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L2 Morphological Instruction Based on Affix Index: A Constructional Approach

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Abstract

This study introduces a pedagogical approach based on Construction Morphology and affix index, aiming to create morphological and syntactic contexts for L2 learners and enhance the effectiveness of teaching derived words. The experiment consisted of an Experimental Group (EG) receiving 40 minutes' morphological instruction and a Control Group (CG) without such intervention. The instructional approach focused on six polysemous affixes, utilizing six sets of affix concordances (each comprising six sentences) to assist learners in conducting morphological analyses of familiar words containing the specified affixes. Subsequently, both groups underwent an immediate post-test evaluating four dimensions of morphological knowledge of new words: relational, syntactic, distributional, and semantic knowledge. The EG engaged in a delayed post-test two weeks later, with adjusted test item sequencing. Results indicated positive short-term effects on comprehensive morphological knowledge and its constituent aspects. However, in the delayed post-test, while no significant difference was observed in relational and semantic knowledge, the EG's mean scores for syntactic and distributional knowledge notably declined. These findings underscore the efficacy of the affix index-based teaching mode in facilitating L2 learners' understanding of morphemic structures and subsequent acquisition of derived words.

Keywords

L2 morphological instruction, affix index, concordance, construction

1. Introduction

Derivation is a fundamental morphological process frequently employed in natural languages, particularly in morphophonetic languages like English, which abound with morphologically complex words (words comprising more than one morpheme). It is estimated that 60% to 80% of the vocabulary

found in English textbooks for third-grade native speakers can be grasped through morphological analysis (Anglin, 1993), indicating the significant role of morphological knowledge in vocabulary acquisition.

While the significance of morphological knowledge has earned widespread recognition within the domain of vocabulary instruction (Deng et al., 2016; Ng et al., 2022; Xu & Jing, 2015), conventional methodologies fall short in efficiently aiding learners in comprehending the complexities of derived words, particularly in the acquisition and instruction of English as a second language. Due to variances in morphological processing mechanisms, Chinese EFL learners tend to assimilate derived words holistically (Chen et al., 2021). Even among advanced learners, their aptitude for discerning morphological cues is typically inferior to that of native speakers (Clahsen & Neubauer, 2010; Yu, 2021).

Drawing upon morphological paradigmatic relationships, this study advances a pedagogical approach centered on affix index, which constructs morphological concordances for English derived words via morphological series (Voga et al., 2014), also referred to as "affix family" (Carlisle, 2010). The objective is to furnish learners with ample morphological cues to facilitate the comprehension of derived words, allowing them to discern the structural makeup and cultivate a systematic morphological awareness. This methodology is anticipated to elevate both the instructional quality and learning outcomes associated with derived words among L2 learners.

2. A Review of Relevant Studies

2.1 Definition of Morphological Knowledge

Morphological knowledge encompasses the capacity to manipulate the morphemic components within complex words (Carlisle, 2010). This ability is commonly evaluated by examining three key dimensions of knowledge: relational knowledge (recognizing that complex words are comprised of morphemes that can appear in other words), syntactic knowledge (understanding the grammatical function of affixes), and distributive knowledge (grasping the combinatorial patterns among morphemes) (Tyler & Nagy, 1989). However, Apel (2014) argued that morphological knowledge extends beyond recognizing the formal characteristics of complex words; it also includes understanding the meanings of affixes and the semantic alterations of roots resulting from morpheme combinations. This comprehensive perspective implies that both the formal and semantic characteristics of morphemes should be considered to enhance learners' morphological awareness (Carlisle, 2010; Ke & Koda, 2019).

2.2 Importance of Morphological Instruction

The debate surrounding the incorporation of morphological instruction into vocabulary teaching is rooted in the concept of "efficiency". A fundamental challenge arises from the balancing act between the sheer volume of words to be taught and the limited time available for instruction. Given the

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considerable time investment required to teach each individual word, there is a pressing need to enhance efficiency through strategic approaches like word formation (Zhang, 2020; Zhang & Pei, 2022; Zoski et al., 2018). This strategy presents itself as a viable solution, as many complex words adhere to predictable patterns and rules. Even in instances where learners have not encountered specific complex words, they can deduce the meanings by analyzing the structural components, particularly when contextual clues are lacking. By imparting an understanding of the patterns underlying complex word formation, educators not only simplify the learning process but also cultivate a tendency for independent word acquisition, thereby fostering long-term lexical development (Baumann et al., 2003; Bowers et al., 2010).

