SPELL CHECKING IN COMPUTER-ASSISTED LANGUAGE LEARNING: A STUDY OF MISSPELLINGS BY NONNATIVE WRITERS OF GERMAN

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ABSTRACT

This thesis investigates spell checking in Computer-Assisted Language Learning. It analyzes nonnative misspellings and evaluates the performance of a generic spell checker. A total of 1027 unique misspellings were collected from 32 beginners and 16 intermediate university learners of German who worked on two different task types. CLASSY, a classification system for nonnative misspellings that has been developed for this thesis, is introduced. CLASSY categorizes misspellings along four taxonomies: competence vs. performance, linguistic subsystem, language influence, and target modification. Results show that 72% of the nonnative misspellings are competence-related rather than accidental typographical mistakes. Furthermore, the generic spell checker tested on the misspellings of this study corrects only 62% of them. The study also indicates that both proficiency level and task type influence the learners' misspellings and affect the spell checker's correction success. Finally, the thesis makes computational and pedagogical suggestions to enhance spell checking for foreign language writers.

DEDICATION

An Friedrich P.J. Rimrott (1927 – 2003)

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GLOSSARY

CALL	Computer-Assisted Language Learning
CLASSY	Classification System for Nonnative Misspellings
L1	First language
L2	Second or foreign language
MV	Multiple violation(s)
SLA	Second Language Acquisition
SV	Single violation(s)

CHAPTER 1: INTRODUCTION

The field of Computer-Assisted Language Learning (CALL) is comprised of diverse computer applications aimed at enhancing the teaching and learning of foreign languages. CALL programs can support listening, speaking, reading, and/or writing skills in a foreign language. This thesis addresses computer-assisted foreign language writing, in particular, foreign language spell checking.

In his introduction to CALL, Warschauer (1996) recognizes three distinct functions of the computer in CALL: *computer as tutor, computer as stimulus*, and *computer as tool*. In his opinion, spell checkers, along with other proofing tools such as grammar checkers, are part of the *computer as tool* function. They empower foreign language learners to understand and use language without necessarily providing them with language learning material.

Researchers have frequently studied the use of word processing and proofing tools in CALL (e.g., Pennington, 1991a, 1991b, 1992, 1993a, 1993b; Iwai, 1997; Hawisher, 1989; Collins, 1989; Biesenbach-Lucas & Weasenforth, 2001; Phinney, 1996). Generally, previous research has concentrated on the quality of computer-assisted writing, the effects of word processing on writers and their revision behaviour and attitudes. In addition, popular proofing tools such as grammar and style checkers have been discussed with respect to their usefulness for nonnative writers (e.g., Tschichold, 1999; Johannessen, Hagen & Lane, 2002; Holmes & de Moras, 1997; Burston, 1998). Much less attention has been paid to the spell checker (Gupta, 1998).

Spell checkers, however, have become highly desirable tools in the foreign language writing classroom due to their apparent success in correcting misspellings. Yet, generic spell checkers are generally geared towards typical native speakers who mostly make accidental typographical mistakes. They are therefore primarily designed

to correct misspellings that involve predictable minimal deviations from the correct spellings. However, due to a lack of proficiency in the foreign language, nonnative writers typically produce errors that tend to deviate from the correct spellings in more substantial ways. These errors are thus harder to correct by a generic spell checker.

Recent development of spell checking tools targeted at nonnative writers (e.g., Ndiaye & Vandeventer Faltin, 2003) is indicative of the interest in specific spelling aids for foreign language learners, especially in a CALL setting. It is surprising, however, that the algorithms of the few spell checking aids that have been developed for foreign language learners are generally not based on a detailed analysis of nonnative misspellings. In addition, generic spell checkers have not been thoroughly evaluated concerning their effectiveness in treating nonnative misspellings. This lack of empirical findings presents the starting point for this research project.

This thesis provides an empirical analysis of misspellings made by foreign language learners. In the spring semester 2004, 48 Anglophone learners of German participated in the present study. The participants were beginner and intermediate learners of German at a university level. A total of 1027 unique misspellings was analyzed. The data were collected from vocabulary and grammar exercises that were part of a CALL program used in the courses. This thesis presents an error classification system that discusses the types and frequencies of nonnative misspellings. It also evaluates the effectiveness of a generic spell checker in correcting nonnative misspellings and provides computational and pedagogical suggestions to enhance spell checking in CALL.

This chapter first presents an overview of previous research on spell checking. Section 1.1 begins with a brief exploration of generic spell checkers and their treatment of typical native speaker misspellings. Subsequently, research on generic spell checkers in relation to native speakers with spelling deficits and nonnative writers is discussed. Section 1.1 concludes with a description of spell checking programs that specifically target foreign language learners and their misspellings. Finally, section 1.2 identifies the research goals of this thesis.

Chapter 2 outlines the methodology of the present study. The 48 study participants are described in terms of their language proficiency, previous exposure to the target language and other learner variables such as age and gender. The CALL environment and the vocabulary and grammar exercises used in the present study are also presented. The chapter further describes the corpus of nonnative misspellings and the data collection as well as error classification procedures.

The topic of Chapter 3 is error classification. The chapter is divided into two sections: a review of literature on the classification of language learner errors and the presentation of CLASSY, the error classification system developed for the present study. The literature review identifies the contributions of error classification and discusses several taxonomies for classifying learner errors. The presentation of CLASSY describes the different error taxonomies used in the classification system and provides examples of nonnative misspellings from the error corpus of this study.

Chapter 4 discusses the types and frequencies of misspellings in the current study. The chapter examines the overall distribution of the 1027 misspellings. It also investigates the influence of proficiency level on nonnative misspellings by comparing the types and frequencies of misspellings made by beginner vs. intermediate learners. In addition, the chapter considers task type as a variable that may affect the kinds and frequencies of misspellings learners produce.

Chapter 5 presents an evaluation of a generic spell checker. The overall correction success rate of the spell checker in treating the misspellings from the corpus is analyzed first. The chapter also investigates the influence of proficiency level and task type on the outcome of the spell checking process.

The concluding sixth chapter provides a summary of the findings of this study and explores computational and pedagogical suggestions to enhance spell checking in CALL. The chapter also outlines possible avenues for future research.

1.1 Spell Checkers and Their Users

Spell checkers are employed by a variety of user groups. The following sections consider research on generic spell checkers and native speakers with and without spelling difficulties as well as nonnative speakers. In addition, research on spell checkers that are specifically designed for nonnative writers is discussed.

1.1.1 Generic Spell Checkers and Native Speakers

The task of computer-based spell checkers is to detect and provide correction alternatives for misspellings in written documents. The algorithms of generic spell checkers are designed to treat misspellings by native speakers. Helfrich and Music (2000), for example, report that an "early decision was to focus on native users, since we are developing a grammar checker and not a language-learning tool" (p. 1036) when designing grammar checkers with in-built spell checkers at *Microsoft*® Corporation (see also Dagneaux, Denness & Granger, 1998). The algorithms assume that most misspellings are accidental mistypings because generally, native speakers possess a high level of proficiency in their native language (L1):

> Most keyboarders know how to spell most words. The frequency of a misspelling seems to be determined more by the frequency of its parent word than by the difficulty of spelling it; most errors are mechanical (typos), not the result of poor spelling. (Pollock & Zamora, 1984, p. 362)

The algorithms of generic spell checkers are largely based on two empirical research findings. First, the vast majority of misspellings contain only a *single* error of omission (e.g., *<spel>/<spell>)[1], addition (*<sspell>), substitution (*<soell>), or transposition (*<sepll>) (Damerau, 1964; Pollock & Zamora, 1984). While Damerau (1964) found that approximately 80% of the misspellings in his corpus contained these single violations, Pollock and Zamora (1984) reported an even greater

[1] In this thesis, orthographic representations of examples are enclosed in angled brackets (e.g., <table>). Misspellings are preceded by a star (e.g., *<tabel>). The notation *<tabel>/<table> denotes that *<tabel> is a misspelling of the target spelling <table>. Further notational conventions include that English translations of German words are italicized and phonemes are enclosed in slashes (e.g., /t/).

proportion of 90 – 95%. As a corollary to this finding, most misspellings involve an edit distance of one, that is, they are within one character in length of the target word (Kukich, 1992).[2] Second, very few misspellings involve an incorrect *first* letter. In Yannakoudakis and Fawthrop's (1983) study, less than 2% of the misspellings were first-letter errors. Pollock and Zamora (in Kukich, 1992) found 3.3%; Mitton (1987) reported a proportion of 7%.

Generic spell checkers provide correction suggestions based on typographical variations of the misspellings (Gupta, 1998) rather than on a linguistic analysis of the cause of the error. Various spell checking techniques have been developed and, apart from problems with proper nouns, rare words, real-word errors (e.g., *<their>/ <there>), and word division errors (e.g., *<theschool>/<the school>), generic spell checkers successfully handle the majority of misspellings made by typical native speakers.[3] Kukich (1992) notes that "most researchers report accuracy levels above 90% when the first three guesses [in a spell checker's list of suggested spelling corrections] are considered" (p. 412). When all guesses are taken into account, the correction success is naturally even higher.

Generic spell checkers have been found to be much less successful when it comes to misspellings of nontypical users such as writers with spelling difficulties or nonnative writers. The following two sections discuss these user groups in turn.

1.1.2 Generic Spell Checkers and Native Speakers with Spelling Difficulties

Several studies have investigated misspellings by native speakers with spelling difficulties (e.g., Mitton, 1987; Montgomery, 1996; Pedler, 2001; MacArthur, Graham, Haynes & DeLaPaz, 1996; Montgomery, Karlan & Coutinho, 2001). Mitton (1987), for example, compared the misspellings of "passable spellers" to those of

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[2] Edit distance is defined computationally as the number of additions, omissions, substitutions, or transpositions needed to convert a misspelling into its target word. For example, the misspelling *<langiag>/<language> has an edit distance of two as one substitution and one addition is necessary to convert *<langiag> into <language>.

[3] For a more detailed discussion on spell checking problems, see Bolton (1993), Mitton (1996), and Kukich (1992). For spell checking methods and algorithms, see Mitton (1996), Kukich (1992), Berghel (1987), Peterson (1980), Damerau (1964), and Pollock and Zamora (1984).

"poor spellers" using a corpus of spelling errors made by 15-year old secondary school students in compositions.[4] He found that the misspellings of competent spellers mainly involved the above-mentioned single letter violations, whereas the misspellings of poorer spellers differed more substantially from the correct words. Although Mitton did not test a spell checker on the misspellings from his corpus, he concluded that spell checking algorithms that only offer correction alternatives for single letter violations are not adequate for many of the misspellings from his corpus.

Based on 974 misspellings by students with learning disabilities, Montgomery (1996) tested the effectiveness of nine spell checkers, including the generic spell checkers *WordPerfect® 5.2 for Windows®*, *Microsoft® Word® 6.0 (DOS)*, and *Microsoft® Works® 4.0*. Overall, the spell checkers provided appropriate correction alternatives for an average of 53% of the misspellings. Less than half the time, the target word was among the first 5 to 10 correction alternatives. Montgomery (1996) concluded that "spell checkers are ineffective in producing appropriate, online word choices for misspellings generated by students with learning disabilities" (p. xiii).

Similarly, Pedler (2001) surveyed the performance of three generic spell checkers (*Microsoft® Word®, Corel WordPerfect®,* and *Lotus Word Pro®*) on 577 distinct misspellings produced by dyslexic writers. For all three programs she found that for only approximately half of the misspellings, the target word was in the list of correction alternatives provided by the spell checkers. In around 50% of these cases, the target word was not among the first 5 suggested corrections. Roughly another quarter of the mistakes was flagged but not corrected, while the remaining mistakes were not detected at all. In line with Montgomery, Pedler (2001) concluded that spell checkers have "limited success with the correction of dyslexics' spelling errors" (p. 37).

[4] Based on a spelling pretest involving ten high-frequency English words, students with a less than perfect score were classified as "poor spellers" and students with 100% spelling accuracy were termed "passable spellers" (see Mitton, 1987).

1.1.3 Generic Spell Checkers and Nonnative Speakers

Only a few studies have touched upon the effectiveness of spell checkers in handling misspellings by foreign and/or second language (L2) learners, another nontypical user group. A study by Holmes and de Moras (1997) inspected the spelling correction component of a generic grammar checker. *Le Correcteur 101* is designed for native speakers of French and was tested on eight essays written by English university students. Overall, 77% of the orthographical errors were detected. However, of those misspellings that were not related to the incorrect use of accents, *Le Correcteur 101* was only able to detect 44%. The program flagged Anglicisms such as *<pleasante>, *<broiderie>, and *<ribbons> as unknown words. Holmes and de Moras (1997) concluded that "the software's usefulness would be extended if it were taught to anticipate some typical Anglophone errors" (p. 104).

Similarly, Burston (1998) evaluated the effectiveness of *Antidote 98*, a grammar and spell checker designed for native French speakers, when tested against 40 second-year student essays by Anglophone learners of French. In contrast to *Le Correcteur 101*, *Antidote 98* often alerts writers of the possible misuse of Anglicisms. While the program dealt with most misspellings effectively, Burston (1998) remarked that *Antidote 98* misidentified "some fairly obvious spelling errors" (p. 209) and failed to recognize sentence initial misspellings.

Although Kese, Dudda, Heyer, and Kugler (1992) did not conduct an empirical analysis, they nevertheless note some shortcomings of generic spell checkers with respect to misspellings that are "intuitively likely to occur" (p. 126) in the writings of nonnative speakers:

> Many more errors could be detected by a spelling corrector if it possessed at least some rudimentary linguistic knowledge. In the case of a word that takes irregular forms (like the German verb "laufen" or the English noun "mouse", for example), a standard system seems to "know" the word and its forms for it is able to verify them, e.g., by simple lexicon lookup. Yet when confronted with a regular though false form of the very same word (e.g. with "laufte" as the 1st/3rd pers. sg. simple past ind. act., or with the plural "mouses"), such a system normally fails to propose the corresponding irregular form ("lief" or "mice") as a correction alternative. (p. 126)

Along those lines, Allerton, Tschichold, and Wieser (2004) argue that generic spell checkers cannot adequately correct nonnative misspellings because, quite frequently, they differ from accidental typing mistakes. The authors maintain that algorithms that specifically target learner language are necessary in order to provide nonnative writers with appropriate feedback.

None of the above studies provide explanations on the exact nature of the shortcomings of generic spell checkers in handling misspellings by nonnative writers.[5] Furthermore, the studies do not distinguish between different groups of foreign language learners. For example, learner variables such as the learner's proficiency of the foreign language are not considered.

1.1.4 Spell Checkers Geared at Nonnative Speakers

The studies on spell checkers and nonnative writers cited above demonstrate that spell checkers have several limitations when it comes to correcting nonnative misspellings. Various programs have been developed in an attempt to enhance spell checking for nonnative writers.

Fallman (2002), for example, developed *the Penguin*, a descriptive grammar and spell checker that uses the Internet as a reference database to determine the spelling of idioms, colloquialisms, names, slang expressions, and words in general. The spell checker retrieves from the Internet the number of hits of a given string. If a writer is unsure of the spelling of a particular word or expression, the number of hits for alternative spellings can be compared to determine the correct spelling (i.e., the alternative with the most hits is likely to be the correct spelling). The main advantages of the spell checker are that it is nonprescriptive and language independent. It can be used complementary with a traditional spell checker to help nonnative writers decide on the correct spelling of words.

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[5] An exception to this is a study conducted by Rimrott and Heift (in press) in which 341 unique misspellings by 34 learners of German were investigated. The study revealed that the generic spell checker in the *Microsoft® Word® 2003* word processing software failed to detect or provide a correction alternative for 48% of the nonnative misspellings.

Bos (1994) describes *Het Spelraam*, a tutoring system for the conjugation and spelling of Dutch verbs. Given the notorious difficulty of spelling Dutch verbs, the system is intended as a spelling aid for writers with elementary spelling knowledge such as children or foreign language learners. The system presupposes that errors are systematic in that they are due to the correct application of incorrect knowledge. The correct spelling of Dutch verbs can be obtained by answering various questions concerning the morphosyntactic features of the intended verb form in a decision tree. Thus, if a verb is misspelled, the system tries to determine at what point in the decision tree the writer made the wrong choice and then guides him or her to the correct answer. Although the program had not been tested extensively at the time of publication, initial results from two pilot studies indicated that students made considerably less errors after using the program for several weeks.

Whereas Bos' (1994) program focuses on morphologically motivated misspellings, De Haan and Oppenhuizen (1994) describe *SPELLER*, a program that mainly targets phonologically motivated misspellings. *SPELLER* is an intelligent tutoring system that supports Dutch students in the learning of English spelling by engaging them in dialog-like interactions to solve spelling problems. Apart from treating common typographical errors such as omissions, additions, and transpositions, the system is able to diagnose misspellings caused by misrepresentations of English phonemes. In English, there are several rules for converting phonemes into graphemes, so-called phoneme-grapheme correspondence rules. For example, the phoneme /ej/ can be represented by, e.g., the grapheme <ai> (<pain>) or <ay> (<play>).[6] *SPELLER* can recognize the use of a wrong English phoneme-grapheme correspondence rule (e.g., using <ai> where <ay> would be required). It can also

[6] According to the *Oxford English Dictionary* (1989), a grapheme is defined as

> the class of letters and other visual symbols that represent a phoneme or cluster of phonemes, as e.g. the grapheme <f> consists of the allographs *f, ff, F, Ff, gh, ph,* and *Ph* which represent the phoneme /f/ in *fun, huffy, Fingal, Ffoulkes, cough, graph,* and *Philip* respectively; so, in a given writing system of a given language, a feature of written expression that cannot be analysed into smaller meaningul units. (entry for *grapheme*)

This thesis follows the *Oxford English Dictionary* definition of grapheme. Accordingly, this thesis makes a discintion between a grapheme and a letter.

diagnose typical Dutch phonemic errors such as the use of a Dutch phoneme-grapheme correspondence rule for writing an English phoneme (e.g., when using the grapheme <ee> to represent the phoneme /ej/). At the time of publication, the program had only been evaluated with respect to a small group of 14- to 17-year old nonnative learners of English. Students with severe spelling problems in English improved their spelling abilities considerably.

Ndiaye and Vandeventer Faltin (2003) developed a spell checker named *FipsCor* tailored to foreign language learners of French. Similar to de Haan and Oppenhuizen's (1994) *SPELLER*, *FipsCor* is geared towards the correction of both typographical and phonologically motivated misspellings. Phonologically motivated misspellings are abundant in French where a single phoneme can be represented by several different graphemes. Using phonological reinterpretation, *FipsCor* is able to retrieve corrections for words that are written phonetically. First, a so-called phonetiser uncovers the phonological representation of a misspelling. Then, the phonological representation is used as the search key in a dictionary to suggest possible corrections. For example, phonological reinterpretation of the misspelling *<sau> yields possible corrections such as <saut>, <seau>, and <sot>, which all share the pronunciation /so/. The program also includes an ad hoc method for treating a specific type of morphological error. According to the authors, language learners commonly produce morphologically motivated misspellings such as overgeneralizations of derivational or inflectional rules (e.g., *<animals>/<animaux> *animals*). In order to circumvent a complete morphological analysis, *FipsCor* features an ad hoc rule-based technique for treating the incorrect plural formation of words ending in *–al* and *–ail*. Ndiaye and Vandeventer Faltin state that numerous rules could be proposed to correct such morphological errors, and this "would be greatly helped by having access to a large learner corpus containing morphological spelling errors from which the correspondence rules could be derived" (p. 222). The performance of *FipsCor* was tested on a small error corpus of authentic and invented L2 misspellings. *FipsCor* was less successful in treating the misspellings than the *Microsoft® Word® 2000* spell checker. Nevertheless, its performance was promising.

CorText is a grammar and spell checker designed for intermediate to advanced French learners of English. In testing this program on English writing produced by Francophone university students, Mydlarski (1999) questioned the program's value for language learners. She maintained that underdetection and overdetection of errors were "too prevalent for the program to be used seriously by nonnative writers" (p. 593).

The educational version of *Sans-Faute* is a grammar and spell checker geared towards beginner and intermediate French learners. Murphy-Judy (2003) evaluated the performance of *Sans-Faute* and compared it to the performance of *Antidote* and *Le Correcteur Didactique* among others.[7] She concluded that overall *Sans-Faute* is "currently the most powerful" (p. 219) tool for nonnative speakers of French. Yet more rigorous testing is needed at this point.

Although the programs described above are all geared towards nonnative misspellings, very few of them are based on an empirical analysis of L2 misspellings. The analysis and classification of errors, however, is crucial to the evaluation and design of CALL programs as has been emphasized by several researchers in the field (e.g., Allerton et al., 2004; Cowan, Choi & Kim, 2003; Ndiaye & Vandeventer Faltin, 2003; Dagneaux et al., 1998; Granger & Meunier, 1994; Juozulynas, 1994).

In sum, the literature reviewed in this section has revealed three issues pertinent to spell checking in CALL:

1. The investigation of authentic learner errors is central to the design and evaluation of spell checking programs. However, very few L2 spell checkers are based on a detailed error analysis.
2. There are no extensive empirical analyses of L2 misspellings that investigate the limitations of generic spell checkers in detail and provide

[7] *Le Correcteur Didactique* is the language learners' version of *Le Correcteur*, a grammar and spell checker for native speakers of French discussed earlier. With respect to *Antidote*, recent versions of the program incorporate nonnative error lists.

insights into the influence of certain variables on error production and correction.

3. Generic spell checkers mainly target single violations typically produced by native speakers. The misspellings of foreign language learners, however, are not adequately addressed.

1.2 Research Goals

Given the findings of the literature review presented in the previous section, the research goals of this thesis are:

1. to develop a classification system for nonnative misspellings of learners of German and to determine frequencies of different types of nonnative misspellings from a learner corpus,
2. to evaluate a generic spell checker with respect to nonnative misspellings and investigate whether certain kinds of misspellings are treated more successfully than others[8], and
3. to provide computational and pedagogical suggestions to enhance spell checking in CALL.

Finally, this thesis considers proficiency level and task type as independent variables to gain insights into the influence of certain factors on L2 misspelling production and correction.

[8] The spell checker in the *Microsoft® Word® 2003* word processing software is used in the present study.

CHAPTER 2:
THE STUDY

This chapter describes the study participants, the CALL program and the task types that were used for data collection in this study. The corpus of misspellings and the procedure for classifying the misspellings into their respective error categories are also discussed.

2.1 Study Participants

The data for this study were collected during the spring semester 2004. In total, 48 university students who were enrolled in one of the first two German language courses at Simon Fraser University or the University of Victoria in Canada participated in the study. As part of their coursework, students used the *E-Tutor*©, an online CALL program for German (www.e-tutor.org). The system also contains a background questionnaire and a pretest which were administered to the students at the beginning of the semester.

The background questionnaire elicits information on the participant's native language, gender, level of computer literacy and previous exposure to the German language. The pretest intends to confirm initial student placement that was administered prior to the students registering in one of the two university courses. In the pretest, students complete 24 exercises that contain vocabulary and grammar constructions from a beginner to an intermediate level. For a detailed description of the system, the questionnaire, and the pretest, see Heift and Nicholson (2001).

Overall, more than 300 students used the *E-Tutor*© during the spring semester 2004. However, for the purposes of this study, a subset of 48 speakers was selected based on native language and proficiency level in German. This study considered only native speakers of English that spoke English with their family and friends. English was also the only L1 for all study participants. Furthermore, learners were divided into

beginners and intermediates based on their course enrolment and pretest score. To ensure a substantial difference in proficiency, speakers were assigned to the two groups according to the following criteria:

1. first-semester German students with a maximum pretest score of 3 out of 24 were assigned to the beginner group, and
2. second-semester German students with a minimum pretest score of 15 out of 24 were assigned to the intermediate group.

Students that did not meet these criteria were excluded from the corpus.

Table 2:1 Characteristics of the Study Participants

Characteristic	Beginners	Intermediates
N = 48	n = 32	n = 16
Native Language		
English	32 students	16 students
Gender		
Female	17 students	13 students
Male	15 students	3 students
Age[a]		
Range	18 – 23 years	18 – 24 years
Average	20.2 years	20.5 years
Comf. with computers[b]		
No	0 students	0 students
Somewhat	5 students	1 student
Yes	26 students	15 students
University German course		
First-semester	32 students	0 students
Second-semester	0 students	16 students
Pretest score (out of 24)		
Range	0 – 3 points	15 – 21 points
Average	1.3 points	17.7 points
Prior German instruction[c]		
0 semesters	31 students	0 students
1 (or more) semesters	1 student	16 students

[a]Age was not reported by one beginner and one intermediate student. [b]Comf. = Comfortable. One of the beginners did not provide an answer to this question. [c]Of all students, only one intermediate indicated more than one semester of previous instruction of German.

Table 2:1 indicates that the 48 study participants are highly homogeneous with respect to native language, educational background, age and computer literacy.[9] All participants are native English speakers enrolled at universities. They are of very similar average age (beginners: 20.2 years; intermediates: 20.5 years) and generally comfortable using computers. The only substantial difference between the two groups of students is proficiency level – the independent learner variable considered in this study.[10] Beginners are enrolled in first-semester German with a low average pretest score (1.3/24) and generally without any previous German instruction. The intermediates, on the other hand, are in their second-semester course with a high average pretest score (17.7/24) and with prior German instruction.[11]

2.2 The *E-Tutor*©

The *E-Tutor*©, which was used for this study, is a parser-based Intelligent Language Tutoring System that contains a variety of task types for grammar and vocabulary practice (see Heift & Nicholson, 2001). As part of their coursework, the 48 study participants used the *E-Tutor*© during the spring semester 2004 for a period of 15 weeks. The completion of the CALL exercises was part of the students' semesterly assignments. According to the course syllabus, beginners worked on chapters 1 to 5, and intermediates on chapters 6 to 10 of the CALL program. Students were only graded on the completion of the exercises but not on the number or gravity of mistakes they produced. Students were able to access the system from any computer with internet access. They could work on the exercises at any time and as often as they wished.

The *E-Tutor*© contains an extensive tracking technology which records the entire interaction between the student and the program, including all misspellings the

[9] Furthermore, the participants are presumably also fairly homogeneous with respect to their motivation to learn German: The German courses were electives and, for this reason, a fairly high motivation can be assumed for all 48 study participants.

[10] Note that the groups also differ in their gender distribution. However, this study does not investigate gender as an independent variable because it is expected to be noninfluential in misspelling production. Additional studies may be necessary.

[11] A more detailed characterization of the individual study participants is provided in Appendix A.

participants produced during completion of the exercises. For each misspelling, the log provides detailed information on student input, student ID, task type, specific exercise completed (chapter and exercise number), and access time.

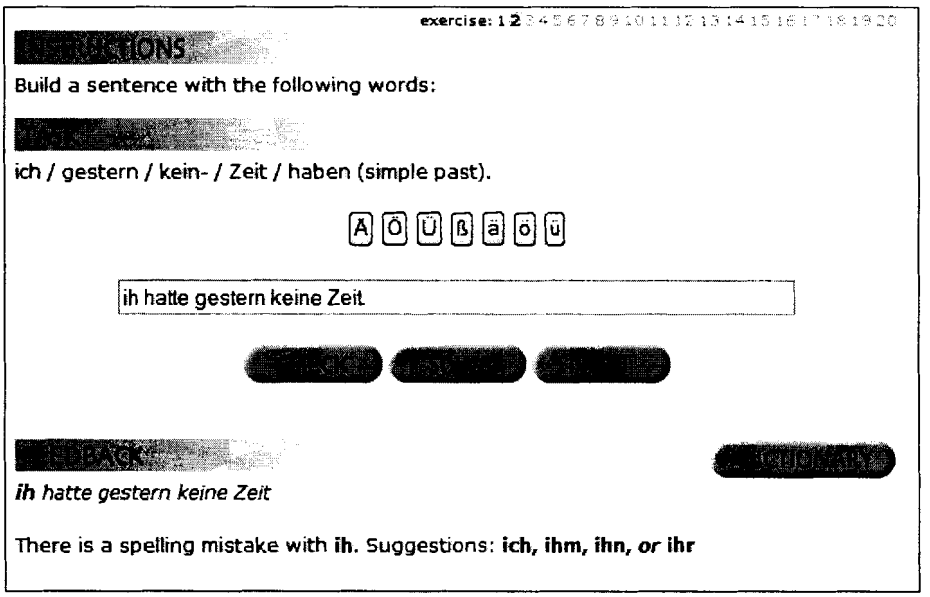
2.3 Two Task Types

For the purposes of the present study, the participants completed two different task types: build-a-sentence and translation. Chapters 1 to 5 of the *E-Tutor*©, which are part of the beginners' syllabus, contain 90 build-a-sentence and 34 translation exercises, while chapters 6 to 10, which are part of the curriculum of intermediate learners, contain 100 build-a-sentence and 25 translation exercises. Figure 2:1 and Figure 2:2 on page 17 show sample exercises with instructions on how to complete the task. The user interface consists of an input field, a button to check the answer, a button to display the most common answers, and a button to advance to the following exercise. If students choose to check their answer, a feedback message either tells them that the answer is correct or informs them of the type of mistake they made (e.g., a grammar or a spelling mistake). In the case of incorrect input, the students may then choose to revise and resubmit their answer or to skip the exercise and move on to the next one. Students also have access to an online bilingual dictionary.

The build-a-sentence task, as illustrated in Figure 2:1, involves constructing sentences using a set of German words that are presented in their uninflected base forms. For example, for the sentence provided in (1)a., students have to provide the simple past of the verb *haben*, determine the inflected indefinite pronoun *keine* (feminine, singular, accusative), and produce the correct word order as shown in (1)b.

