EAGLE: an Error-Annotted Corpus of Beginning Learner German

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Abstract

This paper describes the Error-Annotted German Learner Corpus (EAGLE), a corpus of beginning learner German with grammatical error annotation. The corpus contains online workbook and and hand-written essay data from learners in introductory German courses at The Ohio State University. We introduce an error typology developed for beginning learners of German that focuses on linguistic properties of lexical items present in the learner data and that has three main error categories for syntactic errors: selection, agreement, and word order. The corpus uses an error annotation format that extends the multi-layer standoff format proposed by Lüdeling et al. (2005) to include incremental target hypotheses for each error. In this format, each annotated error includes information about the location of tokens affected by the error, the error type, and the proposed target correction. The multi-layer standoff format allows us to annotate ambiguous errors with more than one possible target correction and to annotate the multiple, overlapping errors common in beginning learner productions.

1. Introduction

Corpora of learner language provide useful data for research in language acquisition and the development of natural language technology. Learner productions provide insight into the language acquisition process and annotated learner corpora allow researchers to easily search for particular phenomena. Annotated data is also useful for developing and customizing tools such as part-of-speech taggers and spell checkers for non-native speakers (cf. Granger, 2003; Meurers, 2009). To support research in these areas for learners of German, we have created the Error-Annotted German Learner Corpus (EAGLE), which is the first freely available error-annotted corpus for beginning learners of German.

2. Data

The learner language data in the EAGLE corpus consists of responses to course-related activities from students in the second and third courses of The Ohio State University’s introductory German sequence. Two main types of data were collected: online workbook responses and final exams. In order to focus on data suited for grammatical error annotation, the EAGLE corpus contains responses to only those activities where the learners were instructed to respond in complete sentences. In the activities where responses were automatically assessed by the online workbook, students often made multiple submissions until they reached the target answer. Each of these responses is stored separately in the corpus.

In total, there are 59,068 tokens in 6,986 responses to 412 activities. When duplicate responses to the same activity are removed (since many students arrived at the same target answer for a given activity), there are approximately 33,000 tokens in 3,500 responses containing a total of 7,500 sentences.

2.1. Online Workbook Data

The online workbook subcorpus contains data collected from the Deutsch: Na Klar! Online Workbook, 4th Edition (Briggs, 2003). Responses were collected from 50 learners (38 in the second course and 12 in the third course) during one quarter at The Ohio State University. The online workbook contains a wide variety of activities including translation exercises, cloze questions, build-a-sentence questions, etc. which the learners completed outside of class with access to reference materials. A translation exercise with sample learner responses is shown in Figure 1.

The online workbook responses range from answers to multiple choice questions to short essays. In order to focus on data suited for grammatical error annotation, the EAGLE corpus contains responses to only those activities where the

Translate into German:

To whom do these articles of clothing belong?

Sample responses:

Wem hat diesen Kleidungsstücke
Wer gehört diese Kleidungen?
Wem gehört diese Kleidungsstücke?
Wem gehörten diesen Kleidungsstücken?
Wem gehörnten dieser Kleidungsstücke zu?
Wem gehören dieser Kleidungsstücke zu?
Wem gehören diese Kleidungsstücke?
Wem gehören dieser Kleidungsstücke?
Wem gehören diese Kleidungsstücke?
Wem gehören diese Artikel der Kleidung?

Figure 1: Sample Exercise from Online Workbook

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2.2. Essay Data

The essay subcorpus contains hand-written essays from 81 learners (43 in the second course and 38 in the third course) collected during a different quarter at Ohio State. The learners are instructed to respond in complete sentences. In the activities where responses were automatically assessed by the online workbook, students often made multiple submissions until they reached the target answer. Each of these responses is stored separately in the corpus.

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1Due to the anonymous data collection, it is not possible to determine whether any of the same learners appear in both the
learners could choose from several different topics and the essays were written as part of a timed exam without access to reference materials. The hand-written data was keyed in and the subcorpus contains 12,412 tokens in 81 essays with an average of 16 sentences per essay.