2.3 Empirical Studies on Morphological Instruction

Due to the crucial role of morphological instruction, significant progress is being made within the realm of vocabulary teaching to explore effective methods for enhancing learners' morphological awareness. Current morphological intervention typically includes three key steps: breaking down derived words, comprehending their constituent parts, and synthesizing the meanings of these parts to derive the overall meaning (Rastle & Merkx, 2011; Wysocki & Jenkins, 1987). However, there has been a notable lack of emphasis on syntactic and distributive knowledge in this regard (Baumann et al., 2002, 2003; Bowers & Kirby, 2010; Crosson & Moore, 2017; Harris et al., 2011; Lin, 2019; Liu, 2014).

2.3.1 Instruction of Relational Knowledge

Research into the instruction of relational knowledge has predominantly focused on syntagmatic knowledge. Syntagmatic knowledge pertains to the understanding of the internal structure of derived words, with its acquisition commonly assessed through morphological decomposition.

The segmentation of complex words holds utmost significance as it serves as the foundational step in morphological analysis or problem-solving (Bowers & Kirby, 2010; Taft & Forster, 1975). Numerous studies have consistently demonstrated the positive impact of morphological intervention on learners' comprehension of the structural intricacies within complex words (Amirjalili et al., 2018; Foorman, 2021; Good, et al., 2015; Gellert et al., 2020; Harris, 2011; Lin, 2019; Yuan & Tang, 2023). For instance, Amirjalili et al. (2018) conducted a study where bases and affixes were isolated from derived words before being exposed to the learners, thus enhancing awareness of morphemic boundaries and reinforcing sensitivity to the linear structure of entire words. Harris et al. (2011) utilized "word maps" to highlight the relationship between complete words and their constituents. Similarly, Lin (2019) clarified the process of word formation to augment learners' awareness of complex word forms. Other studies have involved instructing learners to divide complex words into constituent parts or identify component morphemes through activities like circling (Foorman, 2021; Good et al., 2015; Gellert et al., 2020).

The morphological decomposition utilized in the aforementioned studies is deemed necessary, yet falls short in capturing the full extent of linguistic complexity. Numerous root morphemes undergo

alterations in form during derivation, while certain affixes may exhibit spelling modifications due to phonetic considerations. Consequently, the morphological decomposition approach fails to fully encapsulate the original structure of morphemes. Furthermore, while learners instructed in morphological decomposition outperformed their peers in identifying morphemes, they may not have sufficiently grasped the paradigmatic relationships between different derived words.

Unlike the studies mentioned earlier, a subset of research has employed word family or morphological series to illuminate the paradigmatic relationships within complex words (Bowers & Kirby, 2010; Brimo, 2016; McCutchen et al., 2013). For instance, in Foorman's (2021) investigation, participants were prompted to generate words by adding an affix to a given base. The base-centric approach (Bowers & Kirby, 2010) helped learners to organize their lexicon by word family, enabling swift decomposition of complex words through rapid access to the mental representation of the base. Most target words chosen in these studies are bimorphemic, characterized by high-frequency free morpheme bases, and the majority of base-affix combinations do not cause change in form, thus heightening the likelihood of morphemic identification. However, it is noted that an analysis solely dependent on base recognition for morphological structure understanding is superficial (Carlisle, 2010). While previous studies have reported robust decomposition skills as a result of morphological instruction, it remains unclear whether such intervention techniques can prevent learners from overgeneralizing the structure of simplex words, including pseudo-morphemes, to complex words.

In contrast to scholars employing a base-centric methodology, Brimo (2016) embraced the affix-centric approach, wherein learners categorized words based on affixes. Regrettably, no significant facilitative effects were observed in the assessment of affix identification. Further investigation is warranted to clarify how learners detect the paradigmatic relationship between derived words, particularly L2 learners who may possess lower sensitivity to morphological knowledge compared to native speakers (Silva & Clahsen, 2008).

2.3.2 Instruction of Semantic Knowledge

Decomposition provides an avenue for deciphering the semantic content of derived words. As derived words are constructed from meaningful morphemes, prior research has emphasized the methodology through which learners deduce the meaning of a word from its constituent parts.

Through a generative approach (Harris et al., 2011), current research primarily guides learners in inferring the meanings of entire words based on the meanings of their components. For instance, Harris et al. (2011) encouraged students to consult a provided list of constituent meanings provided by the teacher and then integrate them to deduce the meaning of the word. Brown et al. (2016) and Foorman et al. (2021) aided students in comprehending the affixes by observing the semantic changes that occur during derivation. These studies aimed to reconstruct partial meanings or dissect whole-word meanings through semantic addition or subtraction, disregarding the necessity for affix meanings to exist independently. In reality, affixes serve as shared morphemes of derived words with paradigmatic

relationships and function as attachments to morphological constructions, therefore, detached affixes are meaningless (Booij, 2010). Learners ought to develop their ability to apply analogical analysis based on morphological series to facilitate the transfer of their skills to the learning of new words (Good et al., 2015).

