Automatic Adverb Error Correction in Korean Learners' EFL Writing

Jee-Eun Kim

Department of English Linguistics
Hankuk University of Foreign Studies, Imun-Dong, Dongdaemun-Gu, Seoul, 130-791, Korea

ABSTRACT

This paper describes ongoing work on the correction of adverb errors committed by Korean learners studying English as a foreign language (EFL), using an automated English writing assessment system. Adverb errors are commonly found in learners' writings, but handling those errors rarely draws an attention in natural language processing due to complicated characteristics of adverb. To correctly detect the errors, adverbs are classified according to their grammatical functions, meanings and positions within a sentence. Adverb errors are collected from learners' sentences, and classified into five categories adopting a traditional error analysis. The error classification in conjunction with the adverb categorization is implemented into a set of mal-rules which automatically identifies the errors. When an error is detected, the system corrects the error and suggests error specific feedback. The feedback includes the types of errors, a corrected string of the error and a brief description of the error. This attempt suggests how to improve adverb error correction method as well as to provide richer diagnostic feedback to the learners.

Keywords: An Automated Writing Assessment System, EFL, Adverb Errors, Adverb Categorization, Error Classification, Mal-rules, Error Correction and Diagnostic Feedback

1. INTRODUCTION

The field of research on building an automated writing assessment system is constantly growing as developing practical applications of natural language processing for foreign language learning. Systems handling English writings have been spotlighted because of the importance of English serving as the international common language. Major goals of building such systems include implementation of the functions to detect grammatical errors and possibly correction of the errors. Among the errors recognized in learners' writings, prepositions and determiners have been given more attention than other parts of speech in automatic identification of grammatical errors [2], [5], [6], [8]. Preposition and determiner related errors are also viewed as the most common among the errors committed by East Asian non-native speakers as claimed in [8]. The situation is not different for Korean learners of English. Those learners are observed to frequently commit common errors in the use of adverbs. Adverbs occur frequently in sentences, make important contributions to sentence meaning, and serve various grammatical functions in a sentence.

In the natural language processing field, there are only a handful of attempts to tackle the problems of adverbs although significant work has been done in linguistics. Adverb errors are complicated to be expressed in rules because of the nature of adverbs. Compared to other parts of speech, they are heterogeneous from one another in their forms. There are also various ways to form an adverb, including a phrasal adverb such as '*on purpose*' which is composed of a preposition and a noun. The position of adverb in a sentence is much less restricted than other parts of speech. This characteristic makes it difficult to systematically generalize position related phenomena; that is, it is complicated for adverb errors to be described in grammar rules. In addition, the occurrence of adverb errors is less frequent than preposition or determiner errors. Due to these various factors, identifying adverb errors in an automatic writing assessment system has rarely been approached.

This paper suggests a method to automatically identify and correct English adverb errors appeared in EFL writings composed by Korean learners. Even though adverb presents complicated aspects described above which cause frequent learners' errors, few systems has attempted to focus on adverb and its errors. Correcting adverb errors is a part of the automatic process of English error correction which is an ongoing research project to develop a full-fledged automated English writing assessment system designed to detect various types of grammar errors committed by Korean learners. In order to systematically generalize adverbs, they are initially categorized according to their grammatical functions, meanings and positions within a sentence. Adverb errors are manually identified from learners' sentences, sorted out into appropriate

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* Corresponding author. E-mail : jeeeunk@hufs.ac.kr

categories, and then implemented into mal-rules in addition to general rules to analyze grammatical sentences. Adverb error types are classified adopting a traditional error analysis method. Both adverb categorization and error classification have been implemented using mal-rules. When an adverb error is detected by the system, the error is corrected and error-specific diagnostic feedback is provided.

This paper is organized as follows. The next section describes an adverb error analysis, along with adverb categorization and adverb error classification. In section 3, a methodology of automatic adverb error identification and correction is discussed. Section 4 presents implementation results. Finally, section 5 concludes the paper, suggesting a future research direction.

2. EMPIRICAL ANALYSIS

The three steps in traditional error analysis discussed in [4] have been considered when examining learners' sentences. Those steps refer to effective recognition, description and explanation of errors, which have to be well thought of and implemented into a computational system. In other words, the errors occurred in a learner's sentence should be recognized for a right reason, ruling out false errors. The characteristics of errors should be described explicitly so that the errors can be systemically generalized. When an error is detected, the context where the error occurs also needs to be well explained.