2.3. Preprocessing

The collected data was tokenized using Stefanie Dipper’s German tokenizer (Dipper, 2008) and then anonymized to remove all potentially identifying personal names, streets, cities, and states. In order to maintain coherence in longer responses, each anonymized item receives a code such as “CITY-4” or “FIRSTNAME-13” that is used consistently throughout the corpus.

3. Error Annotation

The EAGLE error typology and annotation format focus on the annotation of grammatical errors present in the learner data. Before the grammatical error annotation begins, non-word spelling errors are corrected as described in section 3.1. Then, the grammatical error typology described in section 3.2 is applied using the multi-layer standoff format described in section 3.3. Each sentence in the corpus is annotated independently without regard to context. If there is no context in which the sentence could be uttered, a series of one or more corrections are annotated that transform the ungrammatical sentence into a grammatical one. Each correction includes information about which tokens are affected by the error, the type of error, and the proposed target correction.

3.1. Non-Word Spelling Errors

Non-word spelling errors were identified and corrected to either a word with the smallest edit distance or to a literal spelling of the word. These corrections build a small spelling error corpus with 1,697 tokens for 1,234 type non-word spelling errors. A sample of the spelling errors shown in Table 2 illustrates a wide range of error types. The spelling errors identified in the EAGLE corpus have not yet been systemically analyzed. For a detailed analysis of spelling errors by non-native writers of German, see Rimrott (2005).

3.2. Error Typology

The error typology, which is informed by two previous classification schemes from Rogers (1984) and Juozulynas (1994), who respectively addressed errors by advanced and intermediate learners of German. The error typology includes five main types of errors: word form (errors within single words that are not non-word spelling errors), selection, agreement, word order, and punctuation. Examples of each type of error are shown in Figure 3. The error types related to grammatical errors – selection, agreement, and word order – focus on linguistic properties of the lexical items present in the data and the relations between these items. Detailed error annotation schemes for these types are shown in Figures 4–6. Each type of error is subcategorized by grammatical features of the words, phrases, or topological fields (Höhle, 1986) affected by the error. For most error types, the annotation proceeds bottom-up by considering the relations between lexical items present in the data. For instance, determiner-adjective-noun agreement is checked whenever a noun phrase with a determiner or adjective is found in a response; if a sentence does not contain any such noun phrases, there is no need to consider determiner-adjective-noun agreement. Exceptions to this are the word order errors that examine the positions of topological fields in a top-down fashion and the “Sentence” selection error, which also checks top-down for the presence of main clauses and finite verbs in each sentence.

3.3. Error Annotation Format

The EAGLE grammatical error annotation uses a multi-layer standoff format first proposed for learner error annotation by Lüdeling et al. (2005) for the FALKO corpus of advanced learner German (Siemen et al., 2006). This format is chosen in order to account for situations where a) errors span multiple words, b) learners make multiple overlapping errors in a single sentence, and c) errors are ambiguous. Standoff annotation allows multiple overlapping errors to be annotated easily and multiple layers allow for multiple target corrections to be specified in the case of ambiguities.

As in Lüdeling et al. (2005), each type of error encompasses three layers in the annotation: location, description, and target. The location layer identifies which words, phrases, or clauses are affected, the description layer specifies the particular type of error such as a subject-verb agreement error, and the target layer gives the target correction that corresponds to the error description. The target correction makes explicit the annotator’s hypothesis about the learner’s intended utterance and shows the correction for the specified error.

Example (1) shows a sentence with multiple errors that will be used in the following sections to illustrate the annotation format. It contains a noun phrase *dieses Hunden* ‘this dog’ where the determiner and the noun disagree in gender, case, and number and a verb complement *Wen* ‘whom’ in the wrong case. First, the agreement error will be considered. Figure 7 shows the appearance of the standoff annotation layers for agreement errors in this example.

| Morphological | *gestudiert/studiert (studied)* |
|---------------|---------------------------------|
|               | *machte/machte (made)*          |
|               | *wollst/willst (want)           |
| Typographical | *heißt/heißt (is called)*       |
|               | *Koffert/Koffert (suitcase)*    |
| Capitalization| *wetter/Wetter (weather)*       |
|               | *maria/Maria*                   |
|               | *hut/Hut (hat)*                 |