Several studies employ metalanguage to explain the meanings of affixes (Foorman, 2021; Davidson & E. O'Connor, 2019; Lin, 2019). However, this approach presents two primary limitations. Firstly, it fails to adequately illustrate the functions of affixes for English suffixes that lack equivalent morphemes in learners' first language (e.g., suffixes that primarily contribute grammatical meaning to the base) and synonymous prefixes that cannot be distinguished solely based on equivalent morphemes. Consequently, the metalinguistic definitions utilized in previous studies impede learners' active processing of morphological information (Bowers & Kirby, 2010). Secondly, the target words selected in these studies often occur in isolation from morphological series, thereby hindering learners' understanding of morphemes. An optimal understanding of morphemic meanings is achieved when learners encounter the same morpheme in various morphological and syntactic contexts (Carlisle, 2010).

2.3.3 Instruction of Syntactic Knowledge and Distributional Knowledge

Numerous studies have explored the linguistic meanings of affixes, with only a limited number of studies focusing on their linguistic functions. Instructional methodologies which primarily centered on rules of word formation revealed that the experimental group outperformed their counterparts in tests determining the parts of speech of learned derived words (Amirjalili & Jabbari, 2018). However, Foorman et al.'s (2021) study found no significant difference between the two groups in nonword part-of-speech judgment tasks. It may be because the experimental group merely mechanically retained the knowledge, which might not effectively transfer to new words.

Research on distributional knowledge primarily involves guiding learners to observe the combination of morphemes by comparing members of morphological families, which positively influences learners' understanding of morphemic meanings (Amirjalili & Jabbari, 2018; Foorman et al., 2021; McCutchen et al., 2021). However, this method has not demonstrated any significant enhancement in learners' ability to apply distributional knowledge (Lin, 2019).

Overall, the function of affixes determines the distribution or combinatorial rules of morphemes, indicating the influence of syntactic knowledge on the acquisition of distributional knowledge. Therefore, further investigation into the acquisition of these two types of knowledge is justified.

2.4 Theoretical Foundation of the Present Study

Based on the insights gleaned from prior research, this study endeavors to pioneer a novel instructional approach known as "affix index". This methodology aims to enhance the capacity of L2 learners to generalize their understanding of morphological knowledge by probing into the nuances of derivative structures. Additionally, the study seeks to illuminate the theoretical underpinnings that emphasize the

impact of morphological instruction on learners' awareness of derivative constructions.

The concept of affix index draws inspiration from Construction Morphology (CxM) theory (Booij, 2010). Booij (2012) pointed out that sufficient encounters of words within the same morphological series, coupled with an understanding of the relationships between their stems, can foster the abstraction of morphological constructions. This phenomenon, termed "morphological context" in the current study, serves as a cue for discovering the connection among complex words, thus enhancing morphological awareness. However, while morphological series offer insights into morphemic relationships and distributions, clues regarding affix functions, morphemic meanings, and whole word meanings necessitate the incorporation of syntactic context. Regrettably, existing research predominantly compares the effects of morphological context and syntactic context on morphological knowledge acquisition, with limited integration of the two (Baumann et al., 2002, 2003; Hamada, 2014). The affix index, proposed by this study, serves as a tool that embeds morphological series within sentences, and affords learners exposure to both morphological and syntactic contexts simultaneously.

3. Method

To examine the efficacy of the affix index-based teaching mode in enhancing the acquisition of L2 derived words, this study conducted an experiment where learners underwent assessments of their morphological knowledge after the treatment. Teaching materials utilized affix concordances, in which the focus was on the affix rather than the base, akin to the Keyword in Context (KWIC) approach. Intermediate English L2 learners were enlisted as participants for the study.

3.1 Participants

A total of 60 first-year English majors from a language university in China participated in this study, with 10 individuals solely engaged in rating the familiarity of words chosen for the teaching experiment. According to self-report, all participants demonstrated comprehension of the concepts of root, affix, and part of speech. Their involvement commenced at the onset of the academic year, preceding the initiation of university courses. Consequently, this study employed their college entrance examination scores (out of 150 points) and vocabulary size test (Nation & Beglar, 2007) scores (out of 140 points) as criteria for grouping. The 50 remaining participants were divided into two groups: an experimental group (EG) that received instruction utilizing the affix index method, and a control group (CG) that received no instructional intervention. An Independent Samples T-test was conducted to analyze the college entrance examination scores ($t = 0.809$, $df = 48$, $p = .422 > .05$) and vocabulary test scores ($t = .477$, $df = 48$, $p = .635 > .05$) between the two groups, indicating no significant differences. Therefore, the two participant groups can be deemed homogeneous concerning English proficiency (see Table 1).