(1) a. ich / gestern / kein- / Zeit / haben (simple past)
I / yesterday / no (base form) / time / have (simple past)
b. Ich hatte gestern keine Zeit.
I had yesterday no time
'I didn't have time yesterday.'

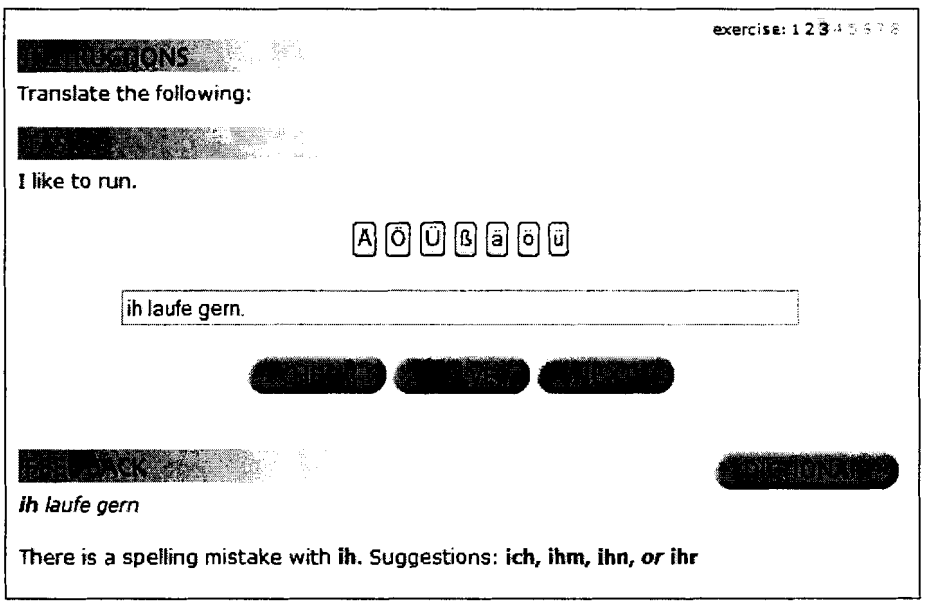
Figure 2:1 Screenshot of a Build-a-Sentence Task



Note. Screenshot reprinted by permission (copyright 2003 T. Heift).

The translation task entails translating sentences from English into German. An example of a misspelling of the personal pronoun <ich> *I* is provided in Figure 2:2. Neither of the task types, however, is explicitly designed to elicit misspellings.

Figure 2:2 Screenshot of a Translation Task



Note. Screenshot reprinted by permission (copyright 2003 T. Heift).

2.4 The Corpus of Misspellings

In this study, a misspelling is defined as a word that does not exist in the *Duden* (2004), the standard German reference dictionary. This definition approximates that of a spell checker which generally flags any word as a misspelling that does not exist in its dictionary. Examples of misspellings and correct spellings according to the definition employed in this study are given in Table 2:2.[12]

Table 2:2 Examples of Misspellings and Correct Spellings

Description	German example	English example[a]
	Misspellings	
- wrongly inflected forms that result in nonexistent words	*<wollst>/<willst> *want*	*<goed>/<went>
- the incorrect use of lower case	*<nacht>/<Nacht> *night*	*<canada>/<Canada>
- foreign words that are not commonly used in the language	*<Suitcase>/<Koffer> *suitcase*	*<lunes>/<Monday>[b]
- compound words that are nonsensical or would not be used by native speakers	*<Nachtmittag>/<Nachmittag> *afternoon*	*<doorfell>/<doorbell>
- words written in old German spelling[c]	*<daß>/<dass> *that*	n/a[d]
- other nonexistent words	*<Scwester>/<Schwester> *sister*	*<recieve>/<receive>
	No misspellings	
- wrongly inflected forms that result in an existing word	<sie gehe>/<sie geht> *she goes*	<she go>/<she goes>
- the incorrect use of upper case	<sie Spielt>/<sie spielt> *she plays*	<she Plays>/<she plays>
- the use of regional, rare, obsolete or otherwise existing words	<Zähre> *tear* (obsolete)	<thou>
- homophone confusions	<mahlen> *grind*/<malen> *paint*	<ate>/<eight>
- the accidental use of common proper nouns	<Schmitt>/<Schnitt> *cut*	<Seattle it!>/<Settle it!>

[a]English examples are used in addition to German examples to make the discussion more accessible to the reader. [b]<lunes> is the Spanish word for *Monday*. [c]German orthography was reformed in 1996. [d]n/a = not applicable.

[12] Note that the research literature identifies a wide variety of definitions for a *misspelling*. Some researchers broaden the realm of misspellings to include the words provided under *No misspellings* in Table 2:2. However, this study takes the German reference dictionary as the main criterion and, for this reason, does not consider these words as misspellings because the words exist as such in the language.

Note that Table 2:2 lists *<goed> for <went> as a misspelling. From a purely linguistic point of view, this error is commonly referred to as a morphological error and not a misspelling. However, from a computational point of view, writing *<goed> for <went> is not any different from writing *<thhe> for <the> because both errors are addressed by a spell checker rather than a grammar proofing tool.

In proofing a text, a two-step process with respect to spell and grammar checking generally applies: First, the text is passed through the spell checker and then passed on to the grammar checker. In fact, the grammar checker will not correct words that have not been recognized or corrected by the spell checker. For example, checking the sentence *<He goed to school.> for spelling and grammar in the English version of the *Microsoft® Word® 2003* word processing software first prompts the spell checker to highlight *<goed> as a word that is "not in dictionary" and to provide the following correction suggestions: <goad, good, gored, geed, god, goes, geode, gold>. This demonstrates that the *Microsoft® Word®* software does not identify *<goed> as a morphological error but as a misspelling.[13] If the writer does not manually correct the word, the grammar checker then underlines the entire sentence and provides the feedback "Fragment (consider revising)". Another example that illustrates the correction sequence in text processors is *<I is goinng to school.>. In this sentence, the spell checker first highlights *<goinng> as a misspelling. If the writer changes *<goinng> to <going>, the grammar checker then highlights <is> as a "Subject-Verb Agreement" error and suggests <am> as a correction. Consequently, any error that results in a nonexistent form has to be treated as a misspelling for the purposes of computer-based correction. Accordingly, this thesis classifies errors such as *<goed>/<went> as morphologically motivated misspellings and distinguishes them from morphological errors (e.g., <I goes>) that contain only existing words.

The corpus of misspellings of this study, the E-Tutor corpus, consists of 1808 misspellings produced by the 48 study participants described previously. On average,

[13] A more sophisticated spell checking process can naturally involve a morphological analysis. However, it is nonetheless the spell checker that evokes the morphological analysis because the word is not recognized as a legitimate word at this stage.

each student made 37.7 misspellings, the range of misspellings per participant was 4 to 154.[14] Each participant produced at least one misspelling in each of the two task types. The corpus of 1808 tokens (nonunique misspellings) contains 1027 types (unique misspellings).

The misspellings were extracted from the *E-Tutor*©'s error log. All submissions that were labelled as misspellings by the program were analyzed individually by the researcher to ensure data accuracy. For example, the CALL program occasionally flagged correct spellings as misspellings. This applied to words that were not contained in its dictionary. These submissions were removed from the misspelling corpus.

For the purposes of this thesis, only misspellings that contained one spelling error were considered.[15] Misspellings with more than one spelling error were removed from the corpus because of their low frequency.[16]

2.5 Error Classification Procedure

One of the goals of this thesis is to classify nonnative misspellings. The error classification procedure applied to this study consists of two steps:

1. each misspelling is matched with a target word, and
2. each misspelling is then assigned to an error category.

The two steps are discussed in the following sections.

---

[14] These numbers are representative of the entire corpus. Throughout the spring semester 2004, the program collected 13,284 misspellings produced by a total of 348 students working on sentence building and translation tasks. The 348 participants produced between 0 and 187 misspellings each with 38.17 misspellings per person on average.

[15] One spelling error does not necessarily correspond to the addition, omission, substitution or transposition of a single letter. A misspelling in which more than one letter is affected can still involve just one spelling error. For example, the misspelling *<Austria> for <Österreich> *Austria* is counted as one spelling error as there is no sensible way of identifying separate errors. An example of a misspelling containing more than one error is *<tashe> for <Tasche> *bag*. This misspelling contains two spelling errors that are independent of each other: (1) the word is incorrectly written in lower case, and (2) the grapheme <sch> is erroneously represented by <sh>.

[16] Overall, the 48 study participants produced a total of 1882 tokens of misspellings (1091 types). Only 68 of those misspellings (64 types) contained more than one spelling error.

2.5.1 Matching Misspellings With Their Target Words

The first step for errors to be classified is to determine the writer's intended target word once a misspelling has been detected. This does not present a major problem in this research project because the target word can generally be deduced from context given the restricted tasks. For instance, if a student writes *<Artz> in a build-a-sentence task where the word <Arzt> *doctor* is provided in the instructions, the target word is most definitely <Arzt>. Likewise, if a learner translates *Austria* as *<Österreicht> in a translation task, the target word can reasonably be assumed to be <Österreich> *Austria.*

In this study, the writer's intended target word was also chosen even if the target word resulted in an error given its grammatical context. For example, if a student writes *<He wotch television>, the target word most likely intended by the writer is <watch> rather than the contextually required <watches>.[17] The target word of a misspelling could not be determined with a reasonable degree of certainty in very few instances. These misspellings were excluded from the analysis. Accordingly, the identification of target words was made as educated and informed as possible by using context clues, keeping the writer's intentions in mind and excluding misspellings where target word identification proved too difficult.

2.5.2 Assigning Misspellings to Error Categories

Each of the 1027 misspellings of the corpus was assigned to an error category according to error classification guidelines that were devised for this study. The error classification guidelines define categories of misspellings and provide guidelines for

[17] Note that grammatical appropriateness is the task of the grammar checker not the spell checker. Once the spell checker provides <watch> as a correction alternative for *<wotch>, the grammar checker flags the subject-verb agreement error. For example, inputting the sentence <He wotch television.> into the *Microsoft® Word® 2003* word processing software demonstrates that the spell checker first detects *<wotch> as a misspelling and suggests <watch> and <witch> as correction alternatives. Once <watch> is chosen as the correct spelling, the grammar checker flags the subject-verb agreement error and provides <watches> as the correct form of <watch>. This clearly indicates a two-step process: First, the spell checker deals with words that do not exist in the language. Second, the grammar checker corrects contextual errors. For the grammar checker to adequately examine grammatical context and flag errors, all words have to be possible words of the language, that is, recognized or corrected by the spell checker.

classifying an error into its respective category (see section 3.2 and Appendix B for a more detailed discussion).

Two coders assigned the misspellings to their respective error categories. The first coder is the author of this thesis, the second coder is a native German speaker with a university degree in English and Linguistics. The first coder explained the research project and the classification guidelines to the second coder, who was also trained on a small corpus of misspellings. Both coders independently classified all 1027 misspellings using the error classification guidelines. The initial consensus in error category assignment between the two coders was 94% (962/1027 misspellings). The remaining 6% of the misspellings were subsequently discussed by the two coders to achieve a final consensus of 100%.

The error classification system developed for this thesis is discussed in the following chapter.

CHAPTER 3:
ERROR CLASSIFICATION

This chapter is divided into two main sections: section 3.1 presents a review of literature on error classification, in particular, it identifies four taxonomies for classifying learner errors. Section 3.2 discusses CLASSY, the classification system for nonnative misspellings developed for this study. CLASSY combines the four error taxonomies into one error classification model. The respective error categories are then described and illustrated with examples from the E-tutor corpus, the corpus of misspellings of this study.

3.1 Classifying Learner Errors

The classification of learner errors is closely tied to error analysis. There are three main approaches to analyzing learner errors: First, *Contrastive Analysis* (e.g., Lado, 1957) maintains that learner errors are due to interference from the native language. Accordingly, researchers in *Contrastive Analysis* compared the learner's L1 with the target language to determine potential errors. However, many of the predictions made by *Contrastive Analysis* were not borne out, that is, many of the errors that were predicted did not occur and many errors occurred that were not predicted (James, 1998). Eventually, *Contrastive Analysis* was abandoned in favour of *Error Analysis* (e.g., Corder, 1974). *Error Analysis* started with a description of learner errors and, if necessary, compared the learner's language with both the target and the native language. *Error Analysis* was criticized for methodological limitations (e.g., fuzzy error classification categories) and scope limitations (e.g., the focus on what learners *cannot* do and the failure to account for changes in learner language over time) (see, e.g., Dagneaux et al., 1998). Finally, the *Interlanguage* approach (Selinker, 1972) shifted focus by not solely emphasizing learner errors. Instead, it

investigates learner language in general and aims to describe and explain changes in learner language over time.

While several of the goals of the *Contrastive Analysis*, *Error Analysis*, and *Interlanguage* approaches underlie any classification of learner errors, the history of L2 error analysis is not further examined here. Instead, the following discussion focuses on contributions of error analysis and classification in CALL. Moreover, the emphasis of the argument lies on different taxonomies for classifying errors that are an essential requirement for the enhancement of spell checking in CALL.

CALL is an interdisciplinary field of study in which several research areas converge. The ones most relevant to the classification of misspellings are second language acquisition (SLA) research, language pedagogy and software evaluation and design. The analysis and classification of learner errors in CALL makes contributions to these three research areas as outlined below.

With respect to SLA research, analyzing and classifying learner errors aids in understanding the nature of the learner's knowledge in the language acquisition process (Dulay, Burt & Krashen, 1982; Corder, 1975). Learner errors may not only be indications of what the learners have *not* learned, they may also demonstrate what they *have* learned (Gass & Selinker, 1994; Corder, 1974). For example, an error form such as *<goed> for target <went> may indicate that:

1. the learner has not yet learned to form the past tense of irregular verbs such as *go* (or the student fails to apply this knowledge consistently), and
2. the learner has already learned that the past tense is generally obtained by adding *<ed>* to the verb stem.

From a language pedagogy perspective, the classification of errors helps to determine the learner's stage in the learning process (Dulay et al., 1982; Corder, 1975). It can indicate to language instructors which areas of the target language present the most difficulty to learners. Accordingly, the most frequent or the most serious errors may be targeted for remedial action.

Error classification also achieves several objectives with respect to CALL software evaluation and design. For example, the effectiveness of a spell checker can be assessed by investigating its success rate in correcting authentic learner errors. The analysis and classification of errors can provide insights as to which classes of errors are effectively handled and which are not. The findings of this software evaluation can then be used to enhance software development. Many researchers have stressed the need to incorporate authentic error data into the design of language learning programs (e.g., Allerton et al., 2004; Cowan et al., 2003; Ndiaye & Vandeventer Faltin, 2003; Granger & Meunier, 1994; Juozulynas, 1994).[18] For example, Cowan et. al. (2003) state that "basing the selection of errors to be targeted for correction research on empirical data ... provides us with many examples of error types that can be built into the CALL program" (p. 455). Accordingly, analyzing and classifying learner errors has received renewed attention in CALL with respect to learner feedback (see, e.g., Dagneaux et al., 1998, Heift, 2001, 2002, 2004).[19]

3.1.1 Taxonomies for Classifying Learner Errors

Previous research has generally classified errors along four taxonomies:

1. the competence/performance taxonomy,
2. the linguistic subsystem taxonomy,
3. the language influence taxonomy, and finally,
4. the target modification taxonomy.

The following sections discuss each taxonomy in turn, providing a definition and previous studies in which the taxonomy has been used.

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[18] See also Helfrich and Music (2000) for similar remarks on the importance of corpus analyses in the design of grammar checkers for native speakers.

[19] The analysis and classification of learner errors has also regained attention in traditional language instruction due to a shift in approaches to teaching grammar. The resistance to teaching grammar in the 1990s has been replaced by a focus on meaningful and contextualized grammar instruction which, as a result, also considers learner errors.

3.1.1.1 The Competence/Performance Taxonomy

The competence/performance taxonomy distinguishes between competence and performance errors. Competence errors involve misconceptions of target language forms and are due to a lack of linguistic knowledge on the part of the writer. They are systematic and/or non-self-corrigible and/or deliberate (in the sense that the erroneous form is assumed to be correct). For example, an error such as *<goed> for <went> demonstrates a systematic overgeneralization of the regular past tense formation rule. While this error might be self-corrigible by students if it is pointed out to them, it is nevertheless systematic and deliberate.

Performance errors, on the other hand, involve "failures to utilise a known system correctly" (Corder, 1975, p. 204) and can be attributed to factors such as inattention, fatigue or motor coordination problems. Performance errors are thus accidental, unsystematic and self-corrigible.[20] Dulay et al. (1982) assert that "the distinction between performance and competence errors is extremely important, but it is often difficult to determine the nature of a deviation without careful analysis" (p. 139) (see also Corder, 1975, 1981).

Several studies of nonnative misspellings have used the competence/ performance taxonomy. For example, Staczek and Aid (1981), and Staczek (1982) distinguished random mistakes, that is, performance mistakes, from competence errors that are further classified according to L1 or L2 interference. Ibrahim (1978) reserved a category for performance errors that were most likely due to "confusion, fatigue, carelessness, or some similar factor" (p. 212). James, Scholfield, Garrett, and Griffith (1993), on the other hand, explicitly mentioned that they excluded performance-based misspellings from their analysis and only attended to competence-related errors.

[20] Other terms have also been used to draw attention to this distinction. In spelling error research, competence errors have been referred to as, for example, cognitive errors (Kukich, 1992), wrong spellings (Mitton, 1987), or linguistically motivated nonwords (Kese et al. 1992). Performance errors have been termed mistypings, typos, typographical errors (Kukich, 1992), mechanical errors (Pollock & Zamora, 1984), or slips (Mitton, 1987). Finally, Corder (1974) refers to competence errors as *errors* and to performance errors as *mistakes*. In this thesis, however, the terms *error* and *mistake* are used interchangeably. Yet, the distinction between competence and performance errors is made consistently.

3.1.1.2 The Linguistic Subsystem Taxonomy

In the linguistic subsystem taxonomy, errors are classified according to the linguistic source of the error: for example, syntax, lexicon, morphology, phonology, or orthography (compare James, 1998; Dulay et al., 1982).[21] Accordingly, lexically, morphologically, phonologically and orthographically motivated misspellings can be distinguished.[22] Lexical misspellings are due to a lack of lexical knowledge on the part of the writer. Morphological misspellings are caused by incorrectly inflecting or deriving words. Phonological misspellings occur when a misspelling is influenced by the target word's phonology. Orthographic errors are surface-level errors involving, for example, capitalization or word division.[23]

The following subsections consider the use of this taxonomy in previous studies of learner errors. Each linguistic subsystem is discussed in turn.[24]

Lexical Misspellings

Lexical misspellings have been reported by, for example, James et al. (1993), and Snyder (1995). In analyzing the English misspellings of 10-11 year old Welsh dominant bilinguals, James et al. (1993) remark the following:

> Lexical cognateness ... lays pitfalls for the speller, who assumes that when two words in L1 and L2 are 'the same', in the sense that they mean and sound similar, then they can be spelled in the same way. ... when the assumption is unwarranted, we have a kind of lexical 'false friend spelling'. (p. 299)

The authors identified *<ruban>/<ribbon> as a lexical misspelling due to the Welsh cognate <ruban>. Snyder (1995) analyzed 660 Spanish misspellings made by native English speakers. In his lexical spelling error category, he distinguished among

[21] The linguistic subsystem taxonomy is termed linguistic category classification by both James (1998) and Dulay et al. (1982).
[22] Note that there is no category for syntactically motivated misspellings because spelling error studies generally investigate words in isolation.
[23] Accordingly, the term *orthographic error* is not synonymous with *spelling error* in this taxonomy,
[24] The terminology used to classify errors varies across researchers. This overview takes errors from previous studies and labels them according to the terminology used in this thesis. For example, whereas some studies identify an error such as *<goed>/<went> as a purely *morphological* error, this study classifies these errors as morphologically motivated *spelling* errors.

borrowings from English, cognatization of English terms, and lexical influence from Spanish based on formal or semantic similarities. For example, he recognized *<panqueques> for Spanish <panqués> *pancakes* as a lexically motivated misspelling influenced by the English spelling <pancakes>.

Lexical misspellings have also been found in nonnative German writing. Juozulynas (1991, 1994), for example, found lexical misspellings such as *<Rauchendetektiv>, literally *smoke detective*, for <Rauchdetektor> *smoke detector* in his analysis of 7701 composition errors made by second-year German students at a U.S. college. In this example, the lack of lexical knowledge of the word <Rauchdetektor> *smoke detector* leads to the misspelling.

Morphological Misspellings

Morphologically motivated misspellings are considered by Ibrahim (1978) in his classification of English spelling errors by Arabic learners. Although he did not specifically use the term, Ibrahim referred to misspellings such as *<savety>/ <safety>, "which may be attributed to the somewhat inconsistent and arbitrary nature of English word derivation" (p. 210). Snyder (1995) also considered morphological spelling errors and found that nearly 70% of the misspellings in his study involved incorrect inflectional endings.[25]

In studies of nonnative German writing, morphological misspellings are discussed by, for example, Rogers (1985), Juozulynas (1991, 1994), Sanders (1991) and Grauberg (1971). Rogers (1985) examined 698 errors from 26 essays written by English-speaking honours students in a first-year university German class. Her corpus contained morphological misspellings such as *<Arbeitsgeber>/<Arbeitgeber> *employer*. Here, a connective morpheme, <s>, is incorrectly added to the compound composed of <Arbeit> *work* and <Geber> *giver*. Sanders (1991) discussed composition errors by U.S. college students in second-year German classes. Both Juozulynas (1991, 1994) and Sanders found morphological misspellings that are due

[25] This percentage seems quite high and may be explained by the fact that Snyder counted all inflectional errors as misspellings even if they did not result in nonexistent words.

to the incorrect use of inflectional rules. In *<gemalen>/<gemalt> *painted*, for example, an incorrect past participle suffix is used (<en> instead of <t>). Grauberg (1971) analyzed 193 errors by 20 Anglophone first-year honours university students. He discussed morphological misspellings such as *<befindete>/<befand> *found* in which an irregular simple past tense form is regularized.

Phonological Misspellings

Not surprisingly, several studies refer to phonologically motivated misspellings because graphemes are orthographic representations of phonemes (e.g., Cook, 1997; Fashola, Drum, Mayer & Kang, 1996; Snyder, 1995; Fashola, 1995; James & Klein, 1994; James et al., 1993; Luelsdorff, 1986; Bebout, 1985; Staczek & Aid, 1981; Ibrahim, 1978). James et al. (1993), for example, found that 38.5% of the Welsh children's misspellings in English could be attributed to Welsh pronunciation and spelling rules. Likewise, Fashola (1995) found that, in contrast to native English speakers, Spanish writers produced significantly more misspellings of English words that could be attributed to the application of Spanish language phonology or orthography.

With respect to L2 German, Thomé's (1987) study of 2576 German misspellings by 61 Turkish students enrolled in a high school in Germany uncovered numerous phonologically motivated misspellings. For example, several errors could be attributed to the students' pronunciation or ambiguous phoneme-grapheme correspondences. Furthermore, Juozulynas (1991, 1994) and Rogers (1985) discussed phonological misspellings involving confusions of <s>, <ss>, and <ß>. In German, all three of these graphemes represent the phoneme /s/. Choosing the wrong grapheme in a given context results in a phonologically motivated misspelling. In addition, Sanders (1991) listed the confusion of the graphemes <ch> and <sch> in her analysis of nonnative German writing.

Orthographic Misspellings

In L2 German, orthographic misspellings have been reported by Thomé (1987), for example. He found that orthographic misspellings frequently occurred

because his Turkish learners of German did not capitalize nouns or split a single word into two. Sanders (1991) and Rogers (1985) also examined word division errors where orthographic misspellings resulted because a single word was written apart or separate words were written together. Juozulynas (1991, 1994) discussed orthographic misspellings of nouns involving the incorrect use of lower case.

3.1.1.3 The Language Influence Taxonomy

The language influence taxonomy has widely been used to investigate the influence of the target language and the writer's native language on nonnative errors. The two main categories here are interlingual and intralingual errors:

1. Interlingual errors are due to a transfer of patterns from the native language to the target language. This definition covers the transfer of lexical, morphological, phonological, or orthographic patterns.
2. Intralingual errors can be "traced to target language resources" (Snyder, 1995, p. 187). For instance, errors that are due to ambiguities in the target language as well as overgeneralizations based on other forms of the target language are intralingual.

Due to difficulties in assigning all errors to these two categories, Dulay et al. (1982) postulate two additional error categories, *ambiguous* and *other* errors:

3. The *ambiguous* category comprises errors that could be both interlingual or intralingual.[26]
4. The *other* category is reserved for errors that cannot be assigned to any of the above categories.

In studies of nonnative misspellings the focus has been on interlingual and intralingual errors. James et al. (1993), for instance, found that while nearly 40% of the misspellings in their corpus were interlingual, another substantial part could be

[26] For example, Dulay et al. (1982, p. 172) cite "*I no have a car" as a construction that could reflect influence from the learner's native language, Spanish, while it is also characteristic of the speech of English children learning their mother tongue. Thus, it could be interlingual or intralingual.

associated with target language overgeneralizations. For example, the researchers listed *<meens>/<means> as an intralingual misspelling in which the wrong grapheme, <ee>, was chosen from a set of possible English graphemes to represent the English phoneme /i/. In a comparison of the English misspellings of Spanish-speaking adults and English-speaking children, Bebout (1985) showed that a large proportion of the nonnative writers' spelling mistakes were interlingual. Snyder (1995), however, found that intralingual misspellings were much more frequent than interlingual ones in his study. Thomé's (1987) study of Turkish 8th-graders in Germany, who had been educated in German for a minimum of three years, showed that L1 interference errors made up less than 5% of all misspellings. Overall, these studies reveal that interlingual as well as intralingual interference can be an essential source of nonnative misspellings.

3.1.1.4 The Target Modification Taxonomy

The target modification classification is concerned with the way a target form has been modified in an erroneous form.[27] The principal error categories in this taxonomy are omission, addition, substitution, and transposition. The four categories may refer to different levels of language, for example, the word-level or the morpheme-level. In a study of errors in the speech of English learners, for instance, the absence of the word *to* in an utterance like *I went school* would be classified as an error of omission.

In previous studies of misspellings, the four error categories refer to individual letters rather than entire words or morphemes. Examples are given in Table 3:1.

Table 3:1 Misspelling Classification According to the Target Modification Taxonomy

Error category	Misspelling/target word
Addition	*<lannguage>/<language>
Omission	*<laguage>/<language>
Substitution	*<lanfuage>/<language>
Transposition	*<langauge>/<language>

[27] The term target modification taxonomy is used in James (1998). Commonly, the taxonomy is also called surface strategy taxonomy (e.g., Dulay et al., 1982; Ellis, 1994) or target deviation taxonomy.

Furthermore, misspellings are generally classified as single or multiple violations depending on the number of changes required to obtain the target word. In single violation misspellings only a single addition, omission, substitution or transposition is needed to convert a misspelling into its target word. In misspellings with multiple violations several changes are required for error repair.[28]

Some researchers have used the target modification taxonomy in nonnative misspelling analyses. Cook (1997), for example, employed the target modification taxonomy in a study of 381 English misspellings by nonnative writers of various language backgrounds. He found the following distribution across categories: 22.3% single additions, 31.5% single omissions, 31.7% single substitutions, 3.1% single transpositions, 3.7% multiple violations, and 7.6% other mistakes (e.g., local accent).

The following section presents CLASSY, the classification system developed for the L2 misspellings of this study.

3.2 CLASSY: The Classification System for Nonnative Misspellings Developed in This Study

3.2.1 The Model

CLASSY is the classification system for nonnative misspellings developed in this study. Unlike previous research, CLASSY combines all of the error taxonomies discussed in section 3.1.1 to reflect the interdisciplinary field of CALL. Accordingly, CLASSY contributes to several research areas: SLA, language pedagogy, and software evaluation and design.

Concerning SLA research and language pedagogy, the distinction between competence and performance errors is important because only competence errors are central to the study of SLA (Ellis, 1994) and to language teaching. The linguistic subsystem taxonomy indicates which subsystem(s) may pose problems to language

[28] In L1 misspelling studies, for example, single vs. multiple violations are distinguished by both Damerau (1964) and Pollock and Zamora (1984) who reported that their corpora contained mainly single violations (see section 1.1.1).

learners and need to be considered in the classroom. The language influence taxonomy sheds light on the roles of the L1 and the L2 in SLA (Dulay et al., 1982) and therefore serves as a guide for language teaching (Corder, 1975).

Regarding CALL software evaluation and development, the competence/ performance distinction is relevant because generic spell checkers are only designed to correct performance errors. The linguistic subsystem taxonomy indicates whether spell checkers require knowledge of different linguistic subsystems. The language influence taxonomy shows whether or not a spell checker needs to be geared to the user's L1. Finally, the target modification taxonomy allows programmers to develop algorithms based on the misspelling's surface deviation from the target word.[29]

The primary classification in CLASSY, as illustrated in Figure 3:1, distinguishes between competence and performance errors. Competence misspellings are then subcategorized according to the linguistic subsystem taxonomy. Misspellings in each linguistic subsystem are further subclassified along both the language influence taxonomy and the target modification taxonomy. Performance errors are subclassified using only the target modification taxonomy.[30]

[29] See Rimrott (2004) for a more detailed discussion on the contributions of the four taxonomies to SLA research, language pedagogy, and software evaluation and design.