For effective recognition, errors have to be captured from learners' sentences along with identification of the following criteria; 1) LINGUITIC LEVEL which refers to pronunciation, grammar, vocabulary and style, 2) FORM which includes omission, insertion and substitution, 3) TYPE, and 4) CAUSE disclosing sources of errors, which are categorized as two domains, interference and interlanguage. Among the criteria, LINGUISTIC LEVEL, FORM and TYPE have been selected and considered for the analysis that this research has performed, excluding CAUSE.[1] LINGUISTIC LEVEL implemented in the system includes lexical/morphological and syntactic levels, at which different types of errors are detected. The notion of FORM has been adopted for error classification; all of the three categories are considered. Omission refers to an absence of a sentence component which should appear in a grammatical structure whereas insertion is considered as the presence of a component which should not occur to be grammatical. Substitution is defined as the use of an incorrect form of a component or a structure instead of a grammatical one.

The traditional analysis makes a distinction between an error and a mistake by adopting TYPE; the former is a result of a lack of linguistic competence whereas the latter is performance based. The system, however, does not distinguish one from the other because one of the goals for an automated writing assessment system is to provide the learners with a report on *any* kind of errors that are found in their writings. In other words, there is no need to distinguish one from the other since the errors of both types cause ungrammaticality of the writings.

The system identifies the errors based on their linguistic characteristics, rather than TYPE. For example, the lexical level of processing captures both errors and mistakes. If an error is a typographical mistake, it is recognized as a spelling error. When an error is related to inflection, it is identified as a morphological error.

2.1 Adverb Categorization

An adverb is known as a word that modifies or adds information to a verb, an adjective, another adverb, a clause or a sentence. Adverbs in a clause serve as a modifier or an adverbial which is an element of a clause structure. They are, however, too heterogeneous to be handled systematically [4]. The heterogeneity is caused by some of the following characteristics. First, many of adverbs represent multiple meanings. Second, their occurring position is rather free in a sentence. Third, their syntactic classification cannot be completed without semantic considerations whose implementation in a computational system is still an ongoing research area.

From a linguistic point of view, adverbs have been rather fully examined in terms of grammatical functions and meanings [11]. Adverbs are categorized into subjunct, adjunct, disjunct and conjunct according to their grammatical functions. These four categories are further divided based on the specification of differences in meaning and preferred positions in a sentence.

Table 1. Adverb Categorization

Class based on Grammatical Function	Subclass based on Meaning & Position	Example
Subjunct	Courtesy	please, courteously
	Volitional	purposely, intentionally
	Focusing Restrictive	only, in particular[2], especially
	Additive	also, even
	Emphasizers	even, indeed, in fact
	Intensifiers	very, extremely, completely
	Downtoners	somewhat
Adjunct	Manner	happily, quickly, fast, well
	Direction, Place	here, there, away
	Time	then, now, recently
	Frequency	hardly, always, often
Disjunct	Degree of truth	frankly, seriously
Conjunct		anyway, so

Table 1. presents the adverb categorization implemented in the lexicon of the system. The information on the categorization is looked up and used as constraints for identifying a linguistic structure containing adverb errors. Currently, the lexicon has listed 684 entries for adverb. Four major classes based on grammatical functions have been

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[1] Error analysis focusing on CAUSE has been discussed in [10].

[2] Two-part adverbs are listed in the lexicon as an entry.

assigned to most of the entries; 317 entries are categorized as subjunct, 142 as adjunct, 128 as disjunct and 46 as conjunct. Some of the subclasses have been merged since separating them into different classes requires further research.

2.2 Adverb Error Classification

When learners' sentences were analyzed, three basic categories have been identified as a set of problematic grammatical features of English adverbs; 1) constituent confusion, 2) misordering, and 3) inappropriate usage. These categories, then, were further classified into five classes in order to generate feedback as error-specific as possible. The grammatical features have been expressed as the surface realizations of a sentence structure, which were then identified by a set of mal-rules. The followings are the description of five classes to identify adverb errors.

1. The form of an adverb is ungrammatical. This is realized as a spelling or inflection error. Most of the errors in this category are detected in the morphological level of processing.

2. An adverb can be confused with a synonymous adverb which has a different syntactic or semantic property. For example, *too* and *either* imply the same meaning, but they are different in their syntactic distribution. When they occur at the end of the sentence, indicating there is a connection with someone or something previously mentioned, *too* has to be used in a positive sentence. *Either*, however, has to appear in a negative sentence. This category is mapped to the errors of inappropriate usage, which is identified at the time of syntactic processing.