Table 1. Descriptive Data of the College Entrance Examination Scores and Vocabulary Test Scores for the Two Groups of Participants

Groups	N	Age	College Entrance Exam			Vocabulary Size Test		
			M	SD	Range	M	SD	Range
EG	25 (F: 21)	18.76	132	9.323	102-145	55.16	11.112	33-71
CG	25 (F: 22)	18.50	130	8.114	109-139	53.84	8.229	34-70

Note: EG = Experimental Group; CG = Control Group; F = Female; M = Mean; SD = Standard Deviation

3.2 Materials

This study employed two distinct categories of materials: instructional materials and assessment materials. The instructional phase selected learned words, whereas the assessment phase included novel words. The strategic use of learned words in the instructional component is aligned with one of the objectives of this study, i.e., to explore the efficacy of the affix index teaching approach in aiding L2 learners to establish interconnections among derived words within their mental lexicon, thus facilitating the formation of relevant morphological constructions. Additionally, the study aimed to assess whether this instructional approach could foster morphological awareness among learners, and enable them to apply previously acquired knowledge to the learning of new words. This rationale underpins the incorporation of novel words in the assessment materials.

3.2.1 Materials for Teaching

In order to ascertain that participants had prior familiarity with the target words, derived words were selected from word lists and texts in English textbooks used in local junior and senior high schools. A total of 36 derived words were identified, comprising 6 affixes: 3 common negative prefixes (*dis-*, *non-*, and *un-*) (White et al., 1989), and 3 frequently occurring suffixes (*-al*, *-ly*, *-en*) (Goodwin & Lipsky, 2012). Each group of 6 words shared one of these affixes and formed distinct clusters. It is noteworthy that each affix has at least two distinct linguistic functions and meanings, and is capable of altering the parts of speech (hence referred to as part-of-speech-altering affixes, White et al., 1989). To establish affix concordances, each of the 36 derived words was embedded in a sentence with contextual cues for its meaning and part of speech. Additionally, the six sentences within each group were vertically aligned to highlight the shared affixes for increased salience (see Appendix A).

To validate the selection of words, word familiarity ratings were conducted using a 5-point scale (1 = least familiar, 5 = most familiar) by 10 participants who were not involved in either the teaching experiment or the subsequent tests. Results indicated that all target words received ratings of 4 (more familiar) or 5 (most familiar), suggesting the suitability of the chosen words for the study (M = 4.676, SD = 0.213, Range: 4.24-4.92).

3.2.2 Materials for Testing

The test consisted of two distinct sections. Section 1 assessed relational knowledge, while Section 2 evaluated syntactic, distributional, and semantic knowledge (refer to Appendix B for the test items). Participants, who had previously completed familiarity ratings, identified unfamiliar words from a selection of candidates. Only those chosen by all the ten participants were incorporated as test items.

In Section 1, there were 36 target words alongside 36 fillers. The target words included the affixes used in the teaching experiment and were categorized into groups of six: four derived words (with identical parts of speech as in the teaching experiment, two for each part of speech) and two monomorphemic words lacking morphological structure but sharing the same letter string as the target affix. The inclusion of monomorphemic words aimed to assess potential overgeneralization of relational knowledge. Fillers comprised derived words or monomorphemic words not orthographically related to the affixes under study.

Section 2 included 24 target words and 24 fillers. These target words shared affixes with words from the teaching experiment. Root words were high-frequency free morphemes sourced from middle school textbooks, allowing for inferring the whole word meaning through morphological analysis. Target words were divided into six groups, each of which contained four words: two real words and two pseudowords. Pseudowords were created through inappropriate combinations of a free morpheme and a letter sequence overlapping with the target affix. Half of the fillers were composed of real derived words, while the remaining half were pseudo-derived words formed according to word formation rules; neither the real nor pseudo affixes overlapped orthographically with the target affixes under study.

All test items were presented in a random order.

3.3 Procedures and Predictions

The EG engaged in a 40-minute morphological instruction session, succeeded by a 25-minute paper-and-pencil morphological test (immediate post-test). Conversely, the CG did not take part in morphological instruction but solely undertook the immediate post-test. This study aimed to scrutinize the short-term impact of the instructional method advocated herein on the acquisition of L2 morphological knowledge.

Subsequently, two weeks later, the EG underwent the test again (delayed post-test), with a reorganized sequence of test items compared to the initial assessment. This phase sought to evaluate the enduring impact of the instructional approach. For comparative analysis of performance between the two tests within the EG, each participant received a unique test number to be inscribed on both test papers. Notably, the CG did not participate in the delayed post-test.

3.3.1 The Teaching Experiment

The researcher conducted a morphological intervention with the aim of guiding students to discern morphological relationships among derived words with a common affix, utilizing affix concordances as instructional aids. Participants were expected to activate their knowledge of target affixes when

encountering new words composed of these affixes.

Outlined below are the detailed teaching steps for one of the affixes:

Step 1: The instructor delivered a presentation via PowerPoint containing 6 affix concordances exemplifying the target affix. Below is a sample of affix concordances for reference.