[30] CLASSY is similar to a model described by van Els, Bongaerts, Extra, van Os, & Janssen-van Dieten (1977/1984). Van Els et al. present a classification system that uses competence vs. performance as its primary distinction. While the performance errors are not subdivided, they further classify competence errors according to the language influence taxonomy into interlingual and intralingual errors. Each of these categories is then subclassified into lexical, morphosyntactic, and phonological errors based on the linguistic subsystem taxonomy.

Figure 3:1 CLASSY

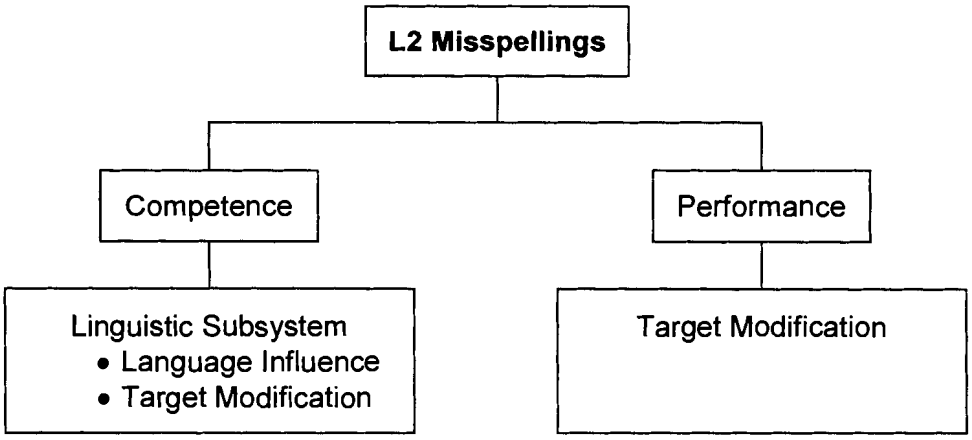

Table 3:2 provides an overview of the individual error categories of each taxonomy used in CLASSY.

Table 3:2 The Individual Error Categories in CLASSY

Competence/ performance	Linguistic subsystem	Language influence	Target modification
Competence	*Lexical*	*Interlingual*	*Single violations*
Performance	*Morphological*	*Intralingual*	*Multiple violations*
	Phonological	*Ambilingual*	
	Orthographic	*Paralingual*	

In the following, CLASSY is discussed and motivated in detail. Section 3.2.2 describes diagnostics for distinguishing between competence and performance errors. The competence category and its subtaxonomies are then presented in Section 3.2.3. Section 3.2.4 portrays the performance category and its subtaxonomy.

3.2.2 Competence vs. Performance Errors

CLASSY primarily distinguishes between competence and performance misspellings. This distinction captures the main difference between native and nonnative writers. Adult native speakers mostly make performance errors whereas nonnative writers also commit competence errors that are due to their lack of proficiency in the target language. Generic spell checkers target native writers and

thus mainly performance errors. The division between competence and performance errors is therefore central to this study.

However, one of the main problems in analyzing learner errors is the assignment of errors to definitive categories (see, e.g., Ellis, 1994; Dulay et al., 1982; Corder, 1974). For example, how can we know that a misspelling is competence-based rather than performance-based? A misspelling such as *<schowered>/ <showered>, for instance, is most likely a performance error if written by a native English speaker, but it might well be a competence error if produced by a German learner of English.[31]

Snyder (1995) points out that "like all other error data, ... [misspellings] may permit multiple, even contradictory analyses" (p. 103). Although there is no definite solution to this problem, Snyder maintains that "what is required where direct insight if [*sic*] unavailable to the researcher is a heuristic which will allow a reasonable, consistent, and meaningful analysis of the data" (p. 103). In the current study, four diagnostics were used to overcome the uncertainty in assigning misspellings to error categories:

1. frequency of occurrence,
2. edit distance,
3. error systematicity, and
4. previous research.

A misspelling was assigned to the competence category if any one of the diagnostics was in favour of this assignment. Each diagnostic is discussed in the following subsections.

3.2.2.1 Frequency of Occurrence

Along the lines of Dulay et al. (1982), error frequency was used to determine category assignments. The rationale behind frequency-related assignments is that

[31] Note that the phoneme /ʃ/ is usually written as <sch> in German.

performance errors are random whereas competence errors are not. Therefore, if the same misspelling occurs frequently or if the same target word is misspelled repeatedly, the probability that competence factors are involved increases. In the present study, several frequency diagnostics were specified after an investigation of the error corpus. A misspelling was counted as a competence error if it was produced by three or more distinct students. Furthermore, each misspelling of a particular target word or target paradigm (e.g., all forms of a verb) was classified as a competence error if the target word or target paradigm was misspelled

- at least five times, or
- by at least four students, or
- by at least two students four or more times, or
- by at least one student three or more times.[32]

These frequency rules were not only applied to whole words but also to morphemes or graphemes within a misspelling. For example, competence factors were also assumed if certain graphemes were frequently misrepresented by other graphemes. The grapheme <ei>, for instance, was misspelled as <ie> more than 70 times. Accordingly, words containing this error were classified as competence-related.

3.2.2.2 Edit Distance

Edit distance was used as a second diagnostic for category assignment. As discussed in the introductory chapter, studies of native speaker misspellings indicate that performance misspellings usually involve an edit distance of one. Therefore, in the current study, misspellings with an edit distance of three or more were classified as competence-related errors. An edit distance of three indicates substantial target modification and thus decreases the likelihood of performance-related factors. In order to give the benefit of the doubt to the performance category, misspellings with an edit

[32] Appendix C displays the frequency of occurrence of each misspelling from the E-Tutor corpus.

distance of two (or one) were only assigned to the competence category if another one of the four diagnostics worked in favour of competence category assignment.

3.2.2.3 Error Systematicity

The third diagnostic stipulates that misspellings involving systematic deviations from the target spellings be classified as competence errors. Systematic deviations are deviations where the strict adherence to a grammar rule triggers a misspelling in a case where the given rule does not apply. For example, to inflect a regular verb in German for second person, singular, present tense, <st> is suffixed to the verb stem. For <gehen> *to go*, for instance, <st> is added to the stem <geh>, resulting in <gehst>. However, verb stems that end in <d> or <t> as in <finden> *to find* present an exception in that they require <e> epenthesis between the stem and the <st> suffix. For language learners, this frequently results in the nonexistent verb form *<findst> instead of <findest>. Due to the systematicity of rule violation, these misspellings are classified as competence errors.

3.2.2.4 Previous Research

The final diagnostic involves mention of a particular error type in the research literature. If previous researchers identified typical errors or error types with a particular group of language learners, the misspellings were included in the category of competence errors. For example, several previous analyses of German learners' errors recognize the confusion of <s>, <ss> and <ß> as typical of learner language (e.g., Rogers, 1985; Juozulynas, 1991, 1994).

3.2.3 Competence Errors

3.2.3.1 The Linguistic Subsystem Subtaxonomy

Competence-based misspellings are due to a lack of knowledge of the lexicon, phonology, morphology or orthography of the target language. Accordingly, they are subclassified as lexical, morphological, phonological, or orthographic according to the linguistic subsystem subtaxonomy illustrated in Table 3:3.

Table 3:3 The Linguistic Subsystem Subtaxonomy

Linguistic subsystem	Example
Lexical	*<Poskeutzah>/<Postleitzahl> *postal code* *<Suitcase>/<Koffer> *suitcase*
Morphological	*<wollst>/<willst> *want* *<gesitzt>/<gesessen> *sat*
Phonological	*<biem>/<beim> *at the* *<Scwester>/<Schwester> *sister*
Orthographic	*<Wieviel>/<Wie viel> *How much* *<gehts>/<geht's> *goes it*

Lexical Misspellings

In this study, lexical errors are defined as spelling mistakes at the word-level where the actual spelling differs from the L2 target spelling because a given vocabulary item has not been (completely) acquired by the learner. In other words, these misspellings are due to a problem with L2 vocabulary on the part of the writer. For example, the lexical category includes misspellings that demonstrate a general lack of L2 vocabulary knowledge (e.g., *<Poskeutzah>/<Postleitzahl> *postal code*) as well as misspellings that involve the transfer of English expressions (e.g., *<Suitcase> for <Koffer> *suitcase*).[33]

Morphological Misspellings

Unlike lexical errors which affect the entire word, morphological misspellings involve morphemes and can be traced to difficulties with inflecting or deriving words. German has a rich morphology that poses several potential problems to foreign language learners. For example, several German verbs require stem vowel changes. In the misspelling *<wollst>/<willst> *want*, the 2nd person singular of the verb <wollen> *to want* is incorrectly regularized by omitting this stem vowel change. In addition, some verbs have different stems in present and past tense forms and there are two past

[33] Throughout this thesis, the vast majority of examples of German misspellings is taken from the E-Tutor corpus. Some examples are also taken from a similar corpus analyzed in Rimrott and Heift (in press). For a list of all 1027 misspellings examined in the current study and the corresponding error categories see Appendix C.

participle suffixes: <en> and <t>.[34] In the misspelling *<gesitzt> for <gesessen> *sat*, for instance, the learner regularized the verb by using the present tense stem of the verb <sitzen> *to sit* (i.e., <sitz>) rather than the past participle stem <sess>. In addition, the student applied the incorrect past participle suffix (<t> instead of <en>).

Phonological Misspellings

Phonologically motivated misspellings contain cases where the actual or assumed phonology of a word has an influence on its orthography. According to James and Klein (1994), the German spelling of English native speakers can be influenced by both German and English phonology and spelling. If these two languages were true alphabetic writing systems with a one-to-one correspondence between phonemes and graphemes, one would expect no phonologically motivated misspellings. However, in German, there are at least two possible spellings for almost every phoneme (Wimmer & Landerl, 1997) and in English, the phoneme-grapheme ambiguities are even greater (Dewey, 1970; Hall, 1961; Wimmer & Landerl, 1997).[35] Due to these ambiguities, the corpus of this study contains several instances of phonological misspellings. For example, in *<biem>/<beim> *at the,* the phoneme /aj/ is represented with the English grapheme <ie> instead of the correct <ei>.

In addition to misspellings that can be attributed to the incorrect application of correct (i.e., *actual*) phoneme-grapheme correspondences, nonnative misspellings may be influenced by the learner's nonstandard pronunciation of words, an inability to hear or distinguish sounds in the foreign language or general difficulties with remembering L2 phoneme-grapheme-correspondences. All of these factors result in the application of incorrect (i.e., *assumed*) phoneme-grapheme correspondences. For example, general difficulties with L2 phoneme-grapheme-correspondences are exemplified in the corpus by the use of the nonexistent grapheme <sc> for <sch> to represent the phoneme /ʃ/ (e.g., *<Scwester>/<Schwester> *sister*).

[34] German has so-called weak and strong verbs. Weak verbs form the past participle with the <t> suffix, strong verbs use <en>.

[35] For example, English students writing in German may choose to represent the phoneme /aj/ with the German graphemes <ei> or <ai> (e.g., <mein> *my*, <Saite> *string*) or the English graphemes <i>, <y>, <ie>, <igh>, and <i_e> (e.g., <hi>, <my>, <lie>, <sigh>, <rise>).

Orthographic Misspellings

Orthographic misspellings, the final linguistic subsystem category, are surface-level errors in the sense that all required letters are present and properly ordered in the misspelling, yet the word is nevertheless spelled incorrectly due to errors involving capitalization or nonletter characters. Capitalization errors are committed when words that are obligatorily capitalized (such as all nouns in German) are written in lower case. Errors involving nonletter characters include the incorrect omission or addition of spaces, hyphens, or apostrophes. The addition or omission of spaces results in word division errors. Word division errors are comprised of split words and run-ons. Split words are misspellings where a single word is written apart and run-ons are cases where two words are written together. Examples of orthographic errors in the corpus are the omission of a nonletter character, a space, in the word division error *<Wieviel> for <Wie viel> *how much* as well as the omission of a nonletter character, an apostrophe, in *<gehts>/<geht's> *goes it.*[36]

3.2.3.2 The Language Influence Subtaxonomy

Competence misspellings in the four linguistic subsystem categories can be further subdivided according to the language influence subtaxonomy into interlingual, intralingual, ambilingual or paralingual misspellings.[37] For example, a lexically motivated misspelling can be influenced by English lexical items (interlingual), other German words (intralingual), both English and German words (ambilingual) or it can involve a general lack of vocabulary knowledge (paralingual). Table 3:4 presents examples of competence misspellings that are subcategorized according to both the linguistic subsystem and the language influence subtaxonomy.

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[36] Note that not all surface-level errors fall into the class of orthographic misspellings. Orthographic misspellings are a subcategory of competence-based misspellings and as such imply deliberation and/or systematicity and/or non-self-corrigibility. Naturally, there are many surface-level errors that do not involve any of these factors. For example, the misspelling *<deineEltern> for <deine Eltern> *your parents* appears to be accidental as evidenced by the word-medial occurrence of the upper case letter <E>. These *accidental* surface-level errors are classified as performance-based along with all other accidental misspellings.

[37] CLASSY employs the language influence error classes discussed in section 3.1.1.3. However, for clarity, the *ambiguous* category is termed *ambilingual* and the *other* category is called *paralingual* in this study.

Table 3:4 The Linguistic Subsystem and Language Influence Subtaxonomies

Linguistic subsystem	Language influence			
	Interlingual	Intralingual	Ambilingual	Paralingual
Lexical	*<Suitcase>/ <Koffer> *suitcase*	*<Metz>/ <Fleisch> *meat*	*<goht>/ <geht> *goes*	*<Poskeutzah>/ <Postleitzahl> *postal code*
Morpho-logical	*<tanzed>/ <tanzte> *danced*[a]	*<gesitzt>/ <gesessen> *sat*	*<Stühls>/ <Stühle> *chairs*	*<arbeits>/ <arbeitest> *work*
Phono-logical	*<biem>/ <beim> *at the*	*<diser>/ <dieser> *this*	*<komst>/ <kommst> *come*	*<Scwester>/ <Schwester> *sister*
Ortho-graphic	*<postkarte>/ <Postkarte> *postcard*	*<Wieviel>/ <Wie viel> *How much*	*<mittag>/ <Mittag> *noon*	*<Morgenabend>/ <Morgen Abend> *tomorrow night*

[a]Although not present in the current study, interlingual morphological errors have been reported elsewhere (e.g., Snyder, 1995).

Interlingual Misspellings

Interlingual errors entail transfer of patterns from a foreign language to the target language. In the present study, this generally involves transfer from English, the participants' native language, to German. However, occasional cases of transfer from French are also attested in the corpus (e.g., *<bicyclette>/<Fahrrad> *bike*).[38] Examples of misspellings in the interlingual category include the lexical misspelling *<Suitcase>/<Koffer> *suitcase*, where the entire lexeme is transferred from English to German and the morphological misspelling *<tanzed>/<tanzte> *danced* where the English past tense morpheme <ed> is incorrectly used. In addition, the category contains phonological misspellings such as *<biem>/<beim> *at the,* in which an English phoneme-grapheme-correspondence is utilized as well as orthographic misspellings like *<postkarte>/<Postkarte> *postcard,* in which a noun is incorrectly written in lower case according to English spelling conventions.

Intralingual Misspellings

The intralingual class comprises misspellings that can be traced to overgeneralizations of German language forms or ambiguities within the German

[38] Odlin (1989) notes that interlingual transfer is not always transfer from the native language.

language. This category includes lexical misspellings such as *<Metz>/<Fleisch> *meat*, an incorrect backformation of the German word for *butcher*, <Metzger>. There are also many morphological misspellings such as *<gesitzt>/<gesessen> *sat*, in which the irregular past participle form of <sitzen> *to sit* is regularized. An example of a phonological misspelling is *<diser>/<dieser> *this* in which the wrong German grapheme <i> was chosen from a set of German graphemes representing the phoneme /i/. In the orthographic misspelling *<Wieviel>/<Wie viel> *How much* the writer overgeneralized the fact that German WH-questions are generally written as one word.

Ambilingual Misspellings

The ambilingual category includes misspellings that are potentially influenced by both German and English. For example, the lexical misspelling *<goht>/<geht> *goes* shows a language influence of both English and German in the spelling of <geht> *goes*. The morphological misspelling *<Stühls>/<Stühle> *chairs* is another example of an ambilingual misspelling. Here, the plural suffix <s>, which exists in both German and English, is used in the wrong context. *<komst>/<kommst> *come* is a phonological ambilingual misspelling: the phoneme-grapheme-correspondence whereby /m/ is represented by <m> is common in both English and German. In the orthographic subsystem, *<mittag>/<Mittag> *noon* is an ambilingual misspelling: time references are frequently lower cased in both English and German (e.g., <tomorrow> in English or <morgen> *tomorrow* in German).

Paralingual Misspellings

The paralingual category contains errors that cannot be attributed to foreign language transfer or target language resources. When in doubt about a language influence category assignment, misspellings were assigned to the paralingual class. This category is largely comprised of lexical misspellings. For example, the lexical misspelling *<Poskeutzah>/<Postleitzahl> *postal code* is due to a general vocabulary problem that is not influenced by the writer's L1 or L2. Furthermore, the morphological misspelling *<arbeits>/<arbeitest> *work* illustrates difficulties with inflecting verbs but it does not involve interlingual or intralingual transfer. The

phonological misspelling *<Scwester>/<Schwester> *sister*, demonstrates the application of the incorrect phoneme-grapheme correspondence whereby /ʃ/ is represented as <sc>. However, this phoneme-grapheme correspondence is neither part of German nor English orthography. Finally, the orthographic misspelling *<Morgenabend>/ <Morgen Abend> *tomorrow night* is also paralingual as it does not involve the transfer of English or German word division patterns.

3.2.3.3 The Target Modification Subtaxonomy

In addition to the language influence subtaxonomy, misspellings in the linguistic subsystem categories are also subclassified according to the target modification subtaxonomy (see Figure 3:1 on page 34). The target modification taxonomy as discussed in section 3.1.1.4 divides misspellings into single and multiple violations and classifies them as additions, omissions, substitutions, or transpositions. Previous spell checking studies have generally focused on single violations and their distribution across addition, omission, substitution and transposition because these are the types of misspellings that typically occur in L1 writing and are addressed by generic spell checkers.

In this thesis, however, the focus is directed towards single vs. multiple violations because a detailed study and comparison of both single and multiple violations with respect to both competence and performance-related misspellings in L2 writing has yet to be conducted.[39] Table 3:5 provides examples of the single and multiple violations of the target modification subtaxonomy considering the linguistic subsystem. For instance, an example of a single violation is the misspelling *<wollst> for <willst> *want*. In contrast, the misspelling *<laüft> for target <läuft> *runs* has an edit distance of two and thus has been classified as a multiple violation.

[39] For reasons of brevity and clarity, this thesis does not further classify single and multiple violations into the four error categories of addition, omission, substitution, and transposition. Instead, it is the distribution of single vs. multiple violations that is relevant to the study at hand because this is the primary distinction between errors that are specifically addressed by spell checkers (i.e., single violations) and those that are not (i.e., multiple violations).

Table 3:5 The Target Modification Subtaxonomy in the Competence Class

Linguistic subsystem	Single violations	Multiple violations
Lexical	*<goht>/<geht> *goes*	*<Suitcase>/<Koffer> *suitcase*
Morphological	*<wollst>/<willst> *want*	*<gesitzt>/<gesessen> *sat*
Phonological	*<diser>/<dieser> *this*	*<laüft>/<läuft> *runs*
Orthographic	*<postkarte>/<Postkarte> *postcard*	*<Morgenabend>/<Morgen Abend> *tomorrow night*

3.2.4 Performance Errors

3.2.4.1 The Target Modification Subtaxonomy

Next to competence errors, performance errors are the second main category of nonnative misspellings. Misspellings in the competence category were motivated and explained by classifying them into linguistic subsystem and language influence categories. Performance errors, however, are accidental, unsystematic, and self-corrigible by definition and as such are not motivated by lack of knowledge of a linguistic subsystem or influenced by a particular language. Performance misspellings are thus subcategorized descriptively only, using the target modification subtaxonomy.

Table 3:6 The Target Modification Subtaxonomy in the Performance Class

Error category	Single violations	Multiple violations
Performance	*<Kno>/<Kino> *movie theatre*	*<Won\her>/<Woher> *From where*

The target modification subtaxonomy in the performance category given in Table 3:6 is identical to the one in the competence category.[40]

The four taxonomies of the error classification model presented here (competence vs. performance, linguistic subsystem, language influence, and target modification) reflect the importance of the different sources of nonnative misspellings by, at the same time, taking into account computational factors that are relevant for

[40] See Appendix B for a summary of the error classification guidelines presented in section 3.2.

the evaluation and development of spell checkers. The classification system is thus comprehensive and general. It meets the three objectives of error classification pursued in this thesis:

1. to advance our understanding of second language acquisition,
2. to enhance teaching pedagogy, and
3. to evaluate and develop spell checkers in CALL.

The following chapter discusses the distribution of the 1027 unique misspellings analyzed in this study across CLASSY's error taxonomies and categories.

CHAPTER 4:
ERROR DISTRIBUTION

Generic spell checkers are designed for native speakers and as such target mainly performance misspellings that result in single violations (see section 1.1.1). Previous studies, as discussed in section 1.1.3, indicate that generic spell checkers are not very successful in treating nonnative misspellings. A detailed analysis of the distribution of nonnative misspellings across various error categories and taxonomies is a first step in the evaluation of existing spell checkers, the enhancement of existing spell checkers, and the development of new ones. Error distribution data also provides information to SLA researchers and language instructors concerning the kinds and frequencies of misspellings in nonnative writing.

Accordingly, this chapter examines the overall distribution of the 1027 nonnative misspellings based on CLASSY, the error classification system for nonnative misspellings discussed in section 3.2. The chapter further considers proficiency level and task type as two variables that may influence the kinds and frequencies of misspellings that occur.

4.1 Overall Error Distribution

Following CLASSY, this section first discusses the competence/performance ratio of the misspellings. Competence errors are then investigated in more detail, first analyzing the linguistic subsystem and language influence distribution, then examining target modification within the linguistic subsystems. The distribution of performance errors according to target modification is also discussed.

4.1.1 Competence vs. Performance Errors

An analysis of the 1027 misspellings made by the learners of German of this study reveals that 72% (735) are competence-based and only 28% (292) fall into the

class of performance errors. Accordingly, and in contrast to L1 misspellings (see studies discussed in section 1.1.1, e.g., Pollock & Zamora, 1984), L2 misspellings are largely due to a lack of language competence rather than to accidental factors.

4.1.2 Competence Errors: Linguistic Subsystem and Language Influence

Table 4:1 displays the distribution of competence misspellings across the linguistic subsystem and language influence subtaxonomies.[41]

Table 4:1 Error Distribution: Linguistic Subsystem and Language Influence

	Language influence									
Linguistic subsystem	Inter-lingual		Intra-lingual		Ambi-lingual		Para-lingual		Total	
Lexical	25	3%	8	1%	13	2%	149	20%	195	27%
Morphological	-	-	294	40%	13	2%	3	0%	310	42%
Phonological	93	13%	78	11%	36	5%	17	2%	224	30%
Orthographic	1	0%	2	0%	2	0%	1	0%	6	1%
Total	119	16%	382	52%	64	9%	170	23%	735	100%

Note. Percentages in this and corresponding subsequent tables are calculated by dividing the number in each cell by the total number of competence misspellings. Dashes in this and all subsequent tables indicate cells for which no data were obtained.

Three points emerge from the data set:

First, morphology (42%) is the main source of competence-related misspellings. While phonology (30%) and the lexicon (27%) are also influential in the production of competence errors, orthographic factors cause hardly any problems for the language learners in this study (1%).[42]

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[41] The linguistic subsystem and language influence subtaxonomies are discussed simultaneously to take into account their interrelatedness (compare section 3.2.3.2).

[42] Orthographic misspellings are competence-related nonletter character and capitalization errors. Two reasons greatly limit their occurrence:

1. nonletter character errors such as the omission of a space between words (e.g., *<deineEltern>/<deine Eltern>) are generally accidental and thus not competence-related, and
2. capitalization errors may only involve nouns that are incorrectly written in lower case because
   a. only nouns are obligatorily capitalized in German but generally not in English, and
   b. the incorrect use of upper case never results in a misspelling because all German words are capitalized sentence-initially.

Furthermore, students generally do not produce many capitalization errors because the rule for capitalizing nouns in German is clear-cut: all nouns are capitalized. Due to their low frequency in the E-Tutor corpus, orthographic misspellings are not discussed here any further.

Second, the majority of competence errors is intralingual (52%) implying that, for spelling purposes, the learner's target language is more influential than the source language (16%). Furthermore, even general spelling difficulties that cannot be attributed to a language influence at all (paralingual: 23%) are more influential than interference from the native language. Not surprisingly, the influence of ambilingual factors is small (9%) given that most transferable patterns are specific to either the L1 or the L2 but not to both L1 and L2.

Third, Table 4:1 further shows that the errors in each linguistic subsystem are not evenly distributed across the four language influence categories. Lexical misspellings cluster in the paralingual class suggesting that a general lack of vocabulary knowledge is more of a determining factor in nonnative writing than lexical transfer from the two languages involved. Morphological misspellings, on the other hand, are mainly intralingual, that is, they are generally due to overgeneralization or simplification of German inflectional rules. In fact, there are no interlingual morphological misspellings at all. While some cases of interlingual morphological transfer are reported in the literature (e.g., Snyder, 1995), morphology is generally believed to be less prone to interlingual transfer than other linguistic subsystems (Odlin, 1989) because learners tend to view inflectional morphology as unique to their own language (Gass & Selinker, 1994). Phonological misspellings are fairly evenly distributed across the interlingual and intralingual categories which demonstrates the importance of both L1 and L2 phonology in L2 spelling (see also James & Klein, 1994). Accordingly, the four most influential competence-related sources of nonnative misspellings are intralingual morphological misspellings (40%), followed by paralingual lexical misspellings (20%) and interlingual and intralingual phonological misspellings (13% and 11%, respectively).

4.1.3 Competence Errors: Linguistic Subsystem and Target Modification

According to CLASSY, competence misspellings in the linguistic subsystems are further considered with respect to the target modification subtaxonomy. Two points surface from an investigation of the error distribution provided in Table 4:2.

Table 4:2 Error Distribution: Linguistic Subsystem and Target Modification

Linguistic subsystem	Target modification: Single violations		Multiple violations		Total		/735
Lexical	107	55%	88	45%	195	100%	27%
Morphological	155	50%	155	50%	310	100%	42%
Phonological	210	94%	14	6%	224	100%	30%
Orthographic	5	83%	1	17%	6	100%	1%
Total	477	65%	258	35%	735	100%	100%

Note. Target modification percentages in this and corresponding subsequent tables are calculated by dividing the number in each cell by the total number of errors in the same row.

First, only 65% of L2 competence misspellings involve single violations. This percentage is much lower than that of typical L1 misspellings. Previous research, as discussed in section 1.1.1, indicated that L1 misspellings are generally performance-based and as such involve 80-95% single violations (Damerau, 1964; Pollock & Zamora, 1984).

Second, it is interesting to note that target modification is related to linguistic subsystem. Whereas lexical and morphological misspellings are quite evenly distributed among single and multiple violations, phonological misspellings are overwhelmingly single violations (94%). Table 4:3 provides examples of misspellings of single and multiple violations in each of the three linguistic subsystems (see Appendix C for a complete list of the E-Tutor misspellings and their error categories).

Table 4:3 Examples of Single and Multiple Violation Misspellings in the Linguistic Subsystems

Linguistic subsystem	Target modification: Single violations	Multiple violations
Lexical	*<en>/<ein> *a* *<is>/<ist> *is*	*<Schestwe>/<Schwester> *sister* *<Austria>/<Österreich> *Austria*
Morphological	*<gebst>/<gibst> *give* *<heißst>/<heißt> *are called*	*<gegehen>/<gegangen> *went* *<Zimmeren>/<Zimmer> *rooms*
Phonological	*<diser>/<dieser> *this* *<irh>/<ihr> *her*	*<Fluß>/<Fluss> *river* <laüft>/<läuft> *runs*

Lexical misspellings frequently involve multiple violations because they are due to insufficient knowledge of lexical items. This is illustrated, for instance, by the lexical misspelling *<Schestwe>/<Schwester> *sister*.

Morphological misspellings also frequently contain multiple violations given that morphemes are often composed of several letters. For example, the use of the present tense stem <geh> instead of the past participle stem <gang> in *<gegehen>/ <gegangen> *went* leads to multiple violations in this morphological error.

Phonological misspellings in German are much more likely to result in single violations as most phonemes are represented by graphemes consisting of one or two letters. For example, substituting one letter for another in a one-letter grapheme or leaving out one letter in a two-letter grapheme results in a single violation (e.g., using the grapheme <i> for <ie> in *<diser>/<dieser> *this* produces a single violation).

The following section investigates the distribution of performance errors according to CLASSY.

4.1.4 Performance Errors: Target Modification

In CLASSY, performance misspellings are subcategorized according to the target modification subtaxonomy. To facilitate comparisons with competence errors, Table 4:4 displays the distribution of performance as well as competence misspellings according to target modification.

Table 4:4 Error Distribution: Target Modification of All Misspellings

Competence/ performance	Target modification: Single violations		Multiple violations		Total		/1027
Competence	477	65%	258	35%	735	100%	72%
Performance	278	95%	14	5%	292	100%	28%
Total	755	74%	272	26%	1027	100%	100%

Confirming similar error distributions in previous studies, the data indicate that performance errors mainly involve single violations (95%). For L1 performance misspellings, for example, a ratio of 80 to 95% of single violations is reported in the literature (Damerau, 1964; Pollock & Zamora, 1984; see section 1.1.1). Examples of performance-based single violation misspellings in the E-tutor corpus include *<ds>/ <das> *the* and *<zumStrand>/<zum Strand> *to the beach*. The similarity in target

modification between L1 and L2 misspellings is not surprising as performance factors are presumably independent of whether individuals write in their L1 or their L2.