3. An adverb is confused with a word with different part of speech, which is linked to the constituent confusion error category. Some of the errors in this category are found when an adverb is used where another part of speech is appropriate as in "*She became famously.*". Adverb *famously* is incorrectly used when the verb *become* specifically requires an adjective *famous*. In other cases, a word other than adverb occurs erroneously replacing an adverb. Adjectives and nouns appear to be the typical ones which are most often confused with adverbs in learners' sentences. For example, *nice*, an adjective is used replacing *nicely* as in "*The work is done nice.*" In addition, an adverb *today* can be confused with its noun sense as in "*I will see her on today.*" where a preposition, *on* is used before *today* to form an adverbial, assuming it is a noun. The errors of this category have to be checked in conjunction with collocated components of the sentence. The errors are detected at the syntactic level of processing.

4. A syntactic position normally occupied by an adverb is incorrect. For example, *always* in "*She makes always me happy.*" must precede the verb *make*, rather than following the verb. This class falls in the misordering category which is regarded as the incorrect placement of an adverb. The current version of the system has implemented 6 placement positions

where adverb is allowed to occur in a grammatical sentence. The first position is the sentence initial position. The second is the sentence medial position which is further classified into three positions; 1) between the subject and the main verb, 2) between the subject and the first auxiliary of the main verb phrase, and 3) after the main verb phrase. The third placement position applies to an adverb which serves as a modifier, and has been further classified into two position types; 1) pre modifiers such as *very*, which precede a modificant, and 2) post modifiers such as *enough*, which follow a modificant. The errors violating a placement position are detected by a syntactic analyzer.

5. A required adverb is omitted or unnecessary one is inserted. Omission and insertion errors have to be checked in the light of semantics rather than syntax. For example, an adverb *often* is missing from learners' sentences as in "*I heard Mary play the piano*" when the intended meaning requires to include *often* or a synonymous adverb as in "*I often heard Mary play the piano.*". The sentence with an adverb omission or insertion error is not necessarily syntactically ungrammatical, but does not coincide with the intended meaning of the question. The current version of the system detects omission and insertion errors by evaluating semantic similarities between the learner's sentence and its corresponding correct answer. The similarities are calculated by identifying the differences between the dependency structures of the two sentences. The errors of this category are considered as a mapping error.

3. ERROR IDENTIFICATION METHOD

Adverb error classification described in section 2.2 is implemented as error production rules, namely mal-rules in the system. When an input sentence is entered, appropriate rules are activated to identify errors while consulting the dictionary information including adverb categorization in particular.

3.1 System Overview

The system is developed aiming to detect and correct overall grammatical errors from a sentence composed by Korean learners of English and offers appropriate feedback on the errors as well as a score[3].

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[3] The current system is an upgraded version of the system introduced in [10].
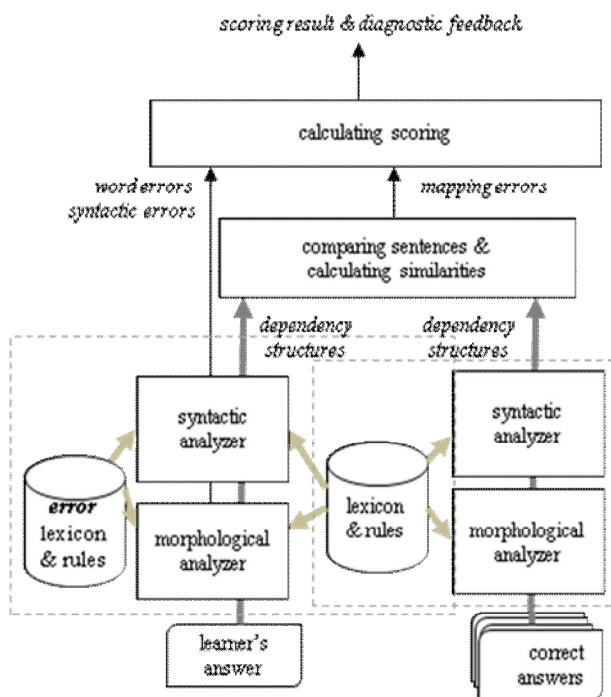
Fig. 1. System Overview

Fig. 1 presents an overview of processing English grammar errors. Adverb errors as well as other grammar errors are detected at two different stages of processing. The initial stage is "intra-sentential error detection module" to identify errors which occur within a sentence, and serves as a main parser. Before the system analyzes a learner's input, it parses a set of questions and their corresponding answer sentences provided by teachers. The sentences undergo morpho-syntactic processing, and then they are converted to a simplified dependency structure based on the parsing result. A dependency structure is represented by a set of nodes and relations between the nodes. Each content word in the sentence is mapped to a node containing the information on grammatical features such as number, person, and aspect. The relations represent a syntactic relation between the nodes, such as subject, object, and so on. The processing result is stored in a database. Error classes 1 to 4 described in section 2.2 are identified by this module.