We apologize for the late	arrival	of the train.
His only chance of	survival	was a heart transplant.
Clearance of the site required the	removal	of a number of trees.
This will reduce the	environmental	risks to our health.
We live in	central	London.
Her words had a	magical	effect on us.

Step 2: Under the guidance of the instructor, students observed the concordances and engaged in discussions pertaining to the following questions.

(1)   What common characteristics do the prominent words share?

(2)   From what roots do these words originate?

(3)   Does the spelling change when the root and the affix "-*al*" are combined?

(4)   What do the roots mean? What are their respective parts of speech?

(5)   What are the parts of speech of the prominent words? Are they consistent with the parts of speech of the roots? How about their meanings?

(6)   Can you illustrate the prominent words with schemas? For instance, the schema for words like "*worker*", "*teacher*", and "*seller*" is $[[X]_V er]_N$.

(7)   Can you identify any other words that can be categorized under the same schema as the prominent words?

3.3.2 The Test

The EG were allocated to a separate classroom distinct from the CG. The CG commenced the test upon completion of the teaching experiment for the EG.

Instructions for both test sections were presented in Chinese, accompanied by examples to enhance comprehension of the requirements. In Section 1, participants were tasked with determining whether test items could be segmented into roots and affixes. If affirmative, they were to write down the morphemes using a "+" sign; a "×" was to be marked if negative. Participants earned 2 points for correctly identifying each monomorphemic word. Since derived words could be deconstructed into roots and affixes, with some roots undergoing changes during derivation, participants needed to

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accurately spell both components to earn 2 points. Identification of only one morpheme resulted in the allocation of 1 point.

In Section 2, participants were tasked with determining the authenticity of given words. If they deemed a word to be genuine, they were instructed to mark a "√" in the parentheses to exhibit their distributional knowledge. Additionally, participants were expected to predict the part of speech (n./v./adj./adv.) to demonstrate their syntactic knowledge, and provide the corresponding Chinese equivalent to showcase their semantic knowledge, with these responses recorded on the provided lines. Conversely, if they believed a word to be pseudo, they were to mark a "×". Each correct answer garnered 1 point.

The scoring distribution for the four facets of morphological knowledge was as follows: relational knowledge: 72 points, distributional knowledge: 24 points, syntactic knowledge: 12 points, and semantic knowledge: 12 points. The total score for the entire test amounted to 120 points.

Two weeks later, the EG underwent the test once more.

3.3.3 Predictions

In the immediate post-test, an Independent Samples T-test would be used to compare the scores between the EG and the CG. A superior performance by the EG would suggest successful activation of morphological knowledge related to the test items due to instructional intervention. In the delayed post-test, a Paired Samples T-test would be employed to analyze scores across both tests, aiming to ascertain the maintenance of morphological awareness in the EG's long-term memory. The absence of significance would indicate a positive long-term effect of the affix index teaching mode on the acquisition of L2 morphological knowledge.

4. Results and Discussion

The filler data were excluded, and the remaining dataset concerning the critical words was analyzed to explore the influence of the teaching method using the affix index on the acquisition of L2 derivational morphological knowledge.

4.1 Results from the Immediate Post-test

The Independent Samples T-test conducted for the immediate post-test revealed statistically significant differences between the EG and the CG across all four aspects of morphological knowledge: relational knowledge ($t = 3.973$, $df = 48$, $p = .000 < .05$), distributional knowledge ($t = 3.545$, $df = 48$, $p = .001 < .05$), syntactic knowledge ($t = 6.835$, $df = 48$, $p = .000 < .05$), and semantic knowledge ($t = 5.593$, $df = 48$, $p = .000 < .05$). Overall, the EG, which received instruction based on the affix index, outperformed the CG in the test of morphological knowledge ($t = 6.656$, $df = 48$, $p = .000 < .05$) (see Table 2).

Table 2. Descriptive Data of the Immediate Post-test for the Two Groups of Participants

Groups	N	Relational knowledge		Distributional knowledge		Syntactic knowledge		Semantic knowledge		Comprehensive knowledge	
		M	SD	M	SD	M	SD	M	SD	M	SD
EG	25	56.76	5.093	14.24	1.615	9.76	1.535	6.40	2.021	87.16	7.504
CG	25	51.08	5.016	12.32	2.174	5.72	2.525	3.16	2.075	72.28	8.284

The present study aimed to investigate the presence of overgeneralization of relational knowledge. This involved conducting a detailed analysis of the identification of monomorphemic words in the first section of the immediate post-test. Results showed that both groups demonstrated overgeneralization tendencies, notably in the segmentation of monomorphemic words with apparent morphological structures (e.g., *dismiss*) into two pseudo-morphemes (e.g., *dis + miss*). However, comparative analysis did not yield any statistically significant variance in the extent of overgeneralization between the two groups ($t = .879$, $df = 48$, $p = .384 > .05$). Thus, the instructional approach employed in this study neither worsened nor alleviated the tendency towards overgeneralization of relational knowledge among learners.