However, whereas both L1 and L2 performance misspellings are similar, the total of L2 misspellings is markedly different from L1 misspellings: More than a quarter (26%) of all L2 misspellings involve multiple violations.[43]

4.1.5 Main Findings

In sum, the analysis of the overall error distribution reveals that nonnative misspellings are different from native speaker misspellings in the following two aspects:

1. L2 misspellings are largely competence-related (72%), whereas L1 misspellings are largely performance-based (Pollock & Zamora, 1984), and
2. L2 misspellings involve more multiple violations than L1 misspellings do. L2 *competence* misspellings, in particular, entail more multiple violations than typical L1 misspellings. The target modification distribution of L2 *performance* misspellings, however, is similar to that of typical L1 misspellings.

With respect to L2 competence misspellings, the distribution analysis exposes four facts:

1. Lexical, morphological, and phonological factors are important in the production of competence misspellings whereas orthographic factors are insignificant,

[43] Note that the difference in target modification between L1 and L2 misspellings can be attributed to the high number of competence errors in the L2 corpus. L2 misspellings are mainly competence-based (72%) and since competence misspellings often involve multiple violations (35%), the percentage of multiple violations in the total error corpus is quite high.

2. intralingual and paralingual factors account for most of the competence misspellings while interlingual and ambilingual factors are less influential,
3. lexical misspellings are generally paralingual, morphological misspellings intralingual, and phonological misspellings inter- or intralingual, and finally,
4. the linguistic subsystem category of a misspelling has an influence on its target modification such that phonological misspellings are mainly single violations whereas both lexical and morphological misspellings involve similar ratios of single and multiple violations.

Of further interest to this study are variables that might affect the kinds and frequencies of misspellings in nonnative writing. For the purposes of this study, the learner's proficiency in German and the task type completed by the participants are considered as variables. The influence of language proficiency on error distribution is explored in the following section. The influence of task type is investigated subsequently.

4.2 Error Distribution for Different Proficiency Levels

Previous research indicates that the types and frequencies of errors nonnative writers produce may be affected by the learners' proficiency level (Ellis, 1994). Compared to beginners, intermediate language learners are more proficient in several areas of the target language such as the lexicon, morphology, phonology, or orthography. Given that misspellings can be motivated by different linguistic subsystems, increased proficiency in any or all of these areas may lead to different error types and frequencies.

The number of interlingual and intralingual errors in general may also be affected by the learner's language proficiency. For example, a study reported by Ellis (1994) found that beginners produced more interlingual errors than intermediate learners whereas intermediates produced more intralingual errors. However, Ellis also

discussed a study that did not find more interlingual errors with respect to beginners. To the author's knowledge, no studies on a possible impact of proficiency level on nonnative *misspellings* have been published.

The participants in this study belonged to one of two language proficiency levels: 32 beginners and 16 early intermediates participated in the study. The beginners produced 560 unique misspellings and the intermediates made 518 unique errors.[44] The following sections investigate the error distribution for beginners and intermediates according to CLASSY.

4.2.1 Competence vs. Performance Errors

Beginners and intermediates have similar competence to performance ratios. The beginners produced 71% (399) competence misspellings and 29% (161) performance misspellings, and the intermediates made 75% (386) competence errors and 25% (132) performance errors.

To determine intergroup variability, a two-sample chi-square test was applied. It indicates that the relationship between proficiency level and error distribution across the competence/performance taxonomy is not significant, χ^2 (1, N = 1078) = 1.29, $p >$ .05. The similarity between the error distribution of the two groups suggests that a competence to performance ratio of approximately 3:1 holds for nonnative writing independent of proficiency level.

4.2.2 Competence Errors: Linguistic Subsystem and Language Influence

Table 4:5 provides a break-down of competence errors across linguistic subsystem and language influence.

[44] Note that the numbers in the two groups do not add up to the total of 1027 unique misspellings as a given misspelling may be produced by both a beginner and an intermediate. This misspelling is counted once in each subgroup, but only once (not twice) in the overall total. The total is therefore smaller than the sum of the subtotals. Beginners produced 913 tokens of misspellings while intermediates produced 895 tokens. The corpus of 1027 types is comprised of 1808 tokens.

Table 4:5 Error Distribution: Linguistic Subsystem and Language Influence for Beginners and Intermediates

Linguistic subsystem	Language influence: Inter-lingual		Intra-lingual		Ambi-lingual		Para-lingual		Total	
					Beginners					
Lexical	17	4%	4	1%	7	2%	117	29%	145	36%
Morphological	-	-	105	26%	6	2%	3	1%	114	29%
Phonological	60	15%	38	10%	28	7%	10	3%	136	34%
Orthographic	1	0%	2	1%	1	0%	-	-	4	1%
Total	78	20%	149	37%	42	11%	130	33%	399	100%
					Intermediates					
Lexical	13	3%	4	1%	7	2%	39	10%	63	16%
Morphological	-	-	210	54%	8	2%	-	-	218	56%
Phonological	42	11%	42	11%	9	2%	8	2%	101	26%
Orthographic	-	-	2	1%	1	0%	1	0%	4	1%
Total	55	14%	258	67%	25	6%	48	12%	386	100%

A two-sample chi-square test indicates significant differences with respect to the error distribution across linguistic subsystem in the two groups, χ^2 (3, N = 785) = 69.88, $p < .05$, $V = .30$. The data provided in Table 4:5 reveal that morphological errors are more frequent in the intermediate group but phonological and lexical errors are more prevalent in the beginner group.

It is not surprising that intermediates make more morphological misspellings (56%) relative to beginners (29%). Morphological misspellings in the E-Tutor corpus mainly involve verbal forms (82%). Present tense forms of verbs are the focus at the beginner level whereas past tense forms are emphasized at the intermediate level. For example, beginners frequently misspell present tense forms of verbs such as *<käuft>/ <kauft> *buys* where a stem vowel change is incorrectly applied to the third person singular form of the verb <kaufen> *to buy*. Intermediates, on the other hand, make many misspellings with past tense forms. For instance, they produce the misspelling of the past participle *<gesitzt>/<gesessen> *sat* in which the inflectional paradigm of a weak verb is incorrectly applied to the strong verb <sitzen> *to sit*. It is the accumulation of complexity at the intermediate level that provides more opportunities for errors. Not only do intermediates have to know the new forms they acquire but they also have to recall the regularities and exceptions learnt at the beginner level.

Beginners, on the other hand, are more influenced by phonological error sources (34%) than intermediates (26%). For example, beginners commit many phonological misspellings such as *<Muzik>/<Musik> *music* that demonstrate the use of English phoneme-grapheme correspondences in German (in this example, the grapheme <z> instead of <s> is incorrectly used to represent the phoneme /z/). Beginners have to acquire the sound system of the target language while at an intermediate level, students are more proficient in the L2 and have generally developed a better command of L2 phonology and L2 phonological spelling conventions, especially in a phonetic language such as German. The decrease in phonological misspellings in the intermediate group is thus quite expected.

Beginners make more lexical errors (36%) than intermediates (16%). Students continue to learn new vocabulary items throughout their language education and thus one might assume that the ratio of lexical misspellings remains the same across the two proficiency levels. However, the fact that intermediates have been exposed to the target language longer might lead to a greater success rate in predicting possible and impossible lexical patterns in the target language. In addition, intermediates might make less lexical misspellings because they are more familiar with function words as well as basic content words that are frequently used in the exercises.

A further two-sample chi-square test indicates that the relationship between proficiency level and error distribution across the language influence categories is also significant, χ^2 (3, N = 785) = 75.06, $p < .05$, $V = .31$. Interestingly, intralingual factors occur more frequently with intermediates while interlingual and paralingual influences are more influential in the beginner group.

It is not surprising that intralingual errors are more frequent for intermediates (67%) compared to beginners (37%). Intermediates make more morphological errors, which, as discussed previously, are largely intralingual.

Greater proficiency in the target language also seems to decrease the learner's reliance on their native language as intermediates produce slightly less interlingual misspellings (14%) than beginners (20%). Beginners, however, commit more paralingual errors (33%) than intermediates (12%), which reflects the declining

importance of (mainly paralingual) lexical misspellings as the student's proficiency increases.[45]

Finally, the four most important individual error categories are the same in both groups: paralingual lexical, intralingual morphological, interlingual and intralingual phonological. The ranking within these four categories, however, is different. Beginners produce mainly paralingual lexical misspellings (29%), whereas over half of all intermediates' misspellings are intralingual morphological (54%). Again, these numbers reflect the importance of vocabulary-related difficulties in the beginner group and morphological difficulties in the intermediate group.

4.2.3 Competence Errors: Linguistic Subsystem and Target Modification

An investigation of the error distribution with respect to target modification displayed in Table 4:6 reveals that beginners and intermediates have similar single violation (SV) to multiple violation (MV) ratios in the lexical category (beginners: 55% SV, 45% MV; intermediates: 59% SV, 41% MV). The difference is not statistically significant, χ^2 (1, N = 208) = .10, $p > .05$. This is expected given that both groups work on exercises according to their skill level. A beginner, who does not know a vocabulary item from chapter 1, is not more likely to produce a single violation misspelling than an intermediate, who has difficulty with a vocabulary item in chapter 7 of the CALL program.

[45] Meaningful comparisons of the two proficiency groups concerning the ambilingual category cannot be made because ambilingual errors involve both L1 and L2 influence. Beginners, however, produce more L1-related misspellings whereas intermediates produce more L2-related misspellings. The ambilingual category is therefore disregarded.

Table 4:6 Error Distribution: Linguistic Subsystem and Target Modification for Beginners and Intermediates

Linguistic subsystem	Target modification: Single violations		Multiple violations		Total		
Beginners							/399
Lexical	80	55%	65	45%	145	100%	36%
Morphological	75	66%	39	34%	114	100%	29%
Phonological	130	96%	6	4%	136	100%	34%
Orthographic	4	100%	-	-	4	100%	1%
Total	289	72%	110	28%	399	100%	100%
Intermediates							/386
Lexical	37	59%	26	41%	63	100%	16%
Morphological	101	46%	117	54%	218	100%	56%
Phonological	93	92%	8	8%	101	100%	26%
Orthographic	3	75%	1	25%	4	100%	1%
Total	234	61%	152	39%	386	100%	100%

Furthermore, it is also not surprising that proficiency level does not affect target modification in phonological misspellings (beginners: 96% SV, 4% MV; intermediates: 92% SV, 8% MV), χ^2 (1, N = 237) = 0.73, $p > .05$. Independent of the writer's proficiency level, phonological misspellings generally involve single violations because graphemes (i.e., letters that represent phonemes), at least in German and English, are largely composed of only one or two letters.

The target modification distribution in the morphological category, however, is significantly different for beginners and intermediates (beginners: 66% SV, 34% MV; intermediates: 46% SV, 54% MV), χ^2 (1, N = 332) = 10.61, $p < .05$, $V = .18$. It is likely to be affected by exercise content. Beginners generally produce misspellings of infinitives and present indicative verb forms (78%) while intermediates mainly misspell simple past, past participle, or subjunctive verb forms (61%) as Table 4:7 indicates.

Table 4:7 Types of Morphological Errors in the Two Proficiency Groups

Group	Morphological category: Verb form *basic*		Verb form *advanced*		Other		Total	
Beginners	89	78%	-	-	25	22%	114	100%
Intermediates	50	23%	132	61%	36	17%	218	100%

Note. "Verb form basic" includes infinitive and present indicative forms, "Verb form advanced" includes simple past, past participle and subjunctive forms. "Other" includes nonverbs such as nouns, adjectives, and adverbs.

Finally, Table 4:8 indicates that multiple violations are frequent in simple past, past participle and subjunctive verb forms (77%) and rare in infinitive and present indicative verb forms (27%).[46] As a result, there are more multiple violations in the intermediate morphological misspelling category given that intermediates inflect more of the advanced forms than beginners.

Table 4:8 Target Modification for Different Types of Morphological Errors

Morphological category	Target modification: Single violations		Multiple violations		Total	
Verb form *basic*	89	73%	33	27%	122	100%
Verb form *advanced*	30	23%	102	77%	132	100%
Other	36	64%	20	36%	56	100%
Total	155	50%	155	50%	310	100%

The discussion demonstrates that the grammatical constructions acquired at the beginner and intermediate proficiency levels affect the distribution of errors in the morphological category. More advanced verb forms generally involve more multiple violations.

The preponderance of multiple violations in the morphological category influences the total distribution of competence errors for intermediates. Accordingly,

[46] Misspellings of infinitive and present indicative verb forms generally involve the stem vowel, the person/number suffix or <e> epenthesis between the stem and the ending. These three error sources usually result in single violations. For example, a single violation is incurred by changing the stem vowel from <i> to <o> in *<wollst>/<willst> *want*. Additional error sources that generally involve multiple violations are introduced when inflecting verbs in the simple past, past participle, or subjunctive. In the past participle, for instance, choosing the wrong past participle suffix (<en> for <t> or vice versa) results in a multiple violation.

intermediates have more multiple violations in the competence class (39%) than beginners (28%), χ^2 (1, N = 785) = 11.78, $p < .05$, $V = .12$.[47]

4.2.4 Performance Errors: Target Modification

Table 4:9 displays the distribution of competence and performance errors according to target modification in the two proficiency groups.

Table 4:9 Error Distribution: Target Modification of All Misspellings for Beginners and Intermediates

Competence/ Performance	Target modification: Single violations		Multiple violations		Total		
Beginners							/560
Competence	289	72%	110	28%	399	100%	71%
Performance	155	96%	6	4%	161	100%	29%
Total	444	79%	116	21%	560	100%	100%
Intermediates							/518
Competence	234	61%	152	39%	386	100%	75%
Performance	124	94%	8	6%	132	100%	25%
Total	358	69%	160	31%	518	100%	100%

Table 4:9 reveals two interesting points:

First, proficiency level does not affect the target modification distribution in the performance category (beginners: 96% SV, 4% MV; intermediates: 94% SV, 6% MV), χ^2 (1, N = 293) = .43, $p > .05$. This is not surprising given that performance-based misspellings are due to factors such as the writer's motor coordination skills, fatigue or inattention.

Second, compared to beginners, intermediates have a slightly higher percentage of multiple violations in total (beginners: 21% MV; intermediates: 31% MV), χ^2 (1, N = 1078) = 14.09, $p < .05$, $V = .11$. This is due to the higher percentage

[47] Not surprisingly, if morphological misspellings are removed from the corpus, the target modification distribution of competence misspellings for beginners and intermediates is similar (beginners: 25% MV; intermediates: 21% MV).

of multiple violations in the morphological category, which is reflected in the competence category and therefore also in the overall total.[48]

4.2.5 Main Findings for Beginners and Intermediates

Table 4:10 summarizes the main proficiency-related tendencies in error distribution.[49]

Table 4:10 Proficiency-related Tendencies in Error Distribution

Error distribution	Comparison of beginners vs. intermediates
Competence/performance	Ratio is similar for both proficiency groups^
Competence misspellings	
Linguistic subsystem*	Ratio of lexical and phonological misspellings is lower for intermediates
	Ratio of morphological misspellings is higher for intermediates
Language influence*	Ratio of interlingual and paralingual misspellings is lower for intermediates
	Ratio of intralingual misspellings is higher for intermediates
Target modification in linguistic subsystems	Ratio of multiple violations in lexical^ and phonological^ misspellings is similar for both proficiency groups
	Ratio of multiple violations in morphological misspellings is higher for intermediates*
Performance misspellings	
Target modification	Ratio of multiple violations is similar for both proficiency groups^
Main categories of competence misspellings in both groups	paralingual lexical, intralingual morphological, interlingual phonological, intralingual phonological

Note. A two-sample chi-square test indicates (*)/does not indicate (^) significant between-group differences in error distribution at the $\alpha = .05$ level.

[48] Once more, it is not surprising that removing morphological misspellings from the calculation results in similar overall target modification distributions for beginners and intermediates (beginners: 17% MV; intermediates: 14% MV).

[49] For interest, this study also investigated whether the tendencies observed for beginners and intermediates were consistent across the two task types completed by the language learners in this study, build-a-sentence and translation. The comparison revealed that the proficiency-related tendencies were by and large sustained in the two tasks.

The following section investigates the influence of task type on the kinds and frequencies of nonnative misspellings.

4.3 Error Distribution for Different Task Types

Besides proficiency level, the student's task might influence the types and frequencies of learner errors. Ellis (1994), for example, notes that "the proportion of transfer and intralingual errors varies in accordance with the task used to elicit samples of learner language" (p. 62). Translation tasks, for instance, have been criticized for triggering interlingual errors (Dulay et al., 1982; Rogers, 1985). Dulay et al. (1982) declare that "the use of translation as an elicitation technique in ... [second language] research artificially increases the L2 learner's reliance on the ... [mother tongue], and accordingly, the proportion of interference errors" (p. 258).[50]

No studies, to the author's knowledge, have examined the influence of task type on the production of nonnative misspellings. To gain insights into this area, the current study investigates two task types: translation and build-a-sentence.

The translation and sentence building tasks were chosen for three reasons: First, both task types are widely used in CALL and in traditional classroom instruction and thus representative of the tasks students commonly perform. Second, the task types are controlled elicitation techniques in which researchers "have available an account of what the learner is trying to express independent of the learner's own words" (Corder, 1981, p. 39; see also Corder, 1975). Third, the two tasks provide representative error data as error avoidance on the part of the learner is difficult if not impossible because the tasks predetermine the usage of certain grammatical structures and words (Lee, 2003, p.11).

[50] However, in a comparison of Spanish errors made by 28 English university students in free compositions and translations, LoCoco (1976) found almost no variation in the amount of interlingual errors obtained from the two tasks.

In this study, 722 unique misspellings were produced in the sentence building task and 337 unique misspellings were committed in translation.[51] The following sections analyze the error distributions for the two task types.

4.3.1 Competence vs. Performance Errors

The competence to performance ratio is similar in build-a-sentence and translation. In build-a-sentence, 71% (514) of the misspellings are competence-related while 29% (208) are performance misspellings. In translation, the ratio is 74% (251) competence to 26% (86) performance. A two-sample chi-square test was applied to determine between-task variability. The test indicates that the relationship between task type and error distribution across the competence/performance taxonomy is not significant, χ^2 (1, N = 1059) = 1.08, $p > .05$, suggesting that both task types elicit a similar distribution of competence vs. performance errors.

4.3.2 Competence Errors: Linguistic Subsystem and Language Influence

Table 4:11 displays error distribution results in the two task types with respect to linguistic subsystem and language influence.

Table 4:11 Error Distribution: Linguistic Subsystem and Language Influence in Build-a-Sentence and Translation

	Language influence									
Linguistic subsystem	Inter-lingual		Intra-lingual		Ambi-lingual		Para-lingual		Total	
				Build-a-sentence						
Lexical	8	2%	2	0%	5	1%	83	16%	98	19%
Morphological	0	0%	259	50%	5	1%	3	1%	267	52%
Phonological	59	11%	48	9%	26	5%	14	3%	147	29%
Orthographic	0	0%	2	0%	0	0%	0	0%	2	0%
Total	67	13%	311	61%	36	7%	100	19%	514	100%

[51] As with proficiency level, the number of misspellings in the two task types does not add up to the total of 1027 types: A misspelling that is produced in both build-a-sentence and translation is counted once in each task type and only once in the overall total. Build-a-sentence contains 1276 tokens of misspellings and translation contains 532 tokens.

Linguistic subsystem	Language influence: Inter-lingual		Intra-lingual		Ambi-lingual		Para-lingual		Total	
					Translation					
Lexical	19	8%	7	3%	9	4%	72	29%	107	43%
Morphological	0	0%	42	17%	8	3%	0	0%	50	20%
Phonological	40	16%	34	14%	11	4%	3	1%	88	35%
Orthographic	1	0%	2	1%	2	1%	1	0%	6	2%
Total	60	24%	85	34%	30	12%	76	30%	251	100%

A two-sample chi-square test reveals that the relationship between task type and error distribution across the linguistic subsystem categories is significant, χ^2 (3, N = 765) = 85.43, $p < .05$, $V = .33$. There are more lexical misspellings in translation (43%) than in build-a-sentence (19%). This is expected as lexical knowledge is a focus of the translation task: It requires students to translate vocabulary items from English into German (see section 2.3 for a description and screenshots of the two task types). For example, translation contains lexical misspellings like *<Austria>, *<Österra>, and *<Osterria>, all of which are misspellings of the target word <Österreich> *Austria.*

Morphological misspellings, on the other hand, are more frequent in build-a-sentence (52%) than in translation (20%). It is likely that build-a-sentence triggers more morphological misspellings because it provides learners with the base forms of German words. With respect to verbs, for example, this might invite learners to use the infinitive stem in verb inflections without careful consideration of the verbal paradigm. For instance, the intralingual morphological misspelling of the past participle *<gebringt>/<gebracht> *brought*, which occurred in build-a-sentence, demonstrates the incorrect use of the infinitive stem with the verb <bringen> *to bring.*[52]

Regarding phonological misspellings, the ratios are fairly similar in build-a-sentence (29%) and translation (35%). This suggests that task type is not an

[52] In build-a-sentence, 267 morphological misspellings were produced. 113 of them involve verbs as target words in which the target stem is different from the infinitive stem. In 53 of these 113 misspellings (47%), students incorrectly used the infinitive stem. The numbers in translation are too small for meaningful comparisons.

influencing factor in the production of phonologically motivated misspellings for these two task types. For example, both task types contain phonological misspellings such as *<speilen>/<spielen> *play* and *<weiss>/<weiß> *know*, which involve the incorrect representation of /i/ as <ei> instead of <ie> and of /s/ as <ss> instead of <ß>, respectively.

With respect to language influence, a two-sample chi-square test indicates significant differences in error distribution for the two task types, χ^2 (3, N = 765) = 48.50, $p < .05$, $V = .25$. The ratio of interlingual misspellings is higher in translation (24%) than in sentence building (13%). This finding provides supporting evidence for the hypothesis that translation tasks may trigger increased interlingual transfer (see, e.g., Dulay et al., 1982). For example, interlingual misspellings in translation frequently involve the complete transfer of English words as in *<France>/ <Frankreich> *France* and *<question>/<Frage> *question.*

Translation also contains more paralingual errors (30%) than build-a-sentence (19%) given that lexical errors, which are generally paralingual, are more common in translations. For example, paralingual lexical misspellings such as *<Poskeutzah> and *<Postelitz>, both misspellings of the target word <Postleitzahl> *postal code*, occur frequently in translation.

In contrast, the build-a-sentence task involves more intralingual misspellings (61%) than the translation task (34%) because morphological errors, which are generally intralingual, are frequent in this task type. For example, build-a-sentence contains intralingual morphological misspellings like *<gebringt>/<gebracht> *brought* and *<fahrte>/<fuhr> *drove*, both of which are due to inflecting strong verbs as weak verbs.

Similar ratios of ambilingual errors in both task types (7% vs. 12%) indicate that this category is not affected by task type. For example, build-a-sentence contains ambilingual misspellings such as *<haven>/<haben> *have*, a lexical error which is influenced by both English and German. Translation also contains ambilingual misspellings like *<goht>/<geht> *goes*, a lexical error which combines the English and the German spelling of the word *goes*.

In both task types, paralingual lexical, intralingual morphological, inter- and intralingual phonological errors are the four most frequent sources of nonnative misspellings. As with proficiency level, task type affects the ranking of the categories. In build-a-sentence, intralingual morphological errors are the most frequent (50%), in translation, paralingual lexical errors are ranked number one (29%). The rankings underline the relevance of morphology-related difficulties in build-a-sentence tasks and vocabulary-related difficulties in translations.[53]

4.3.3 Competence Errors: Linguistic Subsystem and Target Modification

Table 4:12 displays target modification for the linguistic subsystem categories in the two task types.

Table 4:12 Error Distribution: Linguistic Subsystem and Target Modification in Build-a-Sentence and Translation

Linguistic subsystem	Target modification: Single violations		Multiple violations		Total		
Build-a-sentence							/514
Lexical	68	69%	30	31%	98	100%	19%
Morphological	129	48%	138	52%	267	100%	52%
Phonological	138	94%	9	6%	147	100%	29%
Orthographic	2	100%	0	0%	2	100%	0%
Total	337	66%	177	34%	514	100%	100%
Translation							/251
Lexical	49	46%	58	54%	107	100%	43%
Morphological	33	66%	17	34%	50	100%	20%
Phonological	82	93%	6	7%	88	100%	35%
Orthographic	5	83%	1	17%	6	100%	2%
Total	169	67%	82	33%	251	100%	100%

[53] It is quite interesting to note and most likely coincidental that the error distribution for beginners resembles the error distribution in translation while the distribution for intermediates is similar to that in build-a-sentence (compare Table 4:5 on page 54 with Table 4:11 on page 62). For example, being a beginner learner *or* working on translation exercises results in the production of many lexical misspellings. Similarly, being an intermediate learner *or* working on build-a-sentence exercises involves the production of a high number of morphological misspellings.

While the overall ratio of single vs. multiple violations is similar in both task types (66% vs. 67%), the ratio of multiple violations in lexical misspellings is significantly higher in translation (54%) than in build-a-sentence (31%), χ^2 (1, N = 205) = 10.68, $p < .05$, $V = .22$. This is not surprising given that learners are provided with the German spelling of base words in build-a-sentence whereas they receive no clues about German spelling in translation. Therefore, lexical misspellings tend to deviate more from their target words in translations.

The ratio of multiple violations in morphological errors, however, is lower in translation (34%) compared to build-a-sentence (52%), χ^2 (1, N = 317) = 4.59, $p < .05$, $V = .12$. Section 4.2.3 shows that morphological errors of past participles, simple past indicatives, and subjunctives frequently involve multiple violations. There are more multiple violations in build-a-sentence because this task type contains more of these advanced verb forms than the translation task: In the 190 build-a-sentence exercises from chapters 1 to 10, advanced verb forms occur 40 times (21%) whereas advanced verb forms occur only 8 times in the 59 translation exercises (14%). As a result, the opportunity to make morphological errors of advanced verb forms is higher in build-a-sentence. Accordingly, past participles, simple pasts and subjunctives make up 45% of the 267 morphological errors in build-a-sentence but only 26% of the 50 morphological misspellings in translation.

For phonological misspellings, the ratio of multiple violations is similar in build-a-sentence (94%) and translation (93%), χ^2 (1, N = 235) = .00, $p > .05$. Task type has no influence on the fact that phonological misspellings mainly involve single violations as graphemes usually consist of only one or two letters (see section 4.1.3).

4.3.4 Performance Errors: Target Modification

The distribution of competence and performance errors according to target modification in the two task types is presented in Table 4:13.

Table 4:13 Error Distribution: Target Modification of All Misspellings in Build-a-Sentence and Translation

Competence/ Performance	Target modification: Single violations		Multiple violations		Total		
Build-a-sentence							/722
Competence	337	66%	177	34%	514	100%	71%
Performance	200	96%	8	4%	208	100%	29%
Total	537	74%	185	26%	722	100%	100%
Translation							/337
Competence	169	67%	82	33%	251	100%	74%
Performance	80	93%	6	7%	86	100%	26%
Total	249	74%	88	26%	337	100%	100%

Table 4:13 illustrates that target modification for performance errors is not influenced by task type (build-a-sentence: 96% SV, translation: 93% SV), χ^2 (1, N = 294) = .72, $p > .05$. This finding is anticipated given that performance misspellings are accidental by definition. Table 4:13 further shows that task type does not influence the single vs. multiple violation ratio in the corpus as a whole (build-a-sentence: 74% SV, translation: 74% SV).

4.3.5 Main Findings for Build-a-Sentence and Translation

Table 4:14 summarizes the main task-related tendencies in error distribution.[54]

Table 4:14 Task-related Tendencies in Error Distribution

Error distribution	Comparison of build-a-sentence vs. translation tasks
Competence/performance	Ratio is similar in both task types^
Competence misspellings	
Linguistic subsystem*	Ratio of lexical misspellings is higher in translation
	Ratio of morphological misspellings is lower in translation
	Ratio of phonological misspellings is similar in both task types

[54] For interest, the error distribution for beginners in build-a-sentence vs. translation was compared to the error distribution for intermediates in build-a-sentence vs. translation. The comparison revealed that the error distribution tendencies were generally consistent with the overall findings for build-a-sentence vs. translation.

Error distribution	Comparison of build-a-sentence vs. translation tasks
Language influence*	Ratio of interlingual and paralingual misspellings is higher in translation
	Ratio of intralingual misspellings is lower in translation
Target modification in linguistic subsystems	Ratio of multiple violations in lexical misspellings is higher in translation*
	Ratio of multiple violations in morphological misspellings is lower in translation*
	Ratio of multiple violations in phonological misspellings is similar in both task types^
Performance misspellings	
Target modification	Ratio of multiple violations is similar in both task types^
Main categories of competence misspellings in both task types	paralingual lexical, intralingual morphological, interlingual phonological, intralingual phonological

Note. A two-sample chi-square test indicates (*)/does not indicate (^) significant between-task differences in error distribution at the $\alpha = .05$ level.

4.4 Summary of Error Distribution Findings

The error distribution of this study suggests that L2 misspellings are largely competence-based and, in contrast to L1 misspellings, frequently involve multiple violations (26%).