When a learner writes a sentence according to a given question, the system parses it by activating a morpho-syntactic analyzer. This module detects various types of errors such as spelling/morphological, mechanical and syntactic errors. The sentence is then converted to a dependency structure which is to be compared with a set of teacher-provided answers stored in the database. The information of each error is saved for an error report to be referred when error specific feedback is generated for the learners.

The other stage is "inter-sentential error detection module" which identifies errors by comparing dependency structures of a learner's sentence and its corresponding correct answer. Even when the learner's sentence is evaluated as syntactically grammatical, the sentence is yet to be determined as a correct answer due to the following reasons; 1) not containing appropriate tense, number, or person information, 2) failing to

convey the meaning intended by the question, 3) containing unnecessary words or expressions in the sentence, and so on. In such cases, the errors can only be detected by comparing the learner's sentence with the teacher-provided answer set. Semantic similarities between the learner's sentence and a correct answer are calculated by identifying the differences between the two dependency structures. Each node in the dependency structure of the learner's sentence is mapped to the most similar node in the corresponding dependency structure among the answers. Comparing the dependency structures, the system identifies mapping errors, such as mismatching feature values between the nodes, missing nodes, unnecessary nodes, and so on. Error class 5 is identified by this module.

3.2 Data Collection

The data were collected through a test given to the 3rd grade students at junior high school. 81 questions were developed by junior high school teachers who also prepared the corresponding answers. 360 students from two different junior high schools in Seoul participated in the test. Through the test, 29,160 sentences were collected in total. However, 14,258 unique sentences were sorted and used for the research after discarding identical sentences and incomplete sentences. Adverb errors were then manually recognized from those sentences and categorized into appropriate classes.

3.3 Construction of the Rules

Grammar rules are constructed to parse the sentences based on augmented phrase structure grammar which is an upgraded version of phrase structure grammar by adopting attribute-value structures. Conditions and actions are utilized in the grammar, which provides the system with effective constraints on judging grammaticality. Implementing such effective constraints, in turn, determines the accuracy of the system performance. The rules are divided into two types; general rules to parse grammatical sentences and mal-rules to detect erroneous structures. A mal-rule is an error grammar production rule to detect grammar errors while parsing an input sentence. Errors are also identified by general rules applying the grammatical constraints to the input sentence. Mal-rules or error detecting constraints are constructed by formulating error patterns which are manually identified from learners' sentences.

The rules make use of a set of CONDITIONs and a set of ACTIONs. A CONDITION serves as a constraint by which a rule is applied to a constituent with a specific structure. In other words, all the CONDITIONs have to be satisfied for a rule to be fired. While checking the CONDITONs, errors can be recognized and saved with error identification (error ID) for an error report which becomes a basis for diagnostic feedback. When all the CONDITIONs are satisfied, a set of ACTIONS are performed, assigning the head of the structure, a structure type, and a set of features identified.

3.4 Error Detection and Correction

The adverb error classification described in section 2.2 has been implemented in mal-rules. The information on adverb categorization provided in section 2.1 is consulted and used as constraints to specify the context where an error occurs.

INPUT SENTENCE: *She makes always me happy.*

IF	\<subclass of adverb = FREQUENCY> and \<preceding string = main verb>
THEN	\<assign VERB_ADV_ORDER_ERROR as an error ID>

Fig. 2. Misordering

INPUT SENTENCE: *The work is done nice.*

IF	\<POS of current string = adjective> and \<preceding string = a main verb & the verb ≠ sense verb[4]>
THEN	\<assign ADV_ADJ_CONFUS_ERROR as an error ID>

Fig. 3. Constituent Confusion with Adjective[5]

INPUT SENTENCE: *I will see her on today.*

IF	\<POS of current string = noun> and \<one of the other POS of lexeme = adverb & class of the adverb = ADJUCT & subclass of the adverb = TME> and \<POS of preceding string = preposition>
THEN	\<assign ADV_NOUN_CONFUS_ERROR as an error ID>