Figure 2: Example Non-Word Spelling Errors

(1) * Wen gehört *dieses Hunden? whom.A belongs.sg this_dog_N/A.sg dog_masc,D.pl

‘Whom does this dogs belong?’
### Error Type Example Detailed Error Description

#### Word Form
- Ja, Ich zeige ihn ihnen.
- yes, I show him them
- Target: Ja, ich zeige ihm ihnen.
- Capitalization

#### Selection
- Hast du der Reiseprospekt\textsubscript{nom.?} have you the travel brochure\textsubscript{nom.}
- Target: Hast du den Reiseprospekt?
- Verb - NP Complement Case

#### Agreement
- Du arbeiten in Liechtenstein.
- you work\textsubscript{st/3rdplural} in Liechtenstein
- Target: Du arbeitest in Liechtenstein.
- Subject-Verb Agreement

#### Word Order
- Welcher Job diese Dinge verlangen würde?
- which job these things require would
- Target: Welcher Job würde diese Dinge verlangen?
- Finite Verb Position

#### Punctuation
- Gehört dir diese Jacke?
- belongs you this jacket
- Target: Gehört dir diese Jacke?
- Missing Sentence-Final Punctuation

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#### Figure 3: Types of Errors Annotated

| Tokens | Wen | gehört | dieses | Hunden? |
|--------|-----|--------|--------|---------|
| Location | | | | |
| Description | | | | |
| Target | | | | |

Figure 7: Agreement Error Annotation Layers

If we want to annotate the agreement error in \textit{dieses Hunden}, we identify the affected tokens, determine the type of error, and give a target correction as in Figure 8 below.

#### Figure 8: Agreement Error Annotation

| Tokens | Wen | gehört | dieses | Hunden? |
|--------|-----|--------|--------|---------|
| Location | | | 1 | |
| Description | | | Det-Noun Agreement | |
| Target | | | dieser Hund | |

3.3.1. Incremental Analysis

Because responses from beginning learners often contain multiple errors (cf. Heift, 2003), we extend the basic annotation format of Lüdeling et al. (2005) to include error numbering, which is specified in the location layer for each error. The error numbering allows the annotator to specify a series of incremental corrections, each with its own detailed error description, that convert the learner’s response into a grammatical target. Each step assumes that previous corrections have been made, which allows us to address phrase-internal errors, such as agreement errors, before considering selection or word order. For example, all of the words in a noun phrase need to have the same number, gender, and case before it is possible to determine whether that noun phrase is grammatical as a particular complement of a verb.

In example (1) from the previous section, the subject \textit{dieses Hunden} ‘this dogs’ needs to be internally consistent before an annotator can determine whether the subject agrees with the verb \textit{gehört} ‘belong’. In this case, the phrase \textit{dieses Hunden} ‘this dogs’ would be annotated as containing a determiner-noun agreement error with the target correction \textit{dieser Hund} ‘this dog (nom sg)’ and once this is complete, the subject-verb agreement can then be examined and be determined to be grammatical. After examining the subject-verb agreement, we can turn to the other verb complement from the example, \textit{Wen} ‘whom’. Instead of an accusative complement \textit{Wen}, the verb \textit{gehört} requires a dative complement \textit{Wem} ‘to whom’. The annotation including both the agreement error and this verb complement case error is shown in Figure 9 below.

#### Figure 9: Incremental Error Annotation

| Tokens | Wen | gehört | dieses | Hunden? |
|--------|-----|--------|--------|---------|
| Agr. Loc. | | | 1 | |
| Agr. Desc. | | | Det-Noun Agreement | |
| Agr. Target | | | dieser Hund | |
| Sel. Loc. | 2 | | | |
| Sel. Desc. | | | NP Compl. Case | |
| Sel. Target | Wen | | | |

When the two target corrections in Figure 9 are applied to the original sentence, we arrive at a grammatical target sentence:

\[(2) \text{Wem gehört dieser Hund?} \quad \text{to whom belong,1.sg this\textsubscript{masc,N.sg}\ dog\textsubscript{masc,N.sg}} \]

‘To whom does this dog belong?’