L2 competence misspellings are mainly influenced by a lack of lexical, morphological, or phonological knowledge. Orthographically motivated errors are rare. Furthermore, target language transfer and paralingual difficulties account for the vast majority of the L2 misspellings whereas L1 or ambilingual transfer is not as influential. Lexical misspellings are frequently paralingual, morphological misspellings are generally triggered by intralingual transfer. For phonology, both source and target language influences are important.

Linguistic subsystem in competence errors influences target modification: lexical and morphological errors have similar ratios of single vs. multiple violations while phonological errors involve mainly single violations. L2 performance errors resemble L1 performance errors in that they generally involve single violations.

The learner's proficiency level has an influence on error distribution. While the ratio of competence to performance errors is not affected by proficiency level, the relationship between proficiency level and the distribution of errors across the linguistic subsystem and language influence categories is statistically significant. Beginners experience more lexical and less morphological difficulties than intermediates. Accordingly, beginners also make more paralingual errors whereas intermediates produce more intralingual misspellings. Finally, proficiency level has a statistically significant influence on target modification: In the morphological category, intermediates produce more multiple violations than beginners.

The different task types completed by the learners also affect error distribution. While task type does not influence the ratio of competence to performance errors, it has a statistically significant influence on error distribution across the linguistic subsystem and language influence categories. Translation tasks contain higher ratios of lexical as well as interlingual errors than sentence building tasks. Sentence building tasks, on the other hand, involve more morphological and intralingual misspellings than translations. Task type also affects target modification in lexical and morphological misspellings. Lexical errors involve more multiple violations in translations, morphological errors contain more multiple violations in build-a-sentence.

The following chapter investigates the performance of a generic spell checker with respect to the 1027 nonnative misspellings of this study.

CHAPTER 5:
SPELL CHECKER EVALUATION

The algorithms of generic spell checkers are based on research findings from native writers that attribute 80 to 95% of L1 misspellings to performance-related single violations (see section 1.1.1). The analysis of nonnative misspellings in chapter 4, however, indicates that L2 misspellings are quite different from the performance errors typically produced by native speakers. It is therefore necessary to evaluate the effectiveness of a generic spell checker in treating nonnative misspellings in a CALL environment.

This thesis conducts an exemplary evaluation of the generic spell checker included in the *Microsoft® Word® 2003* word processing software.[55] Certainly, other spell checkers are available for German. For example, *Duden Korrektor Plus 2.0* is another German grammar and spell checker designed for native German speakers (for a software review, see Wildner, 2004). However, given that the spell checker in the *Microsoft® Word®* software is widely used and most readily available as it is part of all *Microsoft® Office®* packages, it was chosen for the evaluation in this thesis.

In the assessment of the spell checker's performance, this thesis is concerned with the number of misspellings that are detected and/or corrected. According to Pedler (2001), there are three possible outcomes of the spell checking process:

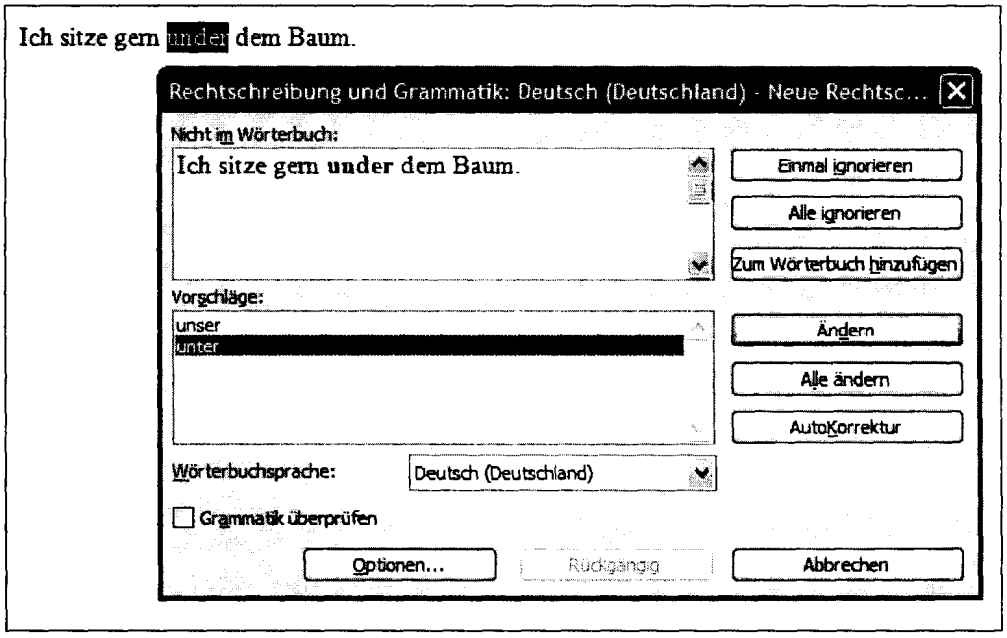
1. misspelling corrected,
2. misspelling uncorrected, and

[55] The PC version of the spell checker was set to standard German and the default settings were used.

3. misspelling undetected.[56]

The most successful outcome occurs when a spell checker detects a misspelling and provides the intended target word in its list of correction alternatives (*misspelling corrected*). Figure 5:1 illustrates this spell checking outcome. The misspelling *<under> for <unter> *under*, in which the English word is used instead of the German word, is detected by the spell checker and the intended target word is provided as the second correction alternative in the spell checker's suggested list.

Figure 5:1 A Corrected Misspelling in the *Microsoft® Word® 2003* spell checker



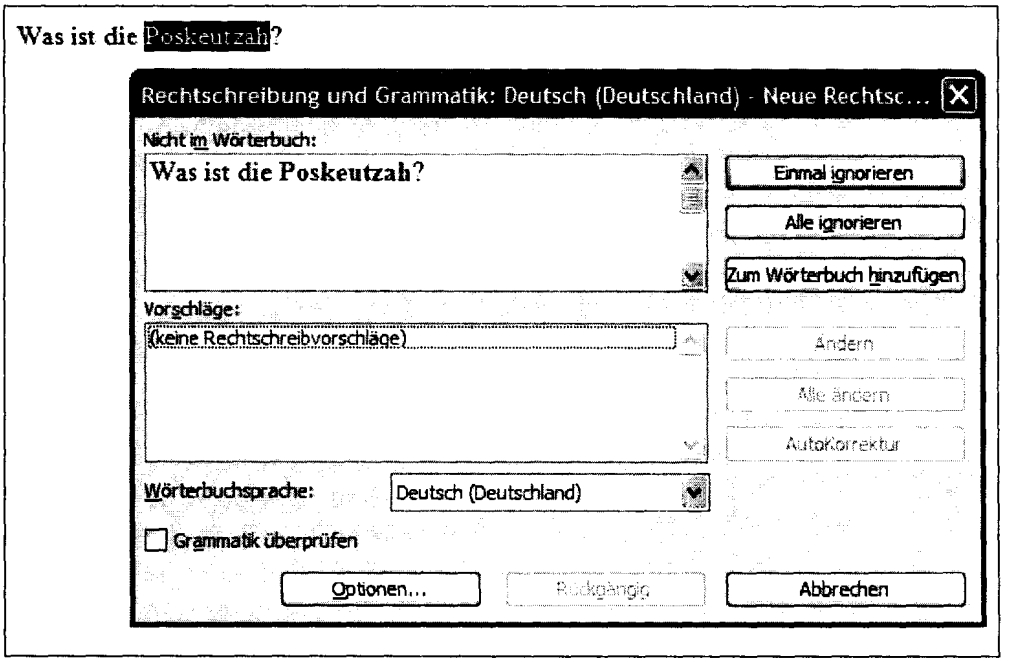
Note. Screenshot reprinted by permission from *Microsoft®* Corporation.

In the second scenario, the spell checker detects the misspelling but does not suggest the target word as a correction (*misspelling uncorrected*). In this case, the spell checker either does not provide a list of correction alternatives at all, or it does not include the target word in the correction list. The former situation is illustrated by

[56] A final possibility is that the spell checker misidentifies an existing spelling as a misspelling if the word is not in the spell checker's dictionary (e.g., in the case of proper names). However, this possibility is excluded in the present study given that the misspelling corpus does not contain existing words.

Figure 5:2 with *<Poskeutzah>/<Postleitzahl> *postal code*, a paralingual lexical misspelling. The spell checker flags the misspelling but provides no correction alternatives ("keine Rechtschreibvorschläge").

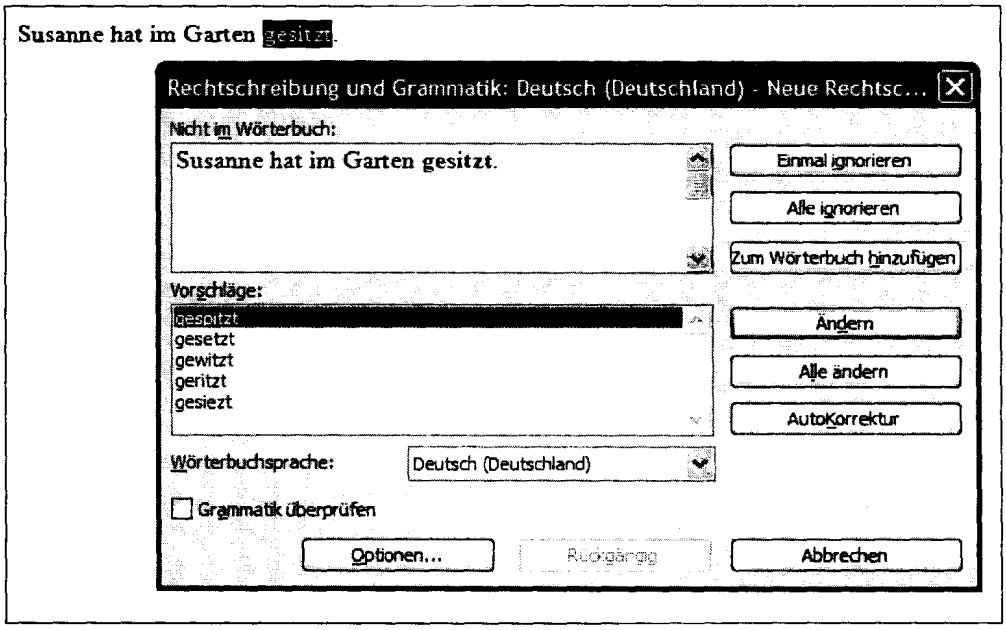
Figure 5:2 An Uncorrected Misspelling (Without List) in the *Microsoft® Word® 2003* spell checker



Note. Screenshot reprinted by permission from *Microsoft®* Corporation.

The latter case occurs with the misspelling *<gesitzt>/<gesessen> *sat*, the past participle of the strong verb <sitzen> *to sit* which is incorrectly inflected as a weak verb. As shown in Figure 5:3, the spell checker flags this misspelling and provides five correction alternatives. However, the target word <gesessen> is not among the choices.

Figure 5:3 An Uncorrected Misspelling (With List) in the *Microsoft® Word® 2003* spell checker

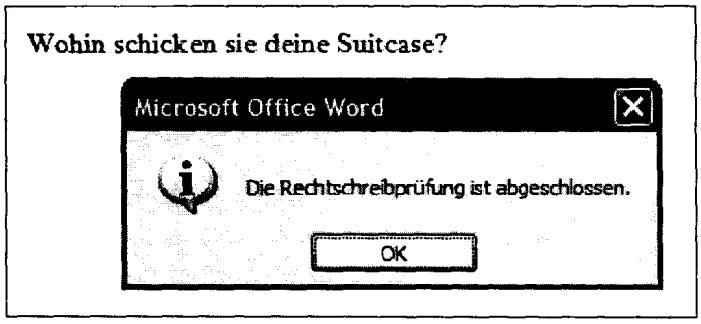


Note. Screenshot reprinted by permission from *Microsoft®* Corporation.

Finally, the least successful outcome of the spell checking process results when the spell checker fails to detect (and hence to correct) the misspelling (*misspelling undetected*). For example, the misspelling *<Suitcase>/<Koffer> *suitcase*, in which the learner used the English rather than the German word for *suitcase*, is not detected by the spell checker as illustrated in Figure 5:4. Instead, the spell checker provides the user with the feedback that the spelling check is complete ("Die Rechtschreibprüfung ist abgeschlossen").[57]

[57] A further evaluation criterion in assessing the effectiveness of a spell checker is the position of a word in a correction list if a misspelling is detected. This is not investigated in detail in this study as a previous study of nonnative misspellings of German found that "for corrected misspellings the target word is generally among the first four suggestions of the spell checker's correction list." (Rimrott & Heift, in press). Nevertheless, a brief investigation of the E-Tutor misspellings reveals that 633 misspellings are corrected in total. For 61% of these misspellings (386), the target word is the first word in the spell checker's list of correction alternatives. In 91% of the cases (573 misspellings), the target word is among the first four suggestions. The findings of this study corroborate those of Rimrott and Heift (in press).

Figure 5:4 An Undetected Misspelling in the *Microsoft® Word® 2003* spell checker



Note. Screenshot reprinted by permission from *Microsoft®* Corporation.

Following the error classification system of CLASSY, the remaining sections discuss the spell checker's performance on the L2 misspellings from the E-Tutor corpus. Section 5.1 presents the overall spell checking results. Section 5.2 discusses proficiency level and task type as variables that may affect the performance of a generic spell checker.

5.1 Overall Spell Checking Results

The spell checker's performance was tested on the 1027 nonnative misspellings from the E-Tutor corpus. Spell checking outcomes are discussed in terms of CLASSY's error taxonomies.

5.1.1 Competence vs. Performance Errors

The spell checking outcomes displayed in Table 5:1 reveal that the generic spell checker in the *Microsoft® Word® 2003* word processing software corrects only 62% of the 1027 nonnative misspellings of this study. This result contrasts sharply

with the correction success for L1 misspellings which is reportedly above 90% (Kukich, 1992).[58]

Table 5:1 Spell Checking: Competence vs. Performance Errors

Error category	Spell checking result								/1027
	Corrected		Uncorrected		Undetected		Total		
Competence	455	62%	243	33%	37	5%	735	100%	72%
Performance	178	61%	91	31%	23	8%	292	100%	28%
Total	633	62%	334	33%	60	6%	1027	100%	100%

Note. Spell checking result percentages in this and corresponding subsequent tables are calculated by dividing the number in each cell by the total number of errors in the same row. For the spell checking result of each misspelling from the E-Tutor corpus see Appendix C.

However, neither the low total correction rate (62%) nor the low correction rate for *competence* misspellings (62%) are surprising. Misspellings by foreign language learners are largely competence-related and often involve multiple violations as illustrated in chapter 4. Generic spell checkers, however, are designed to correct single violation performance errors. Indeed, a closer investigation of the competence misspellings shows that 93% of the single violations are corrected while 95% of the multiple violations are not (see Table 5:5 on page 81).[59]

It is quite unexpected, however, that the spell checker corrects only 61% of the performance errors given that these kinds of errors are specifically targeted by generic spell checkers. The low success rate is especially surprising as 95% of the L2 performance misspellings involve single violations (see Table 4:4 on page 50). However, as discussed in section 1.1.1, generic spell checkers generally do not target misspellings with an incorrectly spelled first letter. Furthermore, upon closer

[58] Misspellings containing more than one spelling error were excluded from the E-Tutor corpus (see section 2.4). Nonetheless, a brief analysis reveals that generic spell checkers are rather unsuccessful at correcting these words. Only 16% (10/64) are corrected, whereas 80% (51/64) are uncorrected and 5% (3/64) are undetected. These findings indicate that words with more than one spelling error are far more difficult to correct than misspellings containing only one spelling error (see also Rimrott & Heift, in press).

[59] The low correction rate for competence misspellings is in line with previous findings by Rimrott and Heift (in press). In an investigation of misspellings by 34 beginner to advanced learners of German working on CALL translation exercises, Rimrott and Heift found that only 52% (124/240) of the competence misspellings were corrected by the spell checker in the *Microsoft® Word® 2003* word processing software.

examination of the performance errors in the corpus, it becomes evident that the characters involved in a misspelling also influence correction success: Misspellings involving letters are corrected more successfully than misspellings involving nonletter characters such as spaces or numbers. For example, the performance misspelling *<ht>/<hat> *has*, in which the letter <a> is omitted, is corrected by the spell checker. However, the performance misspelling *<denFilm>/<den Film> *the movie*, in which a space is omitted, remains uncorrected.

Accordingly, Table 5:2 indicates that the highest correction success is achieved for single letter violations with correctly spelled first letters (92%). However, only 63% of the performance misspellings involve single letter violations in which the first letter is spelled correctly. Furthermore, the correction rate is significantly higher for single letter violations (83%) than for single nonletter violations (6%). And finally, 64% of the single violation performance errors are corrected whereas multiple violation performance misspellings are not corrected at all.

Table 5:2 Spell Checking: Target Modification of Performance Errors

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		/292
Single violations	178	64%	77	28%	23	8%	278	100%	95%
Letter	174	83%	24	11%	11	5%	209	100%	72%
1st correct	170	92%	3	2%	11	6%	184	100%	63%
1st incorrect	4	16%	21	84%	-	-	25	100%	9%
Nonletter	4	6%	53	77%	12	17%	69	100%	24%
1st correct	4	6%	53	78%	11	16%	68	100%	23%
1st incorrect	-	-	-	-	1	100%	1	100%	0%
Multiple violations	-	-	14	100%	-	-	14	100%	5%
Total	178	61%	91	31%	23	8%	292	100%	100%

Note. Multiple violations are not subdivided because they are all uncorrected.

The following section discusses the spell checking results for competence errors in more detail.

5.1.2 Competence Errors: Linguistic Subsystem and Language Influence

The spell checking results for the linguistic subsystem and language influence taxonomies displayed in Table 5:3 indicate that lexical (50%) and morphological (47%) misspellings are treated much less successfully than phonological misspellings (92% corrected). The sample of orthographic errors is too small to draw any conclusions and is therefore disregarded in this and subsequent discussions.

Table 5:3 Spell Checking: Linguistic Subsystem and Language Influence

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		/735
Lexical	97	50%	80	41%	18	9%	195	100%	27%
Interlingual	6	24%	14	56%	5	20%	25	100%	3%
Intralingual	3	38%	3	38%	2	25%	8	100%	1%
Ambilingual	6	46%	4	31%	3	23%	13	100%	2%
Paralingual	82	55%	59	40%	8	5%	149	100%	20%
Morphological	147	47%	151	49%	12	4%	310	100%	42%
Interlingual	-	-	-	-	-	-	-	-	-
Intralingual	137	47%	148	50%	9	3%	294	100%	40%
Ambilingual	9	69%	1	8%	3	23%	13	100%	2%
Paralingual	1	33%	2	67%	-	-	3	100%	0%
Phonological	206	92%	12	5%	6	3%	224	100%	30%
Interlingual	88	95%	4	4%	1	1%	93	100%	13%
Intralingual	67	86%	6	8%	5	6%	78	100%	11%
Ambilingual	36	100%	-	-	-	-	36	100%	5%
Paralingual	15	88%	2	12%	-	-	17	100%	2%
Orthographic	5	83%	-	-	1	17%	6	100%	1%
Interlingual	1	100%	-	-	-	-	1	100%	0%
Intralingual	2	100%	-	-	-	-	2	100%	0%
Ambilingual	2	100%	-	-	-	-	2	100%	0%
Paralingual	-	-	-	-	1	100%	1	100%	0%
All ling. subs.	455	62%	243	33%	37	5%	735	100%	100%
Interlingual	95	80%	18	15%	6	5%	119	100%	16%
Intralingual	209	55%	157	41%	16	4%	382	100%	52%
Ambilingual	53	83%	5	8%	6	9%	64	100%	9%
Paralingual	98	58%	63	37%	9	5%	170	100%	23%

Note. All ling. subs. = All linguistic subsystems.

It is clearly difficult for the spell checker to correct lexical misspellings given their low correction rate of 50%. The spell checker's performance is not surprising, however, given the high number of multiple violations in the lexical category (45%,

see Table 4:2 on page 49). For example, lexical misspellings such as *<Poskeutzah>/ <Postleitzahl> *postal code* or *<Suitcase>/<Koffer> *suitcase* illustrate that lexical misspellings often deviate considerably from their target words. This makes it difficult for the spell checker to suggest the target words.

Like lexical misspellings, morphological misspellings are hard to correct by the generic spell checker used in this study (47%). Again, this can be attributed to the high percentage of multiple violations in the morphological category (50%, see Table 4:2 on page 49). Consider, for example, the misspelling *<gegehen> for <gegangen> *went* in which the present tense stem <geh> instead of the past participle stem <gang> is incorrectly used to form the past participle of <gehen> *to go*. This misspelling deviates so considerably from the target spelling that a generic spell checker is unable to correct it.

It is not unexpected that the generic spell checker in this study effectively treats phonological misspellings (92% corrected) because most of the phonological errors involve single violations (94%, see Table 4:2 on page 49). In fact, closer analysis of the E-Tutor corpus reveals that even the few multiple violations in the phonological category are treated quite successfully (79% corrected, or 11/14). The generic spell checker corrects multiple violations in phonological errors involving confusions of the graphemes <ss> and <ß>, both of which represent the phoneme /s/ in German (e.g., *<Fluß>/<Fluss> *river*). It is likely that these errors are so frequent among native speakers of German that their correction is built into the *Microsoft® Word® 2003* spell checker.[60]

Linguistic subsystem seems to be more of a determining factor than language influence when it comes to spell checking outcomes. Accordingly, interlingual errors are successfully corrected in the phonological category (95%) but they are generally not corrected in the lexical category (24%). Similarly, intralingual errors have a high correction rate in the phonological category (86%) but a low correction rate in the

[60] Note that the spelling rules concerning the use of <ss> and <ß> were revised as part of the German spelling reform of 1996.

lexical (38%) and morphological categories (47%). In total, interlingual and ambilingual errors have fairly high correction rates (80% and 83%, respectively) while intralingual and paralingual errors have low correction rates (55% and 58%, respectively).

Table 5:3 further reveals that 5% of the competence misspellings are not detected by the generic spell checker at all. A closer examination of the corpus shows that 35% (13/37) of the undetected competence misspellings are due to the spell checker's treatment of German compound words. It is not feasible for a German spell checker to list all possible compounds in its dictionary because compounding is a highly productive morphological process in German. Instead, generic spell checkers treat unknown word combinations that are composed of possible German words as correct spellings. For example, the spell checker in this study did not detect the misspelling *<Nachtmittag> (<Nacht> *night* + <Mittag> *noon*) for <Nachmittag> *afternoon* (literally <nach> *after* + <Mittag> *noon*) because, from a morphological point of view, it is a possible compound but not from a semantic point of view.[61]

Undetected misspellings are further explained by the fact that the spell checker does not flag certain English words as misspellings (e.g., *<France>/<Frankreich> *France*, and *<Suitcase>/<Koffer> *suitcase*). Even though these English words may be occasionally used by native German speakers (e.g., in business jargon), they should be explained to the learner as such in a CALL environment.

5.1.3 Competence Errors: Linguistic Subsystem and Target Modification

Table 5:4 displays the spell checking results in the linguistic subsystems according to target modification.

[61] In fact, it is possible to string together a large number of existing German words without the spell checker flagging the resulting spelling as a misspelling. For example, the generic spell checker used in this study does not flag the following made-up word as a misspelling: *<Hoseschranktischstuhlsäge-lampesohnmutter>, literally *pantscupboardtablechairsawlampsonmother*.

Table 5:4 Spell Checking: Linguistic Subsystem and Target Modification

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
									/195
Lexical	97	50%	80	41%	18	9%	195	100%	100%
SV	96	90%	2	2%	9	8%	107	100%	55%
MV	1	1%	78	89%	9	10%	88	100%	45%
									/310
Morphological	147	47%	151	49%	12	4%	310	100%	100%
SV	146	94%	1	1%	8	5%	155	100%	50%
MV	1	1%	150	97%	4	3%	155	100%	50%
									/224
Phonological	206	92%	12	5%	6	3%	224	100%	100%
SV	195	93%	9	4%	6	3%	210	100%	94%
MV	11	79%	3	21%	-	-	14	100%	6%
									/6
Orthographic	5	83%	-	-	1	17%	6	100%	100%
SV	5	100%	-	-	-	-	5	100%	83%
MV	-	-	-	-	1	100%	1	100%	17%
									/735
Total	455	62%	243	33%	37	5%	735	100%	100%
SV	442	93%	12	3%	23	5%	477	100%	65%
MV	13	5%	231	90%	14	5%	258	100%	35%

Note. In this and subsequent tables: SV = single violations, MV = multiple violations.

An investigation of Table 5:4 confirms that the spell checker successfully corrects single violations but is generally unsuccessful at correcting multiple violations. Single violations are corrected 90% of the time or more in all linguistic subsystems and in the total for all competence errors. For example, the interlingual lexical misspelling *<Supermarket>/<Supermarkt> *supermarket*, which contains a single violation, is corrected by the spell checker. The correction rate for multiple violations, on the other hand, is generally very low (1% to 5%). The intralingual morphological misspelling *<gesitzt>/<gesessen> *sat*, for instance, remains uncorrected by the spell checker. However, multiple violations in the phonological category present an exception to this (79% corrected). As discussed in section 5.1.2, multiple violations in phonological misspellings involving the substitution of <ss> for <ß> or vice versa are corrected by the spell checker.

The following section discusses spell checking results for performance errors based on target modification.

5.1.4 Performance Errors: Target Modification

Table 5:5 displays the spell checking results for performance errors as well as competence errors to facilitate comparisons.

Table 5:5 Spell Checking: Target Modification of All Misspellings

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
									/735
Competence	455	62%	243	33%	37	5%	735	100%	100%
SV	442	93%	12	3%	23	5%	477	100%	65%
MV	13	5%	231	90%	14	5%	258	100%	35%
									/292
Performance	178	61%	91	31%	23	8%	292	100%	100%
SV	178	64%	77	28%	23	8%	278	100%	95%
MV	-	-	14	100%	-	-	14	100%	5%
									/1027
Total	633	62%	334	33%	60	6%	1027	100%	100%
SV	620	82%	89	12%	46	6%	755	100%	74%
MV	13	5%	245	90%	14	5%	272	100%	26%

Once more, the data in Table 5:5 confirm that multiple violations are generally not corrected (0%-5% corrected) while single violations have much higher correction rates (64%-93%). Nevertheless, the correction rate for single violations in performance errors is surprisingly low (64%). Reasons for that were already discussed in detail in section 5.1.1 (see, e.g., Table 5:2): Many of the single violations in the performance class are not corrected because they involve nonletter characters and incorrectly spelled first letters. Single violations in the competence category (93%) and in total (82%), however, are corrected successfully.

5.1.5 Main Findings

The evaluation of the generic spell checker on the E-Tutor corpus demonstrates that generic spell checkers exhibit several shortcomings when it comes to correcting nonnative misspellings. Many of the competence-related misspellings

(38%) are not corrected by the generic spell checker. Nonnative writers, however, mainly produce competence errors (72%).

Furthermore, the generic spell checker does not treat performance-related errors as successfully as anticipated. Conceptually, generic spell checkers target single violations of any kind. Practically, however, the algorithms are largely limited to correcting single letter violations with a correctly spelled first letter. The low correction rate for performance misspellings in this study (61%) is due to the fact that several of the performance errors involved nonletter and first letter errors.

Within the class of competence errors, lexical and morphological misspellings have fairly low correction rates (50% and 47%, respectively) due to the high number of multiple violations in these error categories. Phonological errors, on the other hand, are successfully treated by the generic spell checker (92% corrected) because they largely involve single violations. The correction rates in the language influence categories are affected by the linguistic subsystem of a misspelling. Interlingual phonological errors, for example, are corrected effectively but interlingual lexical errors are not.

The findings of this study suggest that spell checking outcomes can largely be predicted for any corpus of misspellings based on the number of single and multiple violations contained in the corpus: Single violations generally have a correction rate of at least 90% whereas multiple violations generally have a correction rate of 5% or less in the E-Tutor corpus.

An investigation of the spell checking results for the two proficiency groups and task types confirms that single violations are corrected far more successfully than multiple violations independent of proficiency level and task type. Accordingly, the following section provides only a more general summary of the spell checking results for the two proficiency groups and task types (see Appendix D for a detailed presentation of the results).

5.2 Spell Checking Results for Different Proficiency Levels and Task Types

5.2.1 Spell Checking Results for Beginners and Intermediates

5.2.1.1 Competence vs. Performance Errors

Table 5:6 presents the spell checking results for competence and performance errors in the two proficiency groups according to target modification.

Table 5:6 Spell Checking: Target Modification of All Misspellings for Beginners and Intermediates

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
Beginners									
									/399
Competence	274	69%	108	27%	17	4%	399	100%	100%
SV	270	93%	8	3%	11	4%	289	100%	72%
MV	4	4%	100	91%	6	5%	110	100%	28%
									/161
Performance	94	58%	50	31%	17	11%	161	100%	100%
SV	94	61%	44	28%	17	11%	155	100%	96%
MV	-	-	6	100%	-	-	6	100%	4%
									/560
Total	368	66%	158	28%	34	6%	560	100%	100%
SV	364	82%	52	12%	28	6%	444	100%	79%
MV	4	3%	106	91%	6	5%	116	100%	21%
Intermediates									
									/386
Competence	222	58%	140	36%	24	6%	386	100%	100%
SV	213	91%	5	2%	16	7%	234	100%	61%
MV	9	6%	135	89%	8	5%	152	100%	39%
									/132
Performance	85	64%	41	31%	6	5%	132	100%	100%
SV	85	69%	33	27%	6	5%	124	100%	94%
MV	-	-	8	100%	-	-	8	100%	6%
									/518
Total	307	59%	181	35%	30	6%	518	100%	100%
SV	298	83%	38	11%	22	6%	358	100%	69%
MV	9	6%	143	89%	8	5%	160	100%	31%

Table 5:6 confirms that target modification is a predictor of spell checking success. For beginners and intermediates, multiple violations in both the performance and the competence category as well as the overall totals have a very low correction rate (6% or less) whereas single violations are corrected far more effectively (61%-93%).

