smaller than that of NLA. Theoretically, the results substantiate NLA's claim that an intensive primarily implicit approach with an intervening explicit treatment phase could potentially yield both implicit and explicit knowledge (Germain, 2017, 2018; Netten & Germain, 2012). Based on the results, explicit knowledge induced by the control condition did not transform into implicit knowledge, and NLA's separate treatment of these two knowledge

types yielded both. These provide support for Paradis (2004) and Ullman's (2015) hypothesis that declarative and procedural memories are dissociable, non-transformable, and only partially interactive. Ullman postulated that "mode of instruction" (implicit or explicit) can determine the amount of reliance on either memory system. As such, classroom instruction predominantly obsessed with explicit treatment of the feature at issue could only trigger declarative processing, as shown in CG-related results. Explicit instruction might also have led to the "dysfunction or attenuation" of declarative memory (Ullman, 2015, p. 139). Procedural memory, on the other hand, has been found to be a more common processing venue for highly complex rules (Ullman, 2015). As to complexity, EAs, have been enumerated among some of the late-learnt grammatical features, which could be attributed to their cross-linguistically variant use features (DeKeyser, 2005; Hassanzadeh & Shahbazi, 2021). Accordingly, a primarily explicit instructional approach, as verbalized in this study's control condition, could not effectively shift processing to procedural memory. In addition, presuming the competitiveness of the two memory systems, learning in either system might hinder learning in the other (see Clahsen & Felser, 2006).

Through alternating implicit and explicit instruction modes, NLA can be said to have made provision for reliance on both memory systems (see Netten & Germain, 2012), hence counterbalancing their competitiveness. Moreover, by initially triggering procedural processing and boarding learning in the limbic system, NLA could be said to have facilitated the learning of complex grammar. In addition, NLA primarily aims at promoting the learning of patterns in procedural memory (Authors, 2023). On account of this, it yielded satisfactory results with EAs, whose learning, particularly in their third use defined in this study (i.e., special nominal categories), can be best advanced through a pattern-based approach.

Empirically, there are only few studies on the effectiveness of NLA for L2 learning, and these studies have not always thoroughly verbalized its modus operandum (e.g., Mohammadi et al., 2019; see Literature Review). The findings are in line with those of Authors (2023), who found NLA effective

for the development of both implicit and explicit knowledge of the present perfect tense. The researchers attributed their findings to:

> (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 … (Authors, 2023, p. 15).

The targeted feature of their study was more salient than EAs, and generally receives more attention in instructional materials. In addition, in both studies, learners, who were at the pre-intermediate proficiency level, developed implicit and explicit knowledge of the feature under study. This observation could counter Hassanzadeh and Shahbazi's (2022) reasoning that intensive explicit instruction could not affect the learning of EAs owing to their non-salient nature. Having obtained similar results, Lopez (2019) and Snape and Yusa (2013) also attributed the ineffectiveness of explicit instruction to EAs' abstract and non-salient nature. Against these propositions, based on the present study's findings, failure of explicit instruction could be attributed to (a) the "mere explicitness" of instruction and (b) the "measures" used to gauge instructional effectiveness, rather than the nature of the feature under study. As for instruction, the results probably point to the significance of facilitating procedural-then-declarative processing of the feature through instruction even when dealing with non-salient features and working with low proficiency learners. Regarding the nature of measures, the control condition featuring an explicit approach in this study produced favorable results only in terms of explicit knowledge measures, one of which (i.e., the EA-focused OPI) necessitated online productive processing in procedural memory. In other words, whether merely explicit instruction is effective likely depends on whether measures entertain declarative or procedural memory systems. Hassanzadeh & Shahbazi's (2022) measure did not involve this demarcation.

Accordingly, their findings should be cautiously interpreted, though they acknowledge, without pointing to memory systems, the greater positive effect of explicit instruction on receptive response items.

CONCLUSION AND IMPLICATIONS

The present study explored the effectiveness of NLA for the development of implicit and explicit knowledge of EAs. The implicit-explicit debate and non/interface positions in SLA (see Ullman, 2015) have informed grammar teaching in such approaches as FoF, FoFs, input-based, and output-based instruction (see Ellis, 2006); these approaches have been mainly investigated in comparative studies and yielded rather inconsistent results (see, e.g., Ellis, 2008; Moradi & Farvardin, 2016; Norris & Ortega, 2000; Shintani, Li, & Ellis, 2013). In the face of approaches focusing on only one aspect of instruction, NLA can be thought of as an initiative integrative approach to language instruction paving the way for reliance on both declarative and procedural memory systems in the course of instruction in a consecutive orality-reading-writing-orality chain. As for grammar teaching, the thematic project-based chain potentially offers learners opportunities to receive input and corrective feedback, produce output, and engage in input-based rule induction in a socially interactive environment. As such, it brings together what the just-mentioned approaches have long hailed as their distinct instructional value. Presuming the non-transformability of declarative and procedural memories in a non-interface position, NLA does this coherently by beginning instruction in procedural memory to stimulate the limbic system, and proceeds to declarative processing before directing learning toward procedural memory again. It resolves the issue of salience, even if it is the case, through explicit instruction and makes provision for internalization and procedural processing in an initial orality phase.

The findings of the present study theoretically support the distinctness of declarative and procedural memory systems, as put forth by Paradis (2004) and Ullman (2015). They also implicate in teaching practice by showing the

effectiveness of NLA for the instruction of grammar features like EAs, which have been viewed as late-learnt owing to their non-salience in the input learners receive. Accordingly, syllabi could be designed based on NLA's procedural underpinnings to intensively treat such features in general English and preparatory standard English exams' courses. An implicit-explicit approach like NLA could potentially yield more favorable results than a merely explicit one.

This stated, it needs to be admitted that the study did not involve the investigation of NLA' long-term effect on implicit and explicit knowledge of EAs. Further research is needed to see knowledge of EAs induced by NLA would be retained in the long run. Targeting other morpho-syntactic features of English, at different levels of input-embedded salience or complexity, could shed more light on NLA's potential for grammar learning. Given NLA's initial development plan for low proficiency learners, the present study's participants were at the pre-intermediate proficiency level. Whether this approach could be as effectively implemented with higher proficiency learners is yet to be seen in future research. Last but not least, replication of this study with different pretest and posttest implicit and explicit knowledge measures could possibly counter potential validity threat in the present study posed by the possible testing effect on the participants' posttest performance.

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No potential conflict of interest was reported by the authors.

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