4.2 Results from the Delayed Post-test

A Paired Samples T-test was conducted to investigate the enduring impact of morphological intervention on the acquisition of L2 derivational knowledge. Results did not show substantial variance between the two tests concerning comprehensive morphological knowledge ($t = 1.286$, $df = 24$, $p = .211 > .05$), relational knowledge ($t = -.370$, $df = 24$, $p = .715 > .05$), and semantic knowledge ($t = -.173$, $df = 24$, $p = .864 > .05$). Conversely, statistically significant differences were observed in distributional knowledge ($t = 2.418$, $df = 24$, $p = .024 < .05$) and syntactic knowledge ($t = 3.733$, $df = 24$, $p = .001 < .05$) (see Table 3).

Table 3. Descriptive Data of the Immediate Post-test and the Delayed Post-test Taken by the EG

Tests	N	Relational knowledge		Distributional knowledge		Syntactic knowledge		Semantic knowledge		Comprehensive knowledge	
		M	SD	M	SD	M	SD	M	SD	M	SD
IP	25	56.76	5.093	14.24	1.615	9.76	1.535	6.40	2.021	87.16	7.504
DP	25	57.16	4.879	13.20	1.979	8.56	2.063	6.48	2.468	85.40	7.065

Note: IP = immediate post-test, DP = delayed post-test

The findings indicated that intervention via the affix index facilitated the EG in transferring morphological knowledge to morpheme identification and comprehending new words, with this transfer ability enduring over a considerable period. However, regrettably, the instructional impact on

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the remaining two knowledge dimensions gradually diminished over time.

4.3 Discussion

Results obtained from the immediate post-test revealed that the average scores of the EG surpassed those of the CG significantly in comprehensive morphological knowledge and its respective four dimensions. This suggests a substantial enhancement in morphological analysis among participants instructed using the affix index method. This outcome aligns with the findings of Amirjalili and Jabbari (2018). The influence of the instructional approach employed in this study on the acquisition of L2 derivational morphological knowledge will be examined from four distinct perspectives below.

4.3.1 Effects on the Acquisition of Relational Knowledge

This study provides valuable insights into the impact of instructional methods on the acquisition of relational knowledge, particularly concerning the deciphering of irregular morphological forms. Furthermore, it lends support to the assertion that morphological instruction should systematically address the complexities of complex word structures (Bowers & Kirby, 2010). A significant finding of this research was the EG's enhanced accuracy in judging the separability of derived words compared to the CG. This finding resonates with existing literature that highlights the effectiveness of targeted interventions techniques in improving learners' morphological awareness and decomposition skills (Amirjalili et al., 2018; Harris et al., 2011; Liu, 2014; White et al., 1989). In Section 1 of the test, participants in the CG, who did not undergo experimental intervention, exhibited some level of morphological decomposition, indicating pre-existing relational knowledge. However, this ability was influenced by the transparency of morphological structure. Specifically, while the CG demonstrated sensitivity to derived words with evident morphological structures, they struggled with those containing alterations in the base form. For instance, 52% of CG participants viewed "*recital*" as indivisible, whereas only 8% of the EG held this perspective. It indicates that learners face challenge in decomposing complex words particularly when the morphological relationship between components is less transparent (Carlisle, 2000).

Another finding was that the EG demonstrated accurate identification and spelling of base forms and affixes when analyzing derived words, while a portion of their counterparts exhibited a higher incidence of spelling errors. For instance, 68% of participants in the CG parsed "*gladden*" into "*glad*" and "*den*", compared to 28% in the EG. The ability of both groups to accurately identify the base form could be attributed to their familiarity with the high-frequency word "*glad*". However, the significant disparity in their recognition of the affix suggests an increased sensitivity in the EG towards the affix "*-en*" following instructional intervention. They could activate previously acquired affix knowledge when encountering new word structures containing this affix, and transfer to the learning of novel word structures. Conversely, the CG's segmentation of the letter string "*den*" from the whole word did not demonstrate morphological awareness. This is further evidenced by their interpretation of another word, "*referral*", where almost two-thirds of the CG perceived the meaningless syllable "*ral*" as a morpheme.

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It indicates that Chinese learners, whose native language is an analytic one with fewer morphemes (Lin, 2019), tend to decode words based on syllables due to the influence of Chinese pinyin (Yu, 2021).