Accordingly, competence misspellings by beginners are more successfully corrected (69%) than competence misspellings by intermediates (58%), χ^2 (2, N = 785) = 10.56, $p < .05$, $V = .12$, because beginners have a higher ratio of single violations in the competence class (72%) than intermediates (61%). Regarding performance misspellings, the data indicate that the correction success is similar for both groups (beginners: 58% corrected, intermediates: 64% corrected), χ^2 (2, N = 293) = 3.77, $p > .05$, as both beginners and intermediates have a similar ratio of single violations in the performance category (96% and 94%, respectively). The fairly low correction rate for single violations in the performance category (61% for beginners, 69% for intermediates) is due to the considerable number of performance misspellings involving nonletter characters or incorrect first letters, thus confirming the overall results presented in the previous section. Finally, the overall spell checking results for beginners and intermediates are not significantly different, χ^2 (2, N = 1078) = 5.69, $p > .05$, although beginners have a slightly higher overall correction rate (66%) than intermediates (59%) due to the greater number of single violations in total (79% vs. 69%).

The following section investigates competence errors in more detail.

5.2.1.2 Competence Errors: Linguistic Subsystem and Target Modification

Table 5:7 displays the spell checking results for misspellings according to linguistic subsystem and target modification in the two proficiency groups.

Table 5:7 Spell Checking: Linguistic Subsystem and Target Modification for Beginners and Intermediates (Selected Data)

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
Beginners									
									/145
Lexical	74	51%	62	43%	9	6%	145	100%	100%
SV	74	93%	2	3%	4	5%	80	100%	55%
MV	-	-	60	92%	5	8%	65	100%	45%
									/114
Morphological	71	62%	38	33%	5	4%	114	100%	100%
SV	71	95%	-	-	4	5%	75	100%	66%
MV	-	-	38	97%	1	3%	39	100%	34%
									/136
Phonological	125	92%	8	6%	3	2%	136	100%	100%
SV	121	93%	6	5%	3	2%	130	100%	96%
MV	4	67%	2	33%	-	-	6	100%	4%
Intermediates									
									/63
Lexical	31	49%	22	35%	10	16%	63	100%	100%
SV	30	81%	1	3%	6	16%	37	100%	59%
MV	1	4%	21	81%	4	15%	26	100%	41%
									/218
Morphological	94	43%	114	52%	10	5%	218	100%	100%
SV	93	92%	1	1%	7	7%	101	100%	46%
MV	1	1%	113	97%	3	3%	117	100%	54%
									/101
Phonological	94	93%	4	4%	3	3%	101	100%	100%
SV	87	94%	3	3%	3	3%	93	100%	92%
MV	7	88%	1	13%	-	-	8	100%	8%

Note. Results for orthographic errors are not displayed due to their low frequency. See Appendix D for the relevant data.

Table 5:7 reveals that proficiency level does not affect the correction success for single and multiple violations in the linguistic subsystem categories. In both proficiency groups, single violations have a consistently high correction rate (81% or more) while multiple violations have a consistently low correction rate (4% or less) in all but the phonological category. As with the overall results discussed in section 5.1.2, the correction rate for multiple violations in the phonological category is higher in both groups because of <ss> and <ß> confusions. This error occurs frequently with learners of German and is corrected by the spell checker.

For both proficiency groups, the ratio of single violations in each linguistic subsystem determines the overall correction rate in the linguistic subsystem. Accordingly, the correction rate for lexical misspellings is low for beginners (51%) as well as for intermediates (49%) given that in both groups, lexical errors frequently involve multiple violations (beginners: 45%, intermediates: 41%). Morphological errors are more effectively corrected for beginners (62%) than for intermediates (43%), χ^2 (2, N = 332) = 11.41, $p < .05$, $V = .19$, since beginners have more single violations (66%) than intermediates (46%) in this error category. Phonological misspellings, on the other hand, are generally corrected in both groups (beginners: 92%, intermediates: 93%) because they usually involve single violations (beginners: 96%, intermediates: 92%).

Section 5.1.2 demonstrated that spell checking outcomes for misspellings in the language influence categories can largely be predicted based on the spell checking results in the linguistic subsystem categories. This finding is confirmed in the two proficiency groups. For example, intralingual morphological errors are more successfully corrected in the beginners' group (64%, see Table D:2 in Appendix D) than in the intermediates' group (42%, see Table D:3 in Appendix D), χ^2 (2, N = 315) = 13.50, $p < .05$, $V = .21$, due to the greater number of single violations in the beginners' morphological category (see Table 5:7).

The following section provides a summary of the spell checking results in the two task types.

5.2.2 Spell Checking Results for Build-a-Sentence and Translation

5.2.2.1 Competence vs. Performance Errors

Table 5:8 presents the spell checking outcomes for competence and performance errors, subcategorized according to target modification, in the two task types.

Table 5:8 Spell Checking: Target Modification of All Misspellings for Build-a-Sentence and Translation

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
				Build-a-Sentence					
									/514
Competence	324	63%	174	34%	16	3%	514	100%	100%
SV	317	94%	6	2%	14	4%	337	100%	66%
MV	7	4%	168	95%	2	1%	177	100%	34%
									/208
Performance	140	67%	58	28%	10	5%	208	100%	100%
SV	140	70%	50	25%	10	5%	200	100%	96%
MV	-	-	8	100%	-	-	8	100%	4%
									/722
Total	464	64%	232	32%	26	4%	722	100%	100%
SV	457	85%	56	10%	24	4%	537	100%	74%
MV	7	4%	176	95%	2	1%	185	100%	26%
				Translation					
									/251
Competence	158	63%	70	28%	23	9%	251	100%	100%
SV	151	89%	7	4%	11	7%	169	100%	67%
MV	7	9%	63	77%	12	15%	82	100%	33%
									/86
Performance	40	47%	33	38%	13	15%	86	100%	100%
SV	40	50%	27	34%	13	16%	80	100%	93%
MV	-	-	6	100%	-	-	6	100%	7%
									/337
Total	198	59%	103	31%	36	11%	337	100%	100%
SV	191	77%	34	14%	24	10%	249	100%	74%
MV	7	8%	69	78%	12	14%	88	100%	26%

On the whole, the findings for task type, like those for proficiency level, corroborate the notion that the ratio of single violations largely determines the outcome of the spell checking process: Multiple violations have a very low correction rate (9% or less); single violations have a much higher correction rate (50% or more).

Accordingly, Table 5:8 illustrates that similar single violation ratios in the competence class of both task types (build-a-sentence: 66%, translation: 67%) correlate with similar ratios of corrected misspellings in build-a-sentence (63%) and translation (63%). In the performance class, however, the spell checking results are surprising at first sight. Despite similar ratios of single violations (build-a-sentence:

96%, translation: 93%), performance errors are corrected more successfully in build-a-sentence (67%) than in translation (47%), χ^2 (2, N = 294) = 14.72, $p < .05$, $V = .22$. The reason for the higher correction in build-a-sentence, however, becomes evident upon closer analysis of the corpus: In build-a-sentence, the performance category includes less single violations containing nonletters or incorrectly spelled first letters (29%, or 57/200) than in translation (46%, or 37/80).[62] Overall, similar ratios of single violations (74% vs. 74%) account for similar correction ratios (64% vs. 59%).

The following section provides a more detailed examination of competence errors.

5.2.2.2 Competence Errors: Linguistic Subsystem and Target Modification

Table 5:9 displays the spell checking results for the linguistic subsystem categories according to target modification in build-a-sentence and translation.

Table 5:9 Spell Checking: Linguistic Subsystem and Target Modification for Build-a-Sentence and Translation (Selected Data)

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
			Build-a-sentence						
									/98
Lexical	60	61%	32	33%	6	6%	98	100%	100%
SV	60	88%	2	3%	6	9%	68	100%	69%
MV	-	-	30	100%	-	-	30	100%	31%
									/267
Morphological	124	46%	136	51%	7	3%	267	100%	100%
SV	123	95%	1	1%	5	4%	129	100%	48%
MV	1	1%	135	98%	2	1%	138	100%	52%

[62] This might suggest that task type affects the learner's production of single violations in performance errors such that there are more nonletter and first letter errors in translation compared to build-a-sentence. However, in a similar study by Rimrott and Heift (in press) that investigated translation tasks only, the ratio of nonletter and first letter errors in single violation performance misspellings was 23% (16/69). Furthermore, 70% (48/69) of the performance misspellings with single violations were corrected. The findings for translation in Rimrott and Heift are similar to those for build-a-sentence obtained in this study. This suggests that task type does not affect the production of first letter and nonletter errors in single violation performance misspellings.

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
									/147
Phonological	138	94%	6	4%	3	2%	147	100%	100%
SV	132	96%	3	2%	3	2%	138	100%	94%
MV	6	67%	3	33%	-	-	9	100%	6%
				Translation					
									/107
Lexical	44	41%	49	46%	14	13%	107	100%	100%
SV	43	88%	1	2%	5	10%	49	100%	46%
MV	1	2%	48	83%	9	16%	58	100%	54%
									/50
Morphological	30	60%	15	30%	5	10%	50	100%	100%
SV	30	91%	-	-	3	9%	33	100%	66%
MV	-	-	15	88%	2	12%	17	100%	34%
									/88
Phonological	79	90%	6	7%	3	3%	88	100%	100%
SV	73	89%	6	7%	3	4%	82	100%	93%
MV	6	100%	-	-	-	-	6	100%	68%

Note. Results for orthographic errors are not displayed due to their low frequency. See Appendix D for the relevant data.

As expected, Table 5:9 reveals that the spell checking results within the linguistic subsystems are predictable based on the respective target modification distribution. In all linguistic subsystems, single violations have a much higher correction rate (88% or more) than multiple violations (2% or less). An exception presents the phonological category in which multiple violations involving <ss>/<ß> confusions are corrected (67%-100%).

Accordingly, in the lexical category, a higher ratio of single violations in build-a-sentence compared to translation (69% vs. 46%) corresponds to a higher correction ratio for lexical errors (61% vs. 41%), χ^2 (2, N = 205) = 8.85, $p < .05$, V = .21. Conversely, a lower ratio of single violations in the morphological category (build-a-sentence: 48%, translation: 66%) relates to a lower ratio of corrected misspellings in build-a-sentence (46%) compared to translation (60%), χ^2 (2, N = 317) = 11.53, $p < .05$, V = .19. Finally, similar ratios of single violation phonological errors in build-a-sentence (94%) and translation (93%) result in similar correction ratios in both task types (94% and 90%, respectively).

As with proficiency level, the spell checking outcomes with respect to the language influence categories is influenced by the ratio of single violations in the linguistic subsystem categories. For example, in both task types, intralingual errors are corrected effectively in the phonological category (build-a-sentence: 88%, translation: 85%, see Table D:7 and Table D:8, respectively, in Appendix D) due to the high number of single violations in the phonological class. However, intralingual errors in the morphological category are corrected more effectively in translation (62%, see Table D:8 in Appendix D) than in build-a-sentence (46%, see Table D:7 in Appendix D) because of the higher ratio of single violation morphological errors in translation.

5.2.3 Main Findings for Proficiency Level and Task Type

The comparison of the spell checker's correction success for both beginners vs. intermediates and build-a-sentence vs. translation supports the main finding that target modification largely determines correction success independent of other factors such as proficiency level or task type. Single violations have a high correction rate whereas multiple violations have a low correction rate. However, two exceptions apply:

1. single nonletter violations, which frequently occur in the performance class, have low correction rates, and
2. multiple violations involving <ss>/<ß> confusions, which frequently occur in the phonological category, have high correction rates.

The following section summarizes the findings of the spell checker evaluation.

5.3 Summary of Spell Checker Evaluation

The evaluation of the generic spell checker provided in the *Microsoft® Word® 2003* word processing software confirms that, generally, single violation misspellings are treated successfully whereas multiple violation errors remain uncorrected. These facts hold irrespective of the competence/performance, linguistic subsystem, or language influence category of a misspelling.

A fundamental issue for L2 spell checking is the correction of competence misspellings, that is, errors that language learners may not be able to correct without additional help. Only 62% of the competence misspellings in this study were corrected by the generic spell checker. Particularly low correction rates surfaced with respect to lexical and morphological misspellings. In contrast, phonological misspellings were treated very successfully. The evaluation further revealed that spell checking results in the language influence categories were affected by the linguistic subsystem the misspellings belonged to. Interlingual and ambilingual misspellings were generally corrected because they were mostly phonological. Intralingual and paralingual errors, however, had lower correction rates because they were by and large of morphological and lexical nature, respectively.

The correction rate for performance errors in this study was also quite low (61%) due to a high number of misspellings involving nonletters and incorrectly spelled first letters – errors which are not effectively corrected by the spell checker. Although the correction rate for performance errors is quite low, it does not represent a major problem in CALL. In contrast to competence errors, performance errors can be easily self-corrected by nonnative writers as long as they are flagged by the spell checker.

The evaluation also compared spell checking outcomes in the two proficiency groups. The analysis corroborates once more that spell checking outcomes depend on the target modification of a misspelling regardless of the writer's proficiency level. Accordingly, the correction ratio for morphological misspellings was significantly higher for beginners than for intermediates because beginners had a higher ratio of single violations in that category. Due to the high number of morphological errors in the corpus, these differences were also reflected in the total for all competence misspellings.

This study also investigated spell checking results in the two task types. The evaluation demonstrated yet again that target modification rather than task type is a predictor of the spell checker's correction success. Lexical errors were corrected more effectively in build-a-sentence compared to translation because of the higher ratio of

single violation lexical errors in build-a-sentence. Conversely, morphological errors had a higher correction rate in translation because these kinds of errors more frequently involved single violations in translation relative to build-a-sentence.

In sum, the findings of this study illustrate that the spell checking outcome can largely be predicted based solely on the ratio of single vs. multiple violations in a given corpus. Other factors such as the writer's proficiency level or whether a misspelling is competence- or performance-related, or lexical or phonological are only influential in as much as they affect the ratio of single and multiple violations.

The results of this study demonstrate that the generic spell checker effectively serves its primary purpose of correcting single violations. However, the error data also show that most misspellings in nonnative writing are competence-based and thus commonly involve greater target modifications. The lack of correction success for multiple violation errors suggests a need for spell checkers that specifically target nonnative competence misspellings.

The following chapter concludes this thesis. It summarizes the findings of this study and presents suggestions for L2 spell checking as well as ideas for future research.

CHAPTER 6: CONCLUSION

This chapter presents a summary of the findings of this thesis. It also provides suggestions to enhance spell checking in CALL and outlines avenues for further research.

6.1 Summary

This thesis presented a study of misspellings by nonnative writers of German and evaluated the performance of a generic spell checker, one that is not specifically designed for nonnative writers, to determine the kinds and frequencies of errors it can successfully correct. During the spring semester 2004, 32 beginner and 16 intermediate learners of German participated in the study. The participants are native English speakers and were enrolled in first-semester or second-semester German courses at Canadian universities. The analysis comprised 1027 unique misspellings that were collected from sentence building and English-to-German translation tasks.

One of the goals of this thesis was to devise a system for the classification of nonnative misspellings and to determine the frequencies of different types of misspellings in nonnative writing. CLASSY, the classification system that was developed as part of this study, makes use of four taxonomies (competence vs. performance, linguistic subsystem, language influence, and target modification) to inform SLA research and language pedagogy as well as software evaluation and design.

CLASSY makes a primary distinction between competence and performance misspellings. Competence misspellings are non-self-corrigible and/or systematic and/or deliberate. They are subclassified according to the linguistic subsystem subtaxonomy into lexical, morphological, phonological and orthographic mis-spellings. Lexical misspellings result from vocabulary-problems while morphological

misspellings are caused by erroneous applications of word formation or inflection rules. Phonological misspellings are due to the incorrect use of phoneme-grapheme correspondence rules, and finally, orthographic misspellings involve the incorrect use of capitalization or nonletter characters. Within the linguistic subsystem categories, misspellings are further subclassified along the language influence subtaxonomy into interlingual, intralingual, ambilingual, and paralingual errors. Whereas interlingual misspellings are due to L1 interference, intralingual errors are caused by L2 interference. Ambilingual errors potentially involve both L1 and L2 interference while paralingual errors cannot be attributed to a language influence. Next to language influence, misspellings in the linguistic subsystems are also subclassified into single violations and multiple violations according to the target modification subtaxonomy. Single violation errors involve an edit distance of one while multiple violation errors have an edit distance of two or more. In contrast to competence misspellings, misspellings in the performance category are accidental, unsystematic, and self-corrigible. They are subdivided into single and multiple violations based on the target modification subtaxonomy.

Frequency counts indicated that 72% of the nonnative misspellings are competence-based while 28% can be attributed to performance factors. In the competence category, morphological errors are the most common (42%), followed by phonological (30%) and lexical (27%) errors with orthographic errors being the most infrequent (1%). In addition, over half of the competence misspellings are intralingual (52%), nearly another quarter are paralingual (23%) while interlingual (16%) and ambilingual (9%) factors are the least influential. Morphological errors are mainly intralingual, lexical errors are generally paralingual and phonological errors involve interlingual and intralingual influences. Accordingly, the four most influential categories of competence misspellings in the corpus are intralingual morphological (40%), paralingual lexical (20%), interlingual phonological (13%), and intralingual phonological (11%) errors. Furthermore, more than a third of all competence misspellings (35%) involve multiple violations. Multiple violations are especially frequent in the lexical (45%) and morphological (50%) categories. In the class of

performance errors, on the other hand, single violations constitute the vast majority (95%).

The thesis also investigated the influence of proficiency level and task type on the distribution of errors across categories. With respect to proficiency level, the analysis showed that the ratio of competence to performance errors is similar for beginners and intermediates but the distribution of competence errors across linguistic subsystem and language influence is significantly different. In particular, beginners produce more lexical and phonological errors than intermediates. Beginners also make more interlingual and paralingual errors. Intermediates, on the other hand, commit more morphological and more intralingual errors. With respect to target modification, intermediates produce more multiple violations than beginners in the morphological category.

Like proficiency level, task type does not influence the ratio of competence to performance errors. However, the error distribution across the linguistic subsystem and language influence taxonomies is significantly different for build-a-sentence and translation tasks. Translation contains more lexical and interlingual errors. Build-a-sentence, on the other hand, shows more morphological and intralingual errors. In addition, there are more multiple violations in lexical errors in translation but more multiple violations in morphological errors in build-a-sentence.

A further goal of this thesis was to evaluate the performance of a generic spell checker on a corpus of nonnative misspellings and to examine whether some types of misspellings are corrected more effectively than others. The evaluation of the generic spell checker in the *Microsoft® Word® 2003* word processing software established that, contrary to claims about L1 misspellings, only 62% of the nonnative misspellings in this study are corrected. Correction rates for competence and performance errors are equally low with 62% and 61%, respectively. The surprisingly low correction success for performance errors is due to a high number of single nonletter violations which are generally not corrected by the spell checker. Competence misspellings have a low correction rate because of the high number of multiple violations in that category. Within the class of competence errors, lexical and morphological

misspellings are frequently not corrected (50% and 53%, respectively) whereas phonological errors are quite successfully treated by the generic spell checker (92% corrected). The degree of target modification is the principal explanation: Lexical and morphological misspellings often involve multiple violations but phonological misspellings are largely single violations. The findings of the evaluation demonstrate that, independent of other factors, single violations are generally corrected very successfully while multiple violations are usually not treated effectively.

The thesis further investigated the influence of proficiency level on the spell checker's correction success. A considerable difference in correction rate was only found in the morphological category. Here, errors by beginners were more often corrected than those by intermediates because of the higher number of single violations in the beginners' morphological category. This difference was also reflected in the competence error category because of the high number of morphological misspellings in the corpus.

In addition, the thesis examined the influence of task type on the performance of the spell checker. The investigation confirmed that target modification largely determines the spell checking outcome. Lexical misspellings were more effectively corrected in build-a-sentence because of a higher ratio of single violation lexical errors in that task type. Morphological misspellings, on the other hand, had a higher correction rate in translation because they contained more single violations in translation than in build-a-sentence. For competence errors in total, the ratio of single violations, and therefore also the spell checker's correction ratio, were similar in both task types.

The spell checker evaluation in this thesis has exposed several shortcomings of generic spell checkers when dealing with text by nonnative writers. A final goal of this thesis was to provide suggestions to enhance spell checking in CALL. Accordingly, the following section presents some computational and pedagogical strategies to that effect.

6.2 Suggestions

The findings of this study prompt several computational and pedagogical suggestions to enhance spell checking for nonnative writers. Along the lines of Tschichold's (1999) strategies for improving L2 grammar checking, two main strategies are proposed to overcome the shortcomings of generic spell checkers in CALL:

1. increasing the spell checker's effectiveness in treating nonnative misspellings, and/or
2. decreasing the language learner's dependence on a spell checker.

The two strategies are discussed in turn below.

6.2.1 Computational Suggestions

The findings of the spell checking evaluation in this thesis substantiate that generic spell checkers do not perform a linguistic analysis of misspellings. Rather, the correction algorithms aim at the target modification of the misspelling: Generally, single violations are corrected, multiple violations are not. However, the findings of this thesis clearly demonstrate that more sophisticated algorithms are necessary to deal with many of the nonnative misspellings effectively.

Three equally important factors should guide decisions about algorithms to be implemented in spell checkers for nonnative writers:

1. error frequency: frequent errors have a higher priority than infrequent errors,
2. error correction rate: errors that have a low correction rate have a higher priority than errors with an already high correction rate, and
3. error predictability: predictable errors have a higher priority than unpredictable errors.

Furthermore, in the context of nonnative writing, efforts to enhance spell checking should be directed at the correction of competence rather than performance

errors. Learners can easily self-correct their performance errors but they generally need assistance in correcting competence errors.

Accordingly, Table 6:1 presents recommendations for L2 spell checking concerning the four most frequent categories of competence errors in the corpus: intralingual morphological, paralingual lexical, and inter- and intralingual phonological misspellings. Other types of competence errors such as interlingual orthographic errors are not included in the table. Their low occurrence in the corpus renders them unfeasible for computational correction from the outset.[63]

Table 6:1 Recommendations for L2 Spell Checking

Error category	Frequency	Correction	Predictability	Recommendation
Intralingual morphological	high (40%)	low (47%)	high	should be targeted primarily
Paralingual lexical	high (20%)	low (55%)	low	not feasible to target
Interlingual phonological	medium (13%)	high (95%)	high	need not be targeted primarily
Intralingual phonological	medium (11%)	high (86%)	high	need not be targeted primarily

Note. Frequency = frequency in competence corpus (taken from Table 4:1 on page 47). Correction = correction rate of generic spell checker (taken from Table 5:3 on page 77).

Table 6:1 indicates that spell checking efforts targeting nonnative writers of German should be primarily directed at the correction of intralingual morphological misspellings because of their high frequency, low correction rate, and high predictability. Intralingual morphological misspellings are highly predictable as they are due to the systematic application of existing word formation and inflection rules in German. In the present study, the correction rate for competence misspellings would

[63] The recommendations for spell checking discussed in this section can be implemented in word processing software similar to the *Microsoft® Word®* software to provide nonnative writers with correction alternatives for misspelled words. The suggestions are also suitable for language learning programs that, in addition to offering correction alternatives for L2 misspellings, provide elaborate grammar and spelling feedback for nonnative writers.

be improved by 20% (148/735) if all uncorrected intralingual morphological misspellings were corrected.

In order to correct morphological misspellings, spell checkers could be equipped with a morphological analyser that "is based on an electronic dictionary that does not simply store all full forms, but is capable of recognizing and generating the morphological structure(s) of words" (Allerton et al., 2004). Algorithms that provide a morphological analysis of existing words and/or morphologically motivated misspellings have been developed for various languages (e.g., for German, see ten Hacken & Tschichold, 2001; Görz & Paulus, 1988; Trost & Dorffner, 1987; for Dutch, see Bos, 1994; for French, see Courtin, Dujardin, Kowarski, Genthial & de Lima, 1991; for Basque, see Aduriz et al., 1997). For L2 spelling correction, a morphological analyser needs to detect erroneous but systematic misspellings (e.g., *<goed>/<went>) and a generator then needs to construct the correct form (e.g., <went>).

As a side note and for illustrative purposes, a spell checking algorithm to treat predictable verb inflection mistakes by nonnative writers of German was developed as part of this study. The algorithm is designed to correct certain cases of intralingual morphological misspellings that were made by beginner and intermediate learners of German. In particular, misspellings due to the incorrect application of stems, stem vowel changes and suffixes in present tense and past participle forms are targeted. Over 100 morphological misspellings of 60 different verbs informed the design of the algorithm. The program uses morphological analysis to determine the intended inflection of misspelled verbs based on wrongly inflected input words. For example, in the misspelling *<gefahrt> for <gefahren> *driven* (infinitive: <fahren> *to drive*) the weak past participle suffix <t> is incorrectly used for the strong past participle suffix <en>. The algorithm removes the prefix <ge> and the suffix <t> to obtain the stem <fahr> and saves the prefix/suffix information for future reference. The program stores stems of a given verb and their predictable mistakes in a file of stem aliases. For example, the file of stem aliases contains the infinitive, present tense, and past participle stems as well as nonexisting stems that nonnative writers tend to use (e.g.,

the nonexisting stem <käuf> for the verb <kaufen> *to buy*, which is obtained by incorrectly changing the stem vowel in <kaufen>). To ascertain the infinitive stem, and ultimately the infinitive of a verb, the stem obtained through prefix and suffix removal is passed on to the file of stem aliases. Once the infinitive stem is determined, the program is able to construct the correctly inflected past participle form using the prefix/suffix information stored previously. If considerably expanded, the program could be used as a module in a generic spell checker. For example, a misspelling could be passed on to the program for morphological analysis if a generic spell checker fails to provide correction alternatives.

Table 6:1 further reveals that paralingual lexical misspellings are potential candidates for correction in L2 spell checking because of their high occurrence and low correction rate. However, paralingual lexical errors are highly unpredictable because they are due to vocabulary difficulties that cannot be traced to any of the languages involved in nonnative writing. Paralingual lexical misspellings are therefore not suitable for computational correction.[64]

Furthermore, Table 6:1 shows that spell checkers for L2 German do not need to specifically target interlingual and intralingual phonological misspellings despite their high predictability and frequency. Phonological misspellings are already

[64] However, a few of the other uncorrected lexical misspellings in this study are more predictable. In particular, uncorrected lexical misspellings due to interlingual influence such as *<address>/<Adresse> *address*, *<Austria>/<Österreich> *Austria*, and *<question>/<Frage> *question* could be fairly easily corrected by L2 spell checkers through the integration of an English – German dictionary. The correction of these errors, however, has a low priority because of their low occurrence (3% of the competence misspellings in this study).

effectively corrected by generic spell checkers because they mainly involve single violations.[65]

With respect to the four language influence categories, the preceding discussion demonstrates that L2 spell checkers need to possess knowledge of the target language to treat intralingual morphological errors. However, spell checkers do not require interlingual, ambilingual or paralingual knowledge because of the low occurrence, high correction rate and/or low predictability of these error types. This suggests that spell checkers can be designed without reference to the learner's native language while being equally successful with all students.

Frequently, spell checkers for nonnative writers consider the learner's proficiency level in the target language. For example, the English grammar and spell checker *CorText* is designed for intermediate to advanced learners whereas the educational grammar and spell checker *Sans-Faute* is geared towards beginner and intermediate French learners (see section 1.1.4). For L2 spell checkers for German, proficiency level and thus the course content for each learner level need to be considered in the correction of intralingual morphological errors. For example, beginners may have only learned to use the present tense of verbs whereas intermediates may have learned to use present and past tenses. Accordingly, L2 spell checkers for learners at the beginner stage do not need to possess knowledge of past tense verb forms.

The computational suggestions discussed above demonstrate the importance of CLASSY's four error taxonomies for the purpose of spell checker evaluation and development. The competence/performance taxonomy reveals that the primary

[65] The situation might be different in other languages such as French, English or Dutch where phonological misspellings presumably involve many multiple violations as graphemes frequently consist of several letters. For example, the phonemes /so/ can be represented by the following graphemes in French: <saut> *jump*, <sauts> *jumps*, <seau> *bucket*, <seaux> *buckets*, <sceau> *seal*, <sceaux> *seals*, <sot> *idiot*, <sots> *idiots* (examples taken from Ndiaye & Vandeventer Faltin, 2003). Accordingly, spell checking algorithms for some languages have been developed that specifically target phonological errors (e.g., for French, see Ndiaye & Vandeventer Faltin, 2003; Courtin et al., 1991; for English, see de Haan & Oppenhuizen, 1994; for Dutch, see van Berkel & De Smedt, 1988). These algorithms generally obtain phonological representations of misspelled words and retrieve from the dictionary correction alternatives that share the same phonological representation.

concern for L2 spell checkers is the correction of competence rather than performance errors.[66] The linguistic subsystem subtaxonomy demonstrates that L2 spell checking efforts should be mainly directed at morphological misspellings rather than lexical, phonological, or orthographic errors. The language influence subtaxonomy shows that intralingual errors have priority over interlingual, ambilingual, and paralingual errors in L2 spell checking. Finally, the target modification subtaxonomy exposes that generally, multiple but not single violations require more effective spell checker treatment.