Fig. 4. Constituent Confusion with Noun

INPUT SENTENCE: *I don't like it, too.*

IF	\<sentence = negative> and \<preceding string = a comma> and \<class of the adverb = DISJUNCT & adverb ≠ negative >
THEN	\<assign "ADV_NEG_ERROR" as an error ID>

Fig. 5. Inappropriate Usage

The examples shown in Fig. 2 through Fig. 5 represent the mal-rules or the constraints implemented within general rules to identify adverb errors at the syntactic level. The mal-rule described in Fig. 2 detects a misordering error if both of the CONDITIONs are satisfied; the adverb in process is a member of Frequency class, and it occurs following the main verb in the

sentence. The first CONDITION shows the use of adverb categorization and the second describes the fourth categories of the error classification. Fig. 4 describes a mal-rule to identify a constituent confusion error, which also makes use of adverb categorization and error classification. The rule in Fig. 5 specifies contextual information by which an inappropriate usage error is identified, checking adverb features in the CONDITION.

As an error ID assigned in ACTION provides a basis for generating a corrected string and appropriate feedback for the error, each ID is mapped to a brief explanation of the error. The corrected string is produced based on the given ID along with the information on the error occurring position within the sentence.

4. IMPLEMENTATION RESULTS

When a learner's sentence is parsed, the parsing result is displayed on the screen, using the system interface. The same screen shows the question, the learner's answer and a teacher provided answer which is selected as the closest to the learner's sentence. Each parsing result includes the followings: 1) the total score of the learner's sentence in addition to the scores obtained from each processing stage, 2) a corrected string or a highlighted string when the erroneous string has to be simply omitted, and 3) a brief explanation of the error. The followings are the captures of the screens displaying the results produced by the automatic identification of various adverb errors.
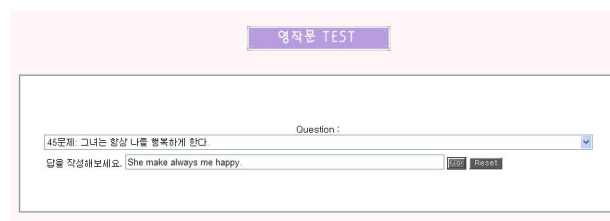

Fig. 6. A Learner's Answer to a Question

Fig. 7. Automatic Error Correction Result - Misordering

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[4] The verbs are also categorized considering their argument types. The sense verbs include taste, smell, look, feel, sound and seem.

[5] It is found that identifying errors on constituent confusion with adjective does not require the information on adverb classification.

Fig. 8. Automatic Error Correction Result – Constituent Confusion

Fig. 6 presents a screen captured when a learner has completed entering an answer sentence according to a given question. Fig. 7 and Fig. 8 represent examples of diagnostic feedback, which was generated based on the results of correcting two different types of adverb errors, misordering and constituent confusion, respectively. The corrected word order is suggested in Fig. 7, and the erroneous string to be omitted is highlighted with red in Fig. 8. The feedback is expected to help the learners understand the nature of the errors and be able to rewrite the sentence by correcting the errors.

5. CONCLUSION

This paper proposed an approach to correcting adverb errors, using an automated English writing assessment system. The sentences composed by Korean learners of English were examined manually. Adverb errors were isolated from the sentences and classified into five categories. Adverbs were also categorized based on their grammatical functions and meanings. Adverb specific error classification was implemented in mal-rules, utilizing adverb categorization information. The generated output showed that the system has identified various adverb errors described in section 2.2 and produced appropriate diagnostic feedback along with their corresponding corrected strings.

The followings will be considered in the future to improve the performance of the system:

1. Adverb categorization will be revisited to refine the classification in the light of both syntax and semantics.
2. Updated error classification will be implemented in the form of mal-rules or grammatical constraints.
3. More learners' sentences will be collected. From larger data, more various types of errors are expected to be recognized.
4. The data will be updated and increased in terms of the size. General English corpus is to be added to study the context where each adverb occurs.

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Jee-Eun Kim
She received the B.S. in English from Hankuk University of Foreign Studies, Korea in 1985, and also received M.S. and Ph.D. in linguistics from Georgetown University, USA in 1989 and 1993 respectively. She had been with Microsoft and Microsoft Korea from 1995 till 2003. She has been with Hankuk University of Foreign Studies since 2008. Her main research interests include computational linguistics and natural language processing.