For example (1), the order in which in the errors are annotated is not important because they do not overlap, but in many instances, the order in which the errors are annotated plays an important role in making it possible to annotate errors that depend on previous target corrections. We will return to the issue of overlapping errors after discussing ambiguous errors in the next section.

3.3.2. Dealing with Ambiguous Errors

Example (1) also illustrates how ambiguous errors, such as a large percentage of agreement errors, can cause difficulties in creating consistent annotation. Considering only the
noun phrase from the previous example, an annotator could have just as easily corrected *dieses Hunden* ‘this dogs’ to *diesen Hunden* ‘these dogs (D pl)’, which would have had both the incorrect number and case as the subject of the sentence. This would have led to further corrections to reach a grammatical target. In order to avoid these kinds of inconsistencies, an annotator chooses the target that minimizes the total number of errors annotated for the given sentence. Thus, instead of trying to minimize the edit distance between the learner response and the target correction, as in many existing error annotation schemes, the EAGLE annotation tries to minimize the total number of annotated errors.

Figure 4: Selection Error Typology

Figure 5: Agreement Error Typology

Figure 6: Word Order Error Typology
often arise in agreement errors, the EAGLE annotation scheme includes two additional layers in the agreement type for a second error description and a second error target. The additional layers are shown in the example in Figure 10, which is described in detail in the next section.

### 3.3.3. Overlapping Errors

A final issue common in learner language productions is overlapping errors. Since different types of errors are annotated in different layers, the multi-layer standoff format makes it simple to annotate such errors. Example (3) shows what the multi-layer standoff format looks like for a response with multiple overlapping errors. This example, which combines errors from several actual learner responses, contains four errors: 1) a subject-verb agreement error, 2) a noun phrase argument in the wrong case, 3) a word order error in the subordinate clause, and 4) a word order error in the main clause. The EAGLE multi-layer standoff annotation for example (3) is shown in Figure 10. In order to show overlapping word order error spans, the word order error layers have been divided into two sets of layers for the main and subordinate clauses.

(3) Als Sofie las, machte sie Reisepläne.

3.4. EAGLE Corpus Annotation

We are using the Partitur (‘musical score’) Editor from the EXMARaLDA (Extensible Markup Language for Discourse Annotation) Project (Schmidt, 2001) to perform the annotation and will distribute the EAGLE corpus in EXMARaLDA XML format. The annotation of the online workbook subcorpus by a single annotator is complete. The frequencies of the main error types are summarized in Figure 11 and the most frequent errors are shown in Figure 12.

### 4. Conclusion and Future Work

The EAGLE corpus is the first corpus of freely available error-annotated data for beginning learners of German and we hope that the error annotation will be useful for research in the areas of language acquisition and intelligent computer-aided language learning. Future work includes the annotation of the essay subcorpus and annotation by additional annotators in order to evaluate the inter-annotator agreement for our error annotation scheme. On the basis of this corpus, we also plan to explore the automatic detection and diagnosis of word order errors for beginning learners of German.

### Acknowledgements

I would like to thank Kathryn Corl from the Department of Germanic Languages and Literatures at The Ohio State University for her assistance in collecting the data and I am grateful to Detmar Meurers, Chris Brew, Michael White, Kathryn Corl, and anonymous reviewers for their helpful feedback.

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| Error Category       | Error Description                                                                 | Count |
|---------------------|-----------------------------------------------------------------------------------|-------|
| Agreement           | Subject-Verb – Number                                                             | 354   |
| Selection           | Verb – NP Complement Case                                                         | 329   |
| Agreement           | Det-Adj-Noun – Gender                                                             | 255   |
| Selection           | Sentence – Finite Verb Missing                                                    | 201   |
| Selection           | Preposition – Complement Case                                                    | 197   |
| Agreement           | Subject-Verb – Person                                                             | 154   |
| Agreement           | Det-Adj-Noun – Case                                                              | 126   |
| Selection           | Verb – Complement Missing                                                        | 121   |
| Agreement           | Det-Adj-Noun – Number                                                            | 115   |
| Selection           | Verb – Two-Way PP Complement with Verb of State/Location                          | 112   |
| Word Order          | Finite Verb – Main Clause                                                        | 108   |

Figure 12: Most Frequent Grammatical Errors in the Online Workbook Subcorpus

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