This study argues that the CG, which did not receive instructional treatment, relied on the familiarity with root words to decide whether derived words could be decomposed. Therefore, the morphological changes in root words may reduce their sensitivity to morphological structure. In the teaching experiment, as morphemes were presented in a structured manner, the EG not only paid attention to individual affixes but also recognized recurring morphemic elements across different words. This helped the EG internalize relational knowledge over time, as observed in the delayed post-test. Like Baumann et al.'s (2000) study, which emphasizes the role of morphemic elements in facilitating morphological analysis, the present study reinforces the crucial role of the instructional methodology in strengthening learners' sensitivity to morphological structures.

4.3.2 Effects on the Acquisition of Distributional Knowledge and Syntactic Knowledge

Two crucial contextual cues provided by morphological series include the alteration of the root form, as discussed in Section 4.3.1 of this article, and the composite pattern between the root and affix, specifically the distribution of morphemes.

The results from the second section of the test revealed the EG's superior judgment of morphemic combinations, indicating their benefit from the morphological intervention. The test items, consisting of unfamiliar words, eliminated the possibility of participants' relying on pre-existing mental lexicons, prompting them to engage in morphological processing. When participants identified a target word as real, it implied that they decomposed the word and then decided whether the combination of morphemes adhered to word formation rules. The improved performance of the EG suggests their ability to recognize constituent morphemes and activate stored morphological constructions, thus validating combinations based on variables in the constructional schema. Research has shown that learners with a strong understanding of morphological rules tend to perform better in tasks involving unfamiliar words or morphemic combinations (Nagy & Anderson, 1984).

Completing a lexical decision task entails not only considering the syntagmatic relationships between morphemes but also the paradigmatic relationships among derived words, along with the linguistic functions of affixes and the part of speech of the roots. The morphological series employed in the teaching experiment provided the EG with a rich morphological context, helping them to generalize, store, and activate morphological constructions when they encountered new words. This finding is in line with Construction Morphology theory (Booij, 2010) concerning the interplay between syntagmatic and paradigmatic relationships in word processing, and corroborates the notion that exposure to morphological series enhances word representations (Bowers et al., 2010). While the morphological context generated positive effects on the acquisition of distributional knowledge by offering cues for paradigmatic relationships, the syntactic context gave hints for the part of speech of derived words and facilitated the EG to understand the functions of the target affixes, namely, the syntactic knowledge.

To investigate the impact of morphological instruction on the discrimination of the linguistic functions of affixes, this study selected six affixes, each exhibiting at least two distinct morphological patterns capable of generating complex words across various parts of speech. An analysis of the results from the syntactic knowledge test revealed a notable contrast between the two groups, indicating a superior grasp of the multifaceted functions of affix by the EG. It is attributed to the systematic and explicit instruction that encourages morphological analysis in a strategic way (Zoski et al., 2018). In contrast, lacking the strategic morphological instruction provided to the EG, the CG predominantly relied on affix family size, as posited by Crossley et al. (2023), to ascertain word classes.

Given that the affixes under scrutiny possess varying productivity levels, with some exhibiting greater compositional ability, the CG were likely to overgeneralize words derived from less productive affixes into dominant parts of speech categories. Moreover, despite the positive impact of morphological instruction on the acquisition of distributional and syntactic knowledge, its enduring effects were limited, potentially due to insufficient sample words within the instructional materials to provide robust stimulus. It suggests a need for further investigation into the design and implementation of morphological instruction to enhance its long-term efficacy. Finally, the nonexistence of long-term effects of instruction on distributional and syntactic knowledge underscores the interrelation between these two aspects of morphological knowledge, elucidating how they intersect to facilitate the formation of derived words.

4.3.3 Effects on the Acquisition of Semantic Knowledge

In contrast to the aforementioned types of knowledge, the enduring positive influence of morphological instruction on the acquisition of semantic knowledge is noteworthy. In the immediate post-test, the enhanced ability of the EG to identify the polysemy of affixes following morphological instruction aligns with Baumann et al.'s (2002) findings emphasizing the significance of morphemic and contextual analyses in deducing word meanings. Specifically, the EG in the present study demonstrated an aptitude for understanding the semantic nuances contributed by affixes within morphological constructs. Conversely, the CG, lacking comprehensive representations of the meanings of less productive affixes, tended to rely on superficial interpretations of affix meanings, potentially leading to inaccuracies in understanding word meanings. For instance, the CG interpreted the three negative prefixes in this study solely as "not", thus translating them into Chinese equivalents like "不" or "没": nonfat as "不胖" (not fat) , unwrap as "不包裹" (not to wrap), and discolour as "没颜色" (not having colour).

Different from this study, Baumann et al.'s (2002) study did not identify any enduring instructional effect on learners' ability to infer the meanings of transfer words. This disparity might be attributed to the 5-week interval between immediate post-test and the delayed post-test, which is longer compared to the relatively shorter period of time in this study.