6.2.2 Pedagogical Suggestions

The second strategy for overcoming the shortcomings of generic spell checkers in CALL is to decrease the language learner's dependence on the performance of the spell checker. In contrast to the computational suggestions described above, the pedagogical strategies do not require modifications of existing or the development of new spell checkers. Instead, they can be easily implemented into the foreign language classroom. Three points are worth considering:

First, although the results of this study indicate that spell checkers are useful in foreign language writing, language learners can be made aware that spell checking in the L2 is much less effective than in the L1. For example, Granger and Meunier (1994) suggest that foreign language proofing tools should provide clear information on what they can and cannot do. Furthermore, the effective use of spell checkers in nonnative writing can be taught to foreign language learners (see, e.g., Burston, 2001a, 2001b). Students should understand that undetected words are not necessarily

[66] Contrary to competence errors, performance errors are not crucial in CALL. Nonetheless, spell checkers could be enhanced by correcting performance-based single nonletter violations. The 53 uncorrected single nonletter violations in the performance class of this study are all run-ons, that is, two words are written together. Correcting run-ons is generally not feasible as it would result "in a combinatorial explosion of the number of possible word combinations or subdivisions that must be considered" (Kukich, 1992, p. 385). However, 28 of the 53 run-ons contain word-medial capital letters (e.g., *<imWinter>/<im Winter> *in winter*) and are thus feasible to correct: Spell checkers could split misspellings at the location of the capital letter. This would increase the correction rate for performance errors in this study by 9.6% (28/292).

correct and that the intended target word is frequently not provided in the spell checker's list of correction alternatives.

Second, various additional resources can be offered to language learners to overcome some of the limitations of spell checkers. For example, given that only 50% of lexical errors in this study are corrected, students can be encouraged to consult dictionaries rather than to rely solely on the spell checker.[67] Furthermore, the low correction rate for morphological errors (47%) suggests that students could benefit from access to morphological paradigms, for example, in the form of online grammars or a dictionary that is structured according to inflection and word formation rules.[68]

Third, the amount of misspellings students produce can be reduced. For example, students can be taught to self-monitor their writing (see, e.g., Burston, 2001a, 2001b). In addition, typical competence misspellings of language learners can be discussed in the foreign language classroom (see Burston, 2001b).

6.3 Further Research

This study exposes avenues for future research in several areas:

Additional studies on the classification of misspellings are needed to examine the transferability of the findings of this study to other learners or languages. For example, this study validated CLASSY as a classification system for nonnative misspellings of German. While this thesis focused on English learners of German, a study by Rimrott and Heift (in press) demonstrates that CLASSY's error taxonomies are also applicable to German misspellings by native speakers of other languages. Subsequent research can test CLASSY's portability to nonnative misspellings in languages other than German. At this point, however, there is no reason to assume that CLASSY is not generic enough to be applicable to other languages with Roman alphabets.

[67] Tschichold (1999) makes a similar suggestion for improving grammar checking in CALL. She proposes to increase user autonomy by providing learners with dictionaries, concordancers, and appropriate feedback.

[68] For an example of a morphological dictionary for German, see ten Hacken and Tschichold (2001) and www.canoo.net.

Moreover, further research is necessary to investigate the influence of learner and task variables on misspelling production and correction. The findings of this study revealed significant differences in error distribution and correction for beginners vs. intermediates and for sentence building vs. translation tasks. More advanced language learners or other task types such as free compositions might influence the production and correction of nonnative misspellings in different ways. Future research can also analyze the influence of other learner variables. For instance, a learner's native language or learning style may affect both the production of misspellings and their correction by a spell checker.

Finally, research on spell checker usage is also needed to investigate how foreign language learners react to the limitations of generic spell checkers. For example, studies can examine how nonnative writers respond to the insufficient or inadequate feedback of generic spell checkers. At the same time, the pedagogical and computational strategies presented in this thesis to enhance spell checking for nonnative writers in CALL can be implemented and subsequently tested with language learners. Clearly, the use of spell checkers in CALL remains a field ripe for research and analysis.

APPENDICES

Appendix A: Study Participants

Table A:1 Characteristics of the Study Participants

ID[a]	Cou[b]	PL[c]	Pre[d]	Sex	Age	L1[e]	in E[f]	Fam[g]	Friends[h]	G[i]	in G[j]	Time[k]	Comp[l]
1	a	B	0	f	20	E	20	E, F, Cr	E, F, I, S, Cr	0	one	<1	y
2	a	B	0	f	19	E	19	E	E	0	no	0	y
3	a	B	0	m	18	E	18	E	E	0	one	<1	y
4	a	B	0	m	18	E	18	E	E	0	no	0	y
5	a	B	0	f	22	E	22	E, C	E	0	sev	<1	y
6	a	B	0	f	21	E	21	E	E	0	one	7-12	y
7	a	B	0	m	20	E	20	E	E	0	no	0	y
8	a	B	0	m	22	E	22	E	E	0	one	<1	s
9	a	B	0	f	19	E	19	E	E	1	sev	<1	y
10	a	B	0	m	18	E	18	E	E	0	no	0	y
11	A	B	0	f	20	E	20	E	E	0	one	<1	y
12	A	B	0	m	-	E	-	E	E	0	sev	<1	y
13	A	B	0	f	23	E	23	E, F	E	0	no	0	-
14	a	B	1	m	18	E	18	E	E	0	no	0	y
15	A	B	1	m	19	E	19	E	E	0	sev	<1	y
16	A	B	1	m	23	E	23	E	E, J	0	no	0	y
17	A	B	1	f	19	E	19	E	E	0	no	0	y
18	A	B	1	m	20	E	20	E	E	0	one	<1	y
19	A	B	2	m	23	E	23	E	E	0	no	0	y
20	A	B	2	f	23	E	23	E	E	0	one	1-3	y
21	A	B	2	f	18	E	18	E	E, F	0	no	0	y
22	A	B	2	f	20	E	20	E	E	0	one	<1	s
23	A	B	2	m	23	E	23	E	E	0	one	<1	y
24	A	B	2	f	20	E	20	E	E	0	one	<1	y
25	a	B	3	m	18	E	18	E	E	0	no	0	s
26	A	B	3	f	21	E	21	E	E	0	no	0	s
27	A	B	3	f	18	E	18	E	E	0	no	0	s
28	A	B	3	f	18	E	18	E, F	E	0	no	0	y
29	A	B	3	f	21	E	21	E	E	0	one	<1	y
30	A	B	3	m	20	E	20	E	E	0	no	0	y
31	A	B	3	f	23	E	23	E	E	0	no	0	y
32	A	B	3	m	20	E	20	E	E	0	no	0	y
33	b	I	15	m	20	E	20	E	E	1	one	1-3	y
34	B	I	15	f	-	E		E	E	1	one	1-3	y
35	B	I	15	f	23	E	23	E	E	5	one	<1	y
36	B	I	15	f	22	E	22	E	E	1	one	<1	y
37	B	I	17	f	19	E	19	E	E	1	one	<1	s
38	B	I	17	f	22	E	22	E	E	1	one	<1	y
39	B	I	17	f	20	E	20	E	E	1	no	0	y
40	b	I	18	m	24	E	24	E	E	1	one	<1	y
41	B	I	18	f	20	E	20	E	E	1	no	0	y
42	B	I	18	f	22	E	22	E	E	1	no	0	y
43	B	I	18	m	19	E	15	E	E	1	one	>12	y

ID[a]	Cou[b]	PL[c]	Pre[d]	Sex	Age	L1[e]	in E[f]	Fam[g]	Friends[h]	G[i]	in G[j]	Time[k]	Comp[l]
44	b	I	19	f	18	E	18	E	E	1	sev	1-3	y
45	B	I	19	f	18	E	18	E	E	1	no	0	y
46	B	I	20	f	19	E	19	E, G	E	1	sev	1-3	y
47	B	I	21	f	22	E	22	E	E	1	no	0	y
48	B	I	21	f	19	E	19	E, F	E, F, S	1	one	<1	y

Note. Answers stem from the questionnaire or the pretest adminstered to the participants at the beginning of the semester. A dash indicates that a participant did not answer the question. [a]ID = participant ID. [b]Cou = course. a/A = first-semester German at Simon Fraser University/University of Victoria, b/B = second-semester German at Simon Fraser University/University of Victoria. [c]PL = proficiency level in German. B = Beginner, I = Intermediate. [d]Pre = score on Pretest (out of 24). In Sex column: f = female, m = male. [e]L1 = native language. [f]in E = years participant has lived in English-speaking country. [g]Fam = language(s) spoken with family members. [h]Friends = language(s) spoken with friends. In L1, Fam, and Friends columns: E = English, F = French, I = Italian, S = Spanish, C = Croatian, J = Japanese, Cr = Creole, G = German. [i]G = semester(s) of German taken before enrolment in current class. [j]in G = number of times participant has been to German-speaking country. one = once, sev = several times, no = never. [k]Time = time participant spent in German-speaking country (in months). [l]Comp = indicates whether participant is comfortable using computers. y = yes, s = somewhat.

Appendix B: Error Classification Guidelines

Figure B:1 Decision Tree for the Competence/Performance Taxonomy

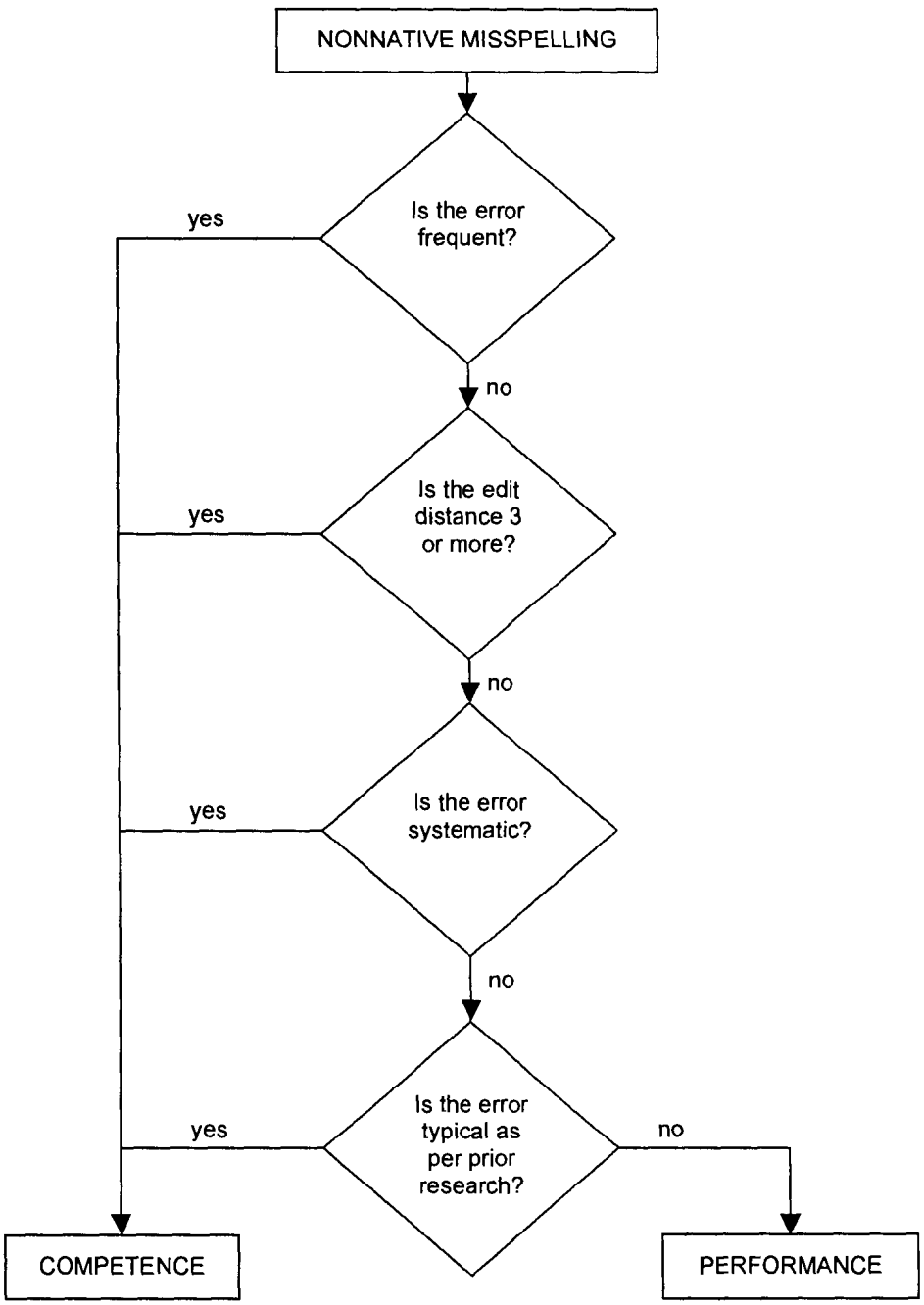


Figure B:2 Decision Tree for the Linguistic Subsystem Subtaxonomy

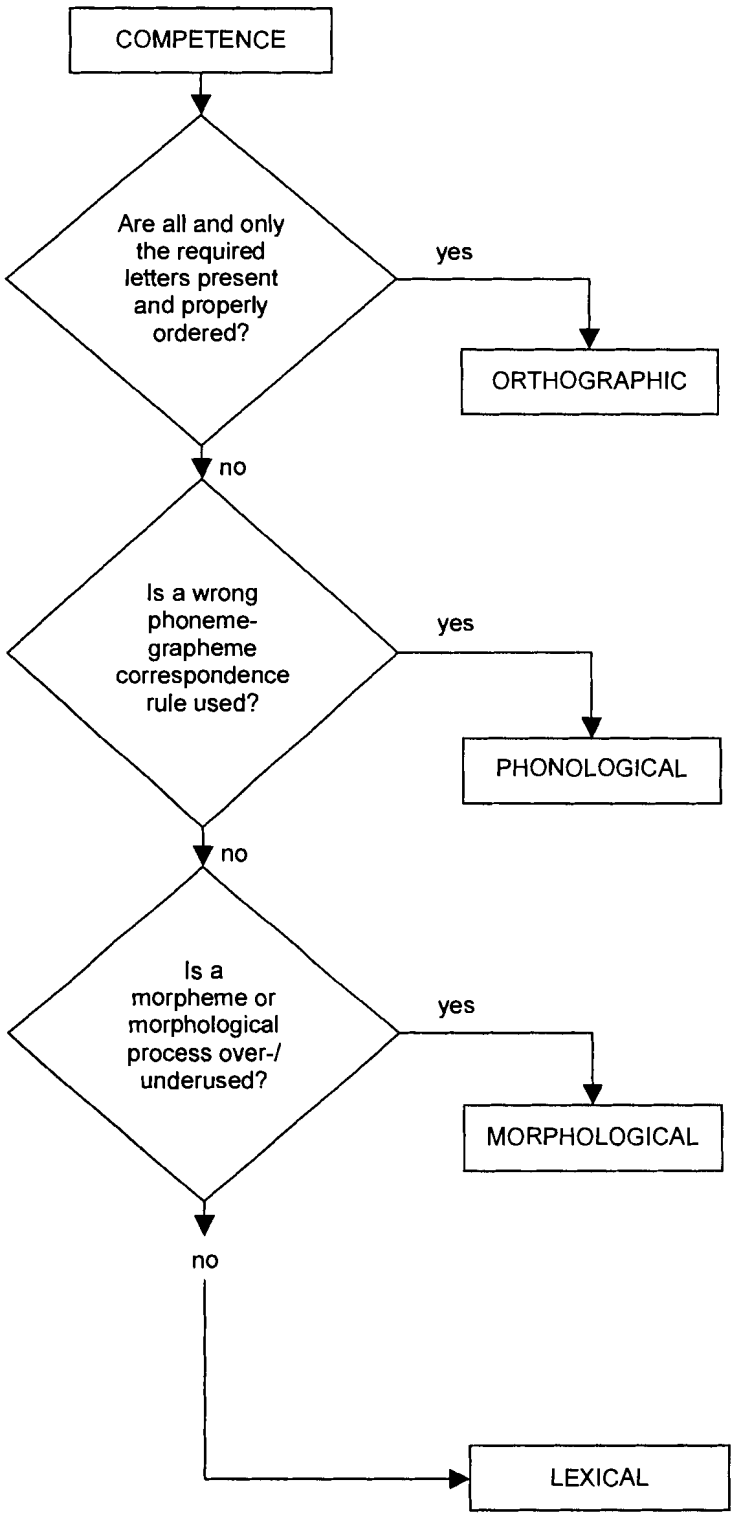


Figure B:3 Decision Tree for the Language Influence Subtaxonomy

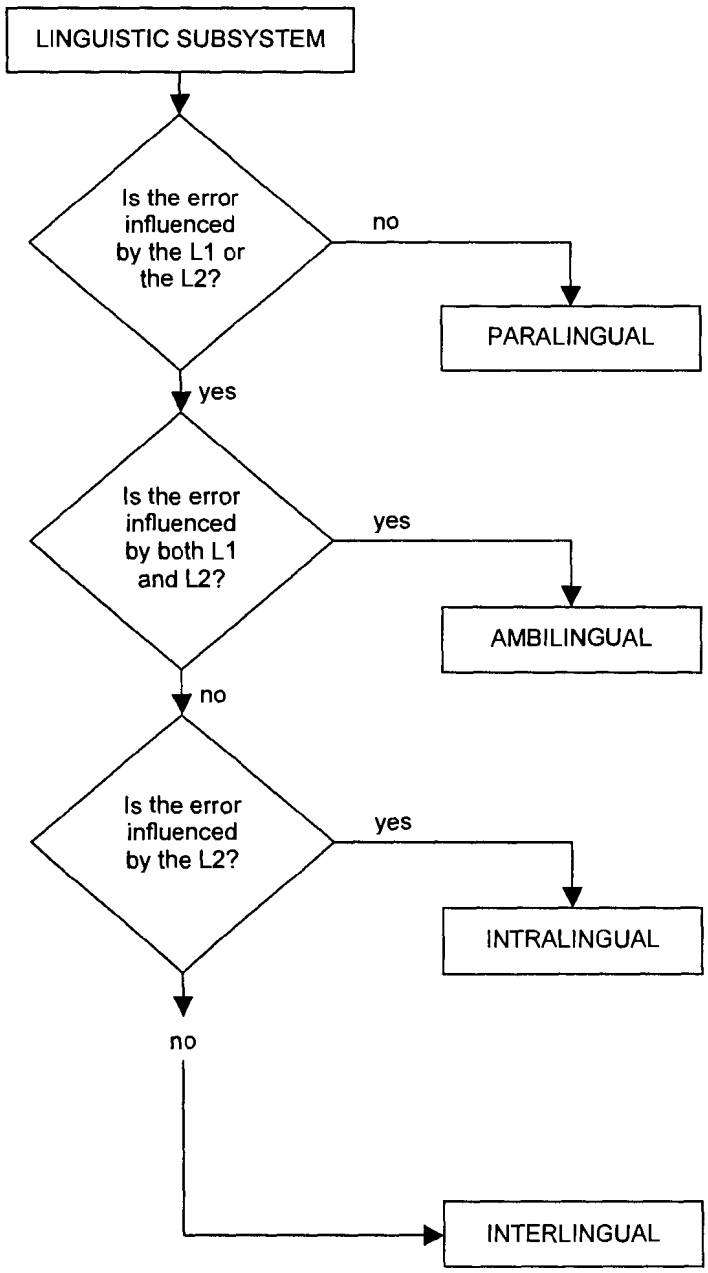
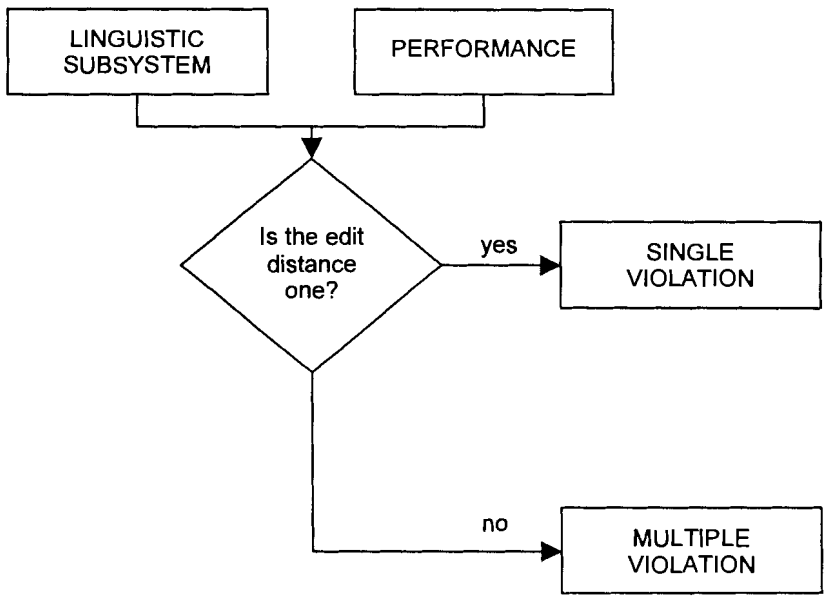


Figure B:4 Decision Tree for the Target Modification Subtaxonomy



Appendix C: The E-Tutor Corpus

Table C:1 The E-Tutor Corpus

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
had	hat	ILE1	2	2	3	1	1
has	hast	ILE1	-1	-1	23	2	2
have	habe	ILE1	3	3	3	1	1
is	ist	ILE1	2	4	123	11	16
Italian	Italien	ILE1	1	1	1	1	1
Rome	Rom	ILE1	0	9	13	2	2
Supermarket	Supermarkt	ILE1	1	1	1	3	3
under	unter	ILE1	2	2	3	2	2
address	Adresse	ILE2	0	0	2	1	1
Austria	Österreich	ILE2	0	0	24	11	16
Balcona	Balkon	ILE2	0	0	2	1	2
Balcone	Balkon	ILE2	0	2	2	1	2
bicyclette	Fahrrad	ILE2	0	0	4	1	1
bread	Brot	ILE2	0	0	2	1	1
Denmark	Dänemark	ILE2	0	0	24	6	8
France	Frankreich	ILE2	-1	-1	4	1	1
husband	Mann	ILE2	0	0	2	1	1
Mr.	Herr	ILE2	-1	-1	4	3	4
Nece	Nichte	ILE2	0	2	2	1	1
Phone	Telefon	ILE2	-1	-1	4	1	1
Postal	Postleitzahl	ILE2	0	1	2	1	1
postal code	Postleitzahl	ILE2	0	1	2	1	1
question	Frage	ILE2	0	0	2	1	1
Soccer	Fußball	ILE2	0	0	4	1	1
Suitcase	Koffer	ILE2	-1	-1	2	1	1
Geschwester	Geschwister	ILG1	4	4	34	2	2
Kaffe	Kaffee	ILG1	-1	-1	1	2	3
Nachtmittag	Nachmittag	ILG1	-1	-1	4	1	2
sonning	sonnig	ILG1	1	1	4	1	1
sonntig	sonnig	ILG1	2	2	4	2	2
gemüchlich	gewöhnlich	ILG2	0	1	2	1	1
micht	mit	ILG2	0	4	2	1	1
unmüblisch	unmöbliert	ILG2	0	0	2	1	1
Biergarden	Biergarten	ILB1	-1	-1	3	1	1
goht	geht	ILB1	1	2	2	1	2
haven	haben	ILB1	3	3	1	1	1
kan	kann	ILB1	1	3	1	1	1
Kousine	Kusine	ILB1	1	1	4	1	1
night	nicht	ILB1	1	1	123	5	5
Bakerei	Bäckerei	ILB2	0	4	4	1	2
Bakeri	Bäckerei	ILB2	0	2	2	1	1
Bettzimmer	Schlafzimmer	ILB2	-1	-1	2	3	3
ohr	oder	ILB2	0	1	1	1	1
Posthalle	Post	ILB2	-1	-1	4	1	1
Sokkar	Fußball	ILB2	0	0	4	1	1
Telephon	Telefon	ILB2	1	1	4	1	1
Aben	Abend	ILN1	11	14	134	4	5
aufgesanden	aufgestanden	ILN1	1	1	3	1	1
augehen	ausgehen	ILN1	2	4	1	2	4
ausporbiert	ausprobiert	ILN1	1	1	3	2	3
ausprobeiert	ausprobiert	ILN1	1	1	3	1	1
deimem	deinem	ILN1	1	1	3	1	1
deimen	deinen	ILN1	1	1	3	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
due	du	ILN1	4	4	1	4	5
einfauft	einkauft	ILN1	1	2	1	1	1
einkafen	einkaufen	ILN1	1	2	3	1	1
einkauren	einkaufen	ILN1	1	1	3	1	1
einschalfen	einschlafen	ILN1	1	3	13	2	2
einschlaufen	einschlafen	ILN1	1	1	1	1	1
En	Ein	ILN1	-1	-1	1	1	2
en	ein	ILN1	-1	-1	12	2	2
ene	eine	ILN1	1	5	2	1	2
enkaufst	einkaufst	ILN1	1	2	1	1	1
feiren	feiern	ILN1	8	11	2	2	2
feirern	feiern	ILN1	1	1	2	1	1
feirert	feiert	ILN1	1	1	2	1	2
feiret	feiert	ILN1	6	8	2	1	1
feirn	feiern	ILN1	1	5	2	1	1
feirt	feiert	ILN1	1	9	24	2	2
Gebursort	Geburtsort	ILN1	1	1	2	1	1
Geburstag	Geburtstag	ILN1	1	1	123	5	7
Geburtsag	Geburtstag	ILN1	1	1	2	1	1
gegagen	gegangen	ILN1	1	1	3	1	2
Gegurtstag	Geburtstag	ILN1	1	1	2	1	1
germ	gern	ILN1	1	2	1	2	3
gertern	gestern	ILN1	1	1	3	1	2
Geschichen	Geschichten	ILN1	2	3	3	1	1
Geschitchten	Geschichten	ILN1	1	1	3	1	1
gester	gestern	ILN1	3	3	34	2	2
Huston	Husten	ILN1	-1	-1	4	1	3
Iche	Ich	ILN1	5	6	2	1	1
icht	ich	ILN1	3	3	2	1	2
ihem	ihrem	ILN1	1	2	1	1	1
ihen	ihren	ILN1	1	5	1	1	1
ihmem	ihrem	ILN1	1	1	1	1	1
ihmer	ihrer	ILN1	1	2	1	1	1
iht	ihr	ILN1	5	6	1	1	2
inkaufen	einkaufen	ILN1	1	1	1	1	1
klingein	klingeln	ILN1	2	2	1	2	4
läft	läuft	ILN1	1	4	1	1	1
langweiling	langweilig	ILN1	1	1	2	1	3
langwelig	langweilig	ILN1	1	2	2	1	2
lanweilig	langweilig	ILN1	1	1	2	2	2
lanzweilig	langweilig	ILN1	1	1	2	1	1
liet	liest	ILN1	1	11	13	3	5
mitgebraucht	mitgebracht	ILN1	-1	-1	3	1	1
Möchest	Möchtest	ILN1	1	2	1	1	1
nacht	nach	ILN1	0	1	12	2	2
nächtes	nächstes	ILN1	1	2	2	1	1
nächtses	nächstes	ILN1	1	1	2	1	1
nächtstes	nächstes	ILN1	1	1	2	1	1
nich	nicht	ILN1	1	2	134	5	5
niht	nicht	ILN1	1	2	3	1	1
Österreicht	Österreich	ILN1	2	2	2	1	1
Östrerreich	Österreich	ILN1	1	1	2	1	2
pareken	parken	ILN1	1	1	1	1	1
parekn	parken	ILN1	1	1	1	1	2
Posleitzahl	Postleitzahl	ILN1	1	1	2	1	1
Postleitzah	Postleitzahl	ILN1	1	1	2	2	2
rese	reise	ILN1	1	6	1	1	1
resise	reise	ILN1	1	1	1	1	1
resisen	reisen	ILN1	1	1	1	1	1
resiste	reiste	ILN1	1	1	1	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
schälft	schläft	ILN1	1	5	1	1	1
scheckst	schenkst	ILN1	4	6	1	1	1
Scheiz	Schweiz	ILN1	1	4	3	1	2
Schläuft	Schläft	ILN1	1	1	1	1	1
Schokalade	Schokolade	ILN1	1	1	1	1	1
Schokilade	Schokolade	ILN1	1	1	1	1	1
Schoklade	Schokolade	ILN1	1	1	1	1	1
schreitt	schreibt	ILN1	3	7	1	1	1
Speilekarten	Speisekarten	ILN1	1	1	4	1	2
Speiskarten	Speisekarten	ILN1	-1	-1	4	1	1
Stereoanlange	Stereoanlage	ILN1	1	1	2	1	1
Theaterstrück	Theaterstück	ILN1	1	1	2	1	2
Tippich	Teppich	ILN1	1	1	2	1	1
Viellecht	Vielleicht	ILN1	1	1	2	1	1
Vielleich	Vielleicht	ILN1	1	1	2	1	1
wohe	wohne	ILN1	1	5	1	1	1
wohen	wohne	ILN1	6	7	1	1	1
Wrecker	Wecker	ILN1	1	1	2	1	2
Zeilung	Zeitung	ILN1	2	5	2	1	1
Zeitund	Zeitung	ILN1	1	1	2	2	2
Zeitunf	Zeitung	ILN1	1	1	1	1	1
arbeist	arbeitest	ILN2	0	2	1	2	3
aufgestahen	aufgestanden	ILN2	0	0	3	1	1
Begurtstag	Geburtstag	ILN2	0	0	2	1	1
Daenmark	Dänemark	ILN2	0	0	2	1	1
Danemärk	Dänemark	ILN2	0	0	2	1	1
Danmark	Dänemark	ILN2	0	0	2	2	2
Danmärk	Dänemark	ILN2	-1	-1	2	1	1
feirer	feiern	ILN2	0	5	2	1	1
gedannkt	gedacht	ILN2	0	1	3	1	1
gedennkt	gedacht	ILN2	0	1	3	1	1
geffallst	gefällst	ILN2	0	0	1	1	1
Gefilt	Gefällt	ILN2	0	7	1	1	1
geght	gegen	ILN2	0	1	1	1	1
geklossen	geschlossen	ILN2	0	1	4	1	1
Gershenk	Geschenk	ILN2	0	0	1	1	1
Geschitchted	Geschichten	ILN2	0	0	3	1	1
gessen	gesessen	ILN2	0	2	3	1	1
gewist	gewusst	ILN2	0	3	3	1	1
gewost	gewusst	ILN2	0	5	3	1	1
gewöst	gewusst	ILN2	0	3	3	1	1
leigt	liest	ILN2	0	6	3	1	1
let	liest	ILN2	0	3	1	1	1
mi	mein	ILN2	0	2	2	1	2
näch	nächstes	ILN2	0	2	2	1	1
nachsts	nächstes	ILN2	0	1	2	1	1
nacht	nächstes	ILN2	0	1	2	1	1
nachtes	nächstes	ILN2	0	6	24	2	2
öffetilichen	öffentlichen	ILN2	0	0	3	1	1
Össtereich	Österreich	ILN2	0	0	2	1	1
Össterich	Österreich	ILN2	0	0	2	1	1
Österich	Österreich	ILN2	0	1	2	1	1
Österra	Österreich	ILN2	0	0	2	1	1
Osterria	Österreich	ILN2	0	0	2	1	1
Östreich	Österreich	ILN2	0	0	2	1	1
Östrerrich	Österreich	ILN2	0	0	2	1	1
Poskeutzah	Postleitzahl	ILN2	0	0	2	1	1
Posleizal	Postleitzahl	ILN2	0	0	2	1	1
Postelizt	Postleitzahl	ILN2	0	0	2	1	1
Postleich	Postleitzahl	ILN2	-1	-1	2	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
Schäulft	Schläft	ILN2	0	0	1	1	1
Schestwe	Schwester	ILN2	0	1	1	1	1
Schestwer	Schwester	ILN2	0	0	1	1	1
schläuf	schläft	ILN2	0	0	1	1	1
schlauft	schläft	ILN2	0	3	1	1	1
schneckst	schenkst	ILN2	0	4	1	1	3
Scholade	Schokolade	ILN2	0	0	1	1	2
Schwest	Schwester	ILN2	0	6	3	1	1
Scläaft	Schläft	ILN2	0	0	1	1	1
seisst	bist	ILN2	0	4	1	1	1
shäft	schläft	ILN2	0	0	1	1	1
Siestt	Siehst	ILN2	0	0	1	1	1
Stereoalange	Stereoanlage	ILN2	0	0	2	1	1
Stereoanlang	Stereoanlage	ILN2	0	0	2	1	1
Stereolange	Stereoanlage	ILN2	-1	-1	2	1	2
Swägerin	Schwägerin	ILN2	0	1	4	1	1
Tappisch	Teppich	ILN2	0	1	2	1	1
Tepisch	Teppich	ILN2	0	1	2	1	1
Tepish	Teppich	ILN2	0	0	2	1	1
Tippic	Teppich	ILN2	0	0	2	1	1
Waganin	Wagen	ILN2	0	0	1	1	1
zeihlen	ziehen	ILN2	0	1	4	1	1
anrufte	anrufe	IMG1	1	3	3	1	1
anruften	anrufen	IMG1	1	1	3	1	1
arbeitst	arbeitest	IMG1	1	2	13	8	9
aufraumen	aufräumen	IMG1	1	4	24	4	6
ausgefällen	ausgefallen	IMG1	1	2	4	1	1
Backerei	Bäckerei	IMG1	2	2	24	3	4
bessten	besten	IMG1	2	4	3	1	1
Brauchtst	Brauchst	IMG1	2	4	1	1	1
Brudern	Bruders	IMG1	2	3	3	1	1
Büche	Bücher	IMG1	6	8	12	7	10
Büchen	Bücher	IMG1	12	12	124	9	14
darft	darf	IMG1	5	5	1	2	3
düscht	duscht	IMG1	1	1	3	1	1
einkäufst	einkaufst	IMG1	1	2	1	2	2
einschlaften	einschlafen	IMG1	1	1	1	1	1
Erkältst	Erkältest	IMG1	1	3	3	2	2
Erkältt	Erkältet	IMG1	1	2	3	1	1
erzahlen	erzählen	IMG1	-1	-1	3	1	1
erzahlt	erzählt	IMG1	-1	-1	3	1	1
fähren	fahren	IMG1	2	4	1	1	4
fähret	fährt	IMG1	2	4	1	2	2
Fahrst	Fährst	IMG1	2	6	1	2	3
fahrst	fährst	IMG1	5	6	13	5	6
feieren	feiern	IMG1	6	9	24	3	4
feieret	feiert	IMG1	3	7	4	1	1
findst	findest	IMG1	1	5	123	8	9
Flüss	Fluss	IMG1	3	3	4	1	1
fuhle	fühle	IMG1	5	5	3	1	1
fuhlt	fühlt	IMG1	2	4	3	1	1
fuhre	fuhr	IMG1	5	6	3	1	2
gearbeiten	gearbeitet	IMG1	1	1	3	1	1
gebleiben	geblieben	IMG1	1	1	3	9	20
gebrucht	gebracht	IMG1	2	6	3	1	1
gebst	gibst	IMG1	6	11	3	1	1
gefähren	gefahren	IMG1	2	3	4	1	2
gefällen	gefallen	IMG1	2	3	23	5	5
gefallst	gefällst	IMG1	2	4	23	3	3
Gefallst	Gefällst	IMG1	2	4	1	9	11