This study demonstrates the critical role of affixes in shaping the semantic content of words, complementing the core meaning carried by roots (Bowers & Kirby, 2010; Ng et al., 2022). It is essential to grasp the significance of affixes, particularly prefixes, in shaping root meanings to accurately interpret the semantic content of a word (Carlisle, 2010). Introducing derived words through affix sorting, akin to the affix index utilized in this research, affords learners the opportunity to discern spelling patterns of morphemes, thereby establishing connections between form and meaning (Zoski et al., 2018). Proficiency in recognizing the semantic nuances conveyed by affixes empowers learners to make precise lexical choices, steering clear of literal or oversimplified translations.

In essence, this study offers evidence that morphological knowledge should be taught in contexts rather than in isolation (Freeman et al., 2019). Presenting words within morphological families proves advantageous in alleviating cognitive load during the learning process (Bowers & Kirby, 2010).

5. Conclusions

This study sheds light on the intricate process where learners actively engage with morphological information, weaving together complex morphological schemas as they encounter derived words with common affixes in affix concordances. The findings highlight the profound efficacy of this pedagogical approach in nurturing the acquisition of L2 morphological knowledge. Particularly noteworthy are the immediate and enduring effects of morphological instruction on various facets of linguistic competence, including relational, semantic, syntactic, and distributional knowledge, with sustained effects observed primarily in the relational and semantic aspects. Learners demonstrated a heightened sensitivity to the underlying morphological structures, facilitating their processing of opaque word-form information. This, in turn, led to improved accuracy in deducing meanings of novel words by referring to acquired morphological schemas. Moreover, learners exhibited refined abilities in the discernment of morphemic combination and parts of speech, supported by enhanced analogical reasoning capabilities.

While this study focused on a specific instructional methodology, its outcomes reveal promising horizons for morphological pedagogy and carry profound implications for L2 morphological instruction. Future studies can examine the application of affix index in teaching novel words, so as to substantiate its efficacy in facilitating vocabulary acquisition. Moreover, forthcoming research endeavors can employ autonomous testing modules to assess different aspects of morphological knowledge. Finally, more instructional sections and longer duration may facilitate the evaluation of the sustained effects of morphological instruction grounded in affix index.

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Appendix A. Affix Concordances Used in the Teaching Experiment

We apologize for the late	arrival	of the train.
His only chance of	survival	was a heart transplant.
Clearance of the site required the	removal	of a number of trees.
This will reduce the	environment	risks to our health.
We live in	central	London.
Her words had a	magical	effect on us.

She is wearing a	golden	ring.
The house was surrounded by a	wooden	fence.
I gave my mum a	woolen	scarf as a present.
If you wear the mask, you will	frighten	the baby.
The university hopes to	strengthe	its ties with the community.
They have to	widen	the road due to heavy traffic.

You look	lovely	in that dress.
He is a warm and	friendly	person.
We back up our computer files at work on a	daily	basis.
The children are playing	happily	on the beach.
We'll repair it as	quickly	as possible.
She folded the letter and put it in her pocket	carefully	.

This is an area reserved for	nonsmokers	and you cannot smoke here.
This so-called translation is pure	nonsense	.
Do you know Gandhi's policy of	nonviolence	?
You don't have to pay. It is a	nonprofit	organization.
Though he is	nonprofession	, he is a first-class player.
British Airways offers	nonstop	flights from London to New York.

He was	unhapp	at being left out of the team.
We were	unlucky	with the weather. It rained constantly.
It would be	unfair	not to let you have a choice.
I need a key to	unlock	the door.
It's not too late to try and	undo	some of the damage.
Could you	undress	the kids for bed, Steve?

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Appendix A. Affix Concordances Used in the Teaching Experiment (Continued)

One major	disadvantag	of the area is the lack of public transport.
If the exercise causes	discomfort	, stop immediately.
She is deaf, but refuses to let her	disability	prevent her from doing what she wants to do.
No, I	disagree	. I don't think it would be the right thing to do.
The plane	disappeared	behind a cloud.
You will be punished if you	disobey	the rule.

Appendix B. Target Words for the Test

Section 1

Affixes	derived words				Words orthographically overlapped	
-al	vocational	accidental	recital	referral	federal	medieval
-en	gladden	hasten	leaden	earthen	pollen	craven
-ly	beastly	shapely	respectively	genuinely	ghastly	grisly
non-	nonstandard	nonparty	nonfiction	nonrestraint	nonetheless	nonce
un-	unearth	unfreeze	uneven	unrest	untoward	unwary
dis-	disproportion	discontent	disregard	disengage	dispute	dismiss

Section 2

Affixes	Real words		Pseudo words	
-al	parental	horizontal	fastal	contental
-en	ashen	fatten	thinnen	keepen
-ly	wholly	queenly	periodly	selectly
non-	nonfat	nonwhite	nonperform	nonjudge
un-	unmask	unwrap	unlove	unmatch
dis-	discolour	disconnect	disflower	disfat