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
geflegen	geflogen	IMG1	1	2	3	1	1
gegengen	gegangen	IMG1	1	1	3	1	1
gehoren	gehören	IMG1	1	6	1	1	1
gehort	gehört	IMG1	2	4	13	2	2
Gehort	Gehört	IMG1	3	4	1	2	2
Gehörtst	Gehörst	IMG1	3	4	1	1	2
gehts	gehst	IMG1	2	3	1	5	9
gemachst	gemacht	IMG1	1	1	3	2	3
geregnen	geregnet	IMG1	2	2	3	4	7
geregnt	geregnet	IMG1	1	2	3	3	7
gerittet	geritten	IMG1	6	6	4	1	1
gerzählt	erzählt	IMG1	0	1	3	1	1
gespeilt	gespielt	IMG1	2	4	3	5	7
getreffen	getroffen	IMG1	1	1	3	1	1
gewäschen	gewaschen	IMG1	1	1	3	1	1
gewisst	gewusst	IMG1	1	5	3	3	3
gewollst	gewollt	IMG1	1	1	3	1	1
gewosst	gewusst	IMG1	1	2	3	1	1
gewuss	gewusst	IMG1	1	2	3	1	1
gingte	ginge	IMG1	2	4	3	1	1
größ	groß	IMG1	1	1	2	1	1
größe	große	IMG1	3	6	4	1	1
größen	großen	IMG1	3	6	4	1	1
größsten	größten	IMG1	2	2	3	1	1
größt	größte	IMG1	2	3	3	1	1
großte	größte	IMG1	2	3	3	1	1
großten	größten	IMG1	2	3	3	1	1
häben	haben	IMG1	6	7	1	1	1
Habst	Hast	IMG1	4	14	13	3	3
habst	hast	IMG1	4	13	13	10	14
hastt	hast	IMG1	3	4	1	1	1
hate	hatte	IMG1	7	12	3	1	1
Hatet	Hattet	IMG1	1	11	3	2	3
Hattst	Hattest	IMG1	1	2	3	1	1
Häuse	Häuser	IMG1	7	7	3	1	1
heiratst	heiratest	IMG1	1	2	1	3	3
heißst	heißt	IMG1	5	5	123	9	21
heißten	heißen	IMG1	3	3	1	1	1
kammen	kämmen	IMG1	3	3	3	1	1
Känn	Kann	IMG1	1	1	2	1	1
kannen	können	IMG1	4	5	3	1	1
Kannt	Kann	IMG1	5	7	1	1	1
kannt	kann	IMG1	5	5	1	5	8
Kannt	Kannst	IMG1	1	7	1	2	3
Kannt	Könnt	IMG1	4	7	1	2	2
Kaufer	Käufer	IMG1	6	7	4	1	1
Käufst	Kaufst	IMG1	3	3	1	1	1
käufst	kaufst	IMG1	3	3	1	1	1
käuft	kauft	IMG1	1	4	1	5	6
klingelnst	klingelst	IMG1	1	1	1	1	1
klingelnt	klingelt	IMG1	1	4	1	1	1
Konnen	Können	IMG1	3	10	3	1	1
konnen	können	IMG1	3	3	4	2	3
konnst	kannst	IMG1	1	2	1	1	1
Konnst	Kannst	IMG1	1	2	3	3	3
könnst	kannst	IMG1	5	6	13	2	2
Könnst	Kannst	IMG1	5	6	13	8	9
Konnt	Könnt	IMG1	3	3	1	1	1
konnt	könnt	IMG1	3	3	13	2	2
Kunder	Kunden	IMG1	4	5	2	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
läuf	läuft	IMG1	1	1	1	1	1
läufe	laufe	IMG1	2	4	24	2	2
läufe	läuft	IMG1	3	4	1	1	2
läufet	läuft	IMG1	3	4	1	2	2
leigt	legt	IMG1	1	6	34	2	3
letztet	letzter	IMG1	5	7	3	1	1
liese	lese	IMG1	5	9	2	1	1
liesst	liest	IMG1	6	6	1	1	1
lisst	liest	IMG1	1	4	1	4	5
mage	mag	IMG1	7	7	1	3	3
Möchtst	Möchtest	IMG1	1	2	1	1	1
Mogt	Mögt	IMG1	1	2	1	1	1
müss	muss	IMG1	3	3	3	1	1
musse	muss	IMG1	7	7	3	2	2
putzst	putzt	IMG1	2	3	3	4	4
Regene	Regens	IMG1	8	9	3	1	1
Regenes	Regens	IMG1	4	4	3	1	1
regnt	regnet	IMG1	1	6	3	1	1
röte	rote	IMG1	-1	-1	4	1	1
schläfen	schlafen	IMG1	2	3	1	1	1
Schläfzimmer	Schlafzimmer	IMG1	1	1	4	1	1
Schwagerin	Schwägerin	IMG1	2	3	4	2	2
Sehst	Siehst	IMG1	6	13	1	1	1
Siehet	Sieht	IMG1	9	12	1	1	1
sitzte	sitze	IMG1	4	6	3	1	1
sitzte	sitzt	IMG1	6	6	3	1	1
sitzten	sitzen	IMG1	3	4	3	2	3
stiehst	stehst	IMG1	3	10	1	1	1
stieht	steht	IMG1	2	10	3	1	1
studeierst	studierst	IMG1	1	1	1	1	1
studeiert	studiert	IMG1	1	1	1	1	1
Stühl	Stühle	IMG1	2	4	13	6	7
tanzst	tanzt	IMG1	3	4	1	1	2
teuresten	teuersten	IMG1	1	1	3	1	1
Verloret	Verlort	IMG1	6	7	3	1	1
verspatet	verspätet	IMG1	1	1	3	1	1
wartst	warst	IMG1	5	8	3	1	1
Willt	Willst	IMG1	1	9	1	1	1
Willtest	Wolltest	IMG1	-1	-1	3	1	1
wirdt	wird	IMG1	6	6	1	1	2
wisste	wusste	IMG1	1	5	3	1	1
Wollst	Willst	IMG1	-1	-1	13	5	5
wollst	willst	IMG1	-1	-1	13	6	7
Wollstest	Wolltest	IMG1	1	1	3	1	1
wüssen	wüssten	IMG1	1	4	3	1	1
angekamm	angekommen	IMG2	0	0	4	1	1
anruftet	anruft	IMG2	0	1	3	1	1
aufgestandt	aufgestanden	IMG2	0	0	3	1	1
aufgestehe	aufgestanden	IMG2	0	0	3	1	1
aufgestehen	aufgestanden	IMG2	0	1	3	4	7
aufgesteht	aufgestanden	IMG2	0	0	3	8	12
ausgeprobieren	ausprobiert	IMG2	0	0	3	6	7
ausgeprobiert	ausprobiert	IMG2	0	0	3	8	13
benimmen	benehmen	IMG2	0	1	3	1	1
Büch	Bücher	IMG2	0	2	13	4	5
Bucheren	Bücher	IMG2	0	5	1	1	1
Buchin	Bücher	IMG2	0	1	1	1	1
därft	darf	IMG2	0	1	1	1	1
deinst	dein	IMG2	0	3	1	1	1
denkte	dachte	IMG2	0	7	3	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
dunkte	dachte	IMG2	0	5	3	1	1
durft	darf	IMG2	0	2	3	1	1
eingekaufen	eingekauft	IMG2	0	2	4	2	4
ergekältet	erkältet	IMG2	0	0	3	1	1
ergezählen	erzählt	IMG2	0	0	3	1	1
ergezählet	erzählt	IMG2	0	0	3	1	1
ergezählt	erzählt	IMG2	0	1	3	2	2
fahrte	fuhr	IMG2	0	4	3	2	2
Fällst ge	Gefällst	IMG2	0	1	3	1	1
gangte	gingt	IMG2	0	1	3	1	1
geausprobieren	ausprobiert	IMG2	0	0	3	1	1
gebleibt	geblieben	IMG2	0	1	3	4	4
gebliebt	geblieben	IMG2	0	1	3	3	13
gebringen	gebracht	IMG2	0	1	3	5	5
gebringest	gebracht	IMG2	0	0	3	1	1
gebringet	gebracht	IMG2	0	0	3	2	2
gebringst	gebracht	IMG2	0	0	3	1	2
gebringt	gebracht	IMG2	0	0	3	9	11
gedank	gedacht	IMG2	0	1	3	2	3
gedanken	gedacht	IMG2	0	3	3	6	6
gedunken	gedacht	IMG2	0	5	3	2	2
gedunkt	gedacht	IMG2	0	7	3	1	1
geduschen	geduscht	IMG2	0	1	3	3	7
geentschuldigen	entschuldigen	IMG2	0	0	3	1	1
geentschuldiget	entschuldigen	IMG2	0	0	3	1	1
geentschuldigt	entschuldigen	IMG2	0	0	3	1	1
geerkälte	erkältet	IMG2	0	0	3	2	2
geerkälten	erkältet	IMG2	0	0	3	2	3
geerkältet	erkältet	IMG2	0	0	3	2	3
geerzählt	erzählt	IMG2	0	0	3	2	2
gefahrt	gefahren	IMG2	0	2	4	3	4
gefährt	gefahren	IMG2	0	6	4	2	2
geflegt	geflogen	IMG2	0	4	3	1	1
gefleigst	geflogen	IMG2	0	0	3	1	1
gefliegen	geflogen	IMG2	1	1	3	7	8
geflieget	geflogen	IMG2	0	0	3	1	1
gefliegt	geflogen	IMG2	0	1	3	9	10
gegehen	gegangen	IMG2	0	2	3	5	5
gegerkältet	erkältet	IMG2	0	0	3	1	1
gegerzählen	erzählt	IMG2	0	0	3	1	1
gegerzählt	erzählt	IMG2	0	0	3	1	3
gegest	gegen	IMG2	0	7	1	1	2
gegt	gegen	IMG2	0	4	1	1	1
gehene	gehe	IMG2	0	3	1	1	1
gehenst	gehst	IMG2	0	2	1	1	1
gehent	geht	IMG2	0	8	1	1	1
gehtest	gehst	IMG2	0	4	1	1	2
gekommt	gekommen	IMG2	0	1	4	1	1
geleben	gelebt	IMG2	0	6	3	1	1
geliest	gelesen	IMG2	0	10	3	2	2
gemachen	gemacht	IMG2	0	1	3	5	7
gentschuldiget	entschuldigen	IMG2	0	0	3	1	1
gepassieren	passiert	IMG2	0	0	3	5	7
gepassieret	passiert	IMG2	0	0	3	1	1
gepassiert	passiert	IMG2	0	0	3	6	9
geprobiert	probiert	IMG2	0	0	3	1	1
gereiten	geritten	IMG2	0	11	4	1	1
gereitet	geritten	IMG2	0	7	4	1	1
gerkälten	erkältet	IMG2	0	0	3	1	1
gerzählen	erzählt	IMG2	0	0	3	2	2

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
Geschwägerin	Schwägerin	IMG2	0	0	4	1	1
geselt	selten	IMG2	0	3	4	1	1
geselten	selten	IMG2	0	4	4	1	1
gesetzen	gesessen	IMG2	0	2	3	1	1
gesitzen	gesessen	IMG2	0	0	3	4	4
gesitzt	gesessen	IMG2	0	5	3	6	10
gesitzten	gesessen	IMG2	0	5	3	1	1
gespeilen	gespielt	IMG2	0	0	3	1	1
gespielen	gespielt	IMG2	0	3	3	2	2
gespieltet	gespielt	IMG2	0	5	3	1	2
gesterst	gestern	IMG2	0	2	3	1	1
geverbracht	verbracht	IMG2	0	0	3	2	2
geverbringt	verbracht	IMG2	0	0	3	1	1
geverletzen	verletzt	IMG2	0	0	3	1	2
geverlieren	verloren	IMG2	0	0	3	2	2
geverlierst	verloren	IMG2	0	0	3	1	1
geverliert	verloren	IMG2	0	0	3	4	4
geverloren	verloren	IMG2	0	0	3	2	2
geverspäten	verspätet	IMG2	0	0	3	1	1
geverspätet	verspätet	IMG2	0	0	3	1	1
gewascht	gewaschen	IMG2	0	7	3	12	20
gewäscht	gewaschen	IMG2	0	1	3	3	3
gewessen	gewusst	IMG2	0	6	3	2	2
gewolltet	gewollt	IMG2	0	5	3	1	1
gewonnt	gewonnen	IMG2	0	7	3	2	2
gewossen	gewusst	IMG2	0	3	3	1	1
gewussen	gewusst	IMG2	0	2	3	1	1
gezieht	gezogen	IMG2	0	5	3	2	2
geziehten	gezogen	IMG2	0	5	3	1	1
habte	hat	IMG2	0	10	1	1	1
Hausn	Hauses	IMG2	0	5	3	1	1
heiratenin	heiraten	IMG2	0	0	1	1	1
heißenst	heißt	IMG2	0	1	1	1	1
immeret	immer	IMG2	0	0	1	1	1
kamm	käme	IMG2	0	4	3	1	1
kannet	kann	IMG2	0	6	1	1	1
Kanntst	Konntest	IMG2	0	3	3	1	1
Kennenen	Kennen	IMG2	0	1	1	1	1
klingelnet	klingelt	IMG2	0	1	1	1	1
kömme	käme	IMG2	0	4	3	1	1
kommene	komme	IMG2	0	3	1	1	1
kommenst	kommst	IMG2	0	1	1	1	1
kommte	kam	IMG2	0	4	3	1	1
kommte	käme	IMG2	0	4	3	1	1
lebente	lebten	IMG2	0	1	3	1	1
les	liest	IMG2	-1	-1	1	1	1
lesenet	liest	IMG2	0	0	1	1	1
möch	möchte	IMG2	0	2	3	1	1
müss	müsste	IMG2	0	3	3	1	1
nehmten	nahmen	IMG2	-1	-1	4	1	2
Samstaget	Samstag	IMG2	0	3	1	1	1
schnellerste	schnellste	IMG2	0	0	3	1	1
seinst	bist	IMG2	0	6	1	1	2
seint	ist	IMG2	0	9	1	2	2
studeierest	studierst	IMG2	0	1	1	1	1
Stuhlen	Stühle	IMG2	0	8	1	4	4
Stuhler	Stühle	IMG2	0	2	1	1	1
tanzenest	tanzt	IMG2	0	0	1	1	1
tanzent	tanzt	IMG2	0	4	1	1	1
verbrangen	verbracht	IMG2	0	1	3	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
verbrangt	verbracht	IMG2	0	2	3	1	4
verbrongen	verbracht	IMG2	0	1	3	1	1
Verdienenst	Verdienst	IMG2	0	2	1	1	1
Verdienent	Verdient	IMG2	0	5	1	1	1
vergebracht	verbracht	IMG2	0	1	3	4	4
vergelieren	verloren	IMG2	-1	-1	3	1	2
verstehene	verstehe	IMG2	0	4	1	1	2
vorbeigekamm	vorbeigekommen	IMG2	0	0	4	1	1
vorbeigekommt	vorbeigekommen	IMG2	0	0	4	1	1
waschte	wäscht	IMG2	0	6	3	1	1
waschtet	wuscht	IMG2	0	4	3	1	1
werdt	wird	IMG2	0	6	1	12	16
wuss	weiß	IMG2	0	0	3	1	2
ziehten	zogen	IMG2	0	5	3	1	1
Zimmeren	Zimmer	IMG2	0	6	2	2	2
Zimmerinen	Zimmer	IMG2	0	0	2	1	1
Arbeitzimmer	Arbeitszimmer	IMB1	-1	-1	24	7	8
Badzimmer	Badezimmer	IMB1	-1	-1	2	1	1
Büches	Bücher	IMB1	4	4	1	1	1
Cousines	Cousine	IMB1	3	3	4	1	1
Fraus	Frau	IMB1	2	2	4	1	1
Katzes	Katze	IMB1	8	8	3	1	1
Serviettes	Servietten	IMB1	2	3	4	2	2
Speisekartes	Speisekarten	IMB1	2	2	4	1	1
Stadts	Stadt	IMB1	3	3	3	3	4
Stühles	Stühle	IMB1	5	5	1	1	1
Stühls	Stühle	IMB1	4	4	1	1	1
Krankschwester	Krankenschwester	IMB2	-1	-1	4	3	4
Studentcafeteria	Studentencafeteria	IMB2	0	0	2	1	1
gegn	gegen	IMN1	1	3	1	1	1
arbeits	arbeitest	IMN2	0	1	1	1	1
kommes	kommst	IMN2	0	4	1	1	1
ausprobeert	ausprobiert	IPE1	1	1	3	1	1
Beir	Bier	IPE1	4	8	4	2	2
bie	bei	IPE1	1	3	4	1	1
biem	beim	IPE1	1	1	3	1	1
braushe	brauche	IPE1	1	3	1	1	1
Breif	Brief	IPE1	2	5	1	2	4
Daz	Das	IPE1	2	5	2	1	1
dei	die	IPE1	3	7	1	1	1
deise	diese	IPE1	1	2	24	3	3
deisen	diesen	IPE1	3	3	4	1	1
Deutch	Deutsch	IPE1	1	1	1	1	1
diener	deiner	IPE1	5	10	1	1	1
entshuldigen	entschuldigen	IPE1	1	1	3	2	2
farht	fahrt	IPE1	2	2	2	1	1
färht	fährt	IPE1	1	2	1	2	2
gegan	gegen	IPE1	2	2	14	2	3
Geshäfte	Geschäfte	IPE1	1	1	3	2	2
Geshichte	Geschichte	IPE1	2	3	3	1	1
Geshichten	Geschichten	IPE1	2	3	3	1	1
heir	hier	IPE1	1	7	1	2	2
Heir	Hier	IPE1	1	11	13	4	5
hieraten	heiraten	IPE1	1	1	1	1	1
hieratet	heiratet	IPE1	1	1	1	1	1
Hoffentlish	Hoffentlich	IPE1	1	1	4	1	1
Ic	Ich	IPE1	1	3	1	1	1
Irh	Ihr	IPE1	2	3	1	1	1
irh	ihr	IPE1	2	3	13	5	6
kien	kein	IPE1	2	3	12	2	3

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
kiene	keine	IPE1	1	3	1	1	1
kine	keine	IPE1	1	2	3	1	1
langwilig	langweilig	IPE1	1	1	2	1	1
leigt	liegt	IPE1	2	6	3	1	1
lieder	leider	IPE1	3	4	2	1	1
mien	mein	IPE1	4	6	12	3	3
miene	meine	IPE1	1	6	4	1	1
mienen	meinen	IPE1	5	6	3	1	1
minem	meinem	IPE1	1	1	1	1	1
Muzik	Musik	IPE1	1	1	2	1	1
Nachspiese	Nachspeise	IPE1	0	1	4	3	4
Nachtish	Nachtisch	IPE1	1	1	3	2	2
Österriech	Österreich	IPE1	1	1	2	1	1
riese	reise	IPE1	3	7	1	1	1
Schreibtish	Schreibtisch	IPE1	1	1	1	1	1
Schwiez	Schweiz	IPE1	2	2	1	1	1
seiben	sieben	IPE1	9	9	4	3	6
Sessal	Sessel	IPE1	1	1	2	1	2
shenkt	schenkt	IPE1	1	2	1	1	1
sher	sehr	IPE1	1	1	2	1	2
shläft	schläft	IPE1	1	1	1	1	1
Shlafzimmer	Schlafzimmer	IPE1	1	1	2	1	1
shon	schon	IPE1	1	1	1	1	1
Shuhe	Schuhe	IPE1	1	1	1	1	1
Shwester	Schwester	IPE1	1	1	1	1	1
Sien	Sein	IPE1	3	13	1	1	1
siene	seine	IPE1	2	9	1	2	2
speilen	spielen	IPE1	1	5	34	2	2
Speilkarten	Spielkarten	IPE1	1	1	4	1	1
Speilt	Spielt	IPE1	1	5	13	2	2
speilt	spielt	IPE1	1	5	14	3	3
Spiesekarte	Speisekarte	IPE1	1	1	4	2	2
Spiesekarten	Speisekarten	IPE1	1	1	4	2	2
studeire	studiere	IPE1	1	1	1	1	1
studeirt	studiert	IPE1	1	1	1	1	1
Teppish	Teppich	IPE1	1	1	2	1	1
übre	über	IPE1	4	4	4	1	3
un	an	IPE1	0	5	2	1	2
veil	viel	IPE1	1	1	13	2	3
veile	viele	IPE1	1	1	3	1	2
Veilleicht	Vielleicht	IPE1	-1	-1	2	1	1
veilleicht	vielleicht	IPE1	1	1	2	1	1
Verdeint	Verdient	IPE1	4	4	3	1	1
Vielliecht	Vielleicht	IPE1	1	1	2	1	1
Viertal	Viertel	IPE1	1	2	24	2	2
Vorspiese	Vorspeise	IPE1	2	2	4	1	1
Wagan	Wagen	IPE1	1	2	1	1	1
Washt	Wascht	IPE1	1	2	3	2	2
Wäsht	Wäscht	IPE1	1	1	3	1	1
wei	wie	IPE1	5	10	2	2	2
Wei	Wie	IPE1	6	14	12	2	6
weirklich	wirklich	IPE1	1	1	2	1	1
Whin	Wohin	IPE1	1	2	3	1	1
Whoer	Woher	IPE1	1	1	1	1	1
whone	wohne	IPE1	1	1	1	1	1
whont	wohnt	IPE1	1	1	1	1	1
wiel	weil	IPE1	1	4	4	1	1
wieß	weiß	IPE1	2	3	3	1	1
wundershönen	wunderschönen	IPE1	1	1	3	1	1
zich	sich	IPE1	0	2	4	1	2

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
Ziet	Zeit	IPE1	6	10	13	5	5
Zietung	Zeitung	IPE1	6	6	2	3	3
zwishen	zwischen	IPE1	1	1	3	1	1
Ik	Ich	IPE2	1	3	2	1	1
Mijn	Mein	IPE2	0	0	1	1	1
abeite	arbeite	IPG1	3	4	2	1	1
abeiten	arbeiten	IPG1	3	4	2	1	1
abeitet	arbeitet	IPG1	3	4	2	1	1
aine	eine	IPG1	0	1	1	1	1
Artz	Arzt	IPG1	2	3	34	3	5
Bergern	Bergen	IPG1	2	7	3	1	2
Brudes	Bruders	IPG1	1	3	3	1	1
Compüter	Computer	IPG1	1	1	1	1	1
Danemark	Dänemark	IPG1	1	1	24	2	3
dern	den	IPG1	4	6	1	1	3
Di	Die	IPG1	-1	-1	3	1	1
di	die	IPG1	-1	-1	3	2	2
diesern	diesen	IPG1	2	3	4	2	3
disch	dich	IPG1	1	1	3	1	3
diser	dieser	IPG1	1	1	4	1	2
ducht	duscht	IPG1	1	5	3	1	1
entschuldegen	entschuldigen	IPG1	1	1	3	1	1
fruher	früher	IPG1	1	2	4	1	1
fur	für	IPG1	2	2	2	1	1
Gerburtstag	Geburtstag	IPG1	1	1	123	4	4
Gerld	Geld	IPG1	3	4	1	1	1
Gerschenk	Geschenk	IPG1	1	1	1	1	2
gerstern	gestern	IPG1	2	2	3	3	3
Giesela	Gisela	IPG1	1	1	3	1	1
Großwater	Großvater	IPG1	1	1	1	1	1
gröste	größte	IPG1	3	4	3	1	1
Güten	Guten	IPG1	2	7	2	1	1
hasslich	hässlich	IPG1	1	1	2	2	2
Hauß	Haus	IPG1	1	7	3	1	1
heise	heiße	IPG1	4	6	1	1	1
heist	heißt	IPG1	8	8	1	1	1
Höffentlich	Hoffentlich	IPG1	1	1	4	1	1
imme	immer	IPG1	1	2	1	1	1
Kätze	Katze	IPG1	4	7	34	2	2
Kuche	Küche	IPG1	7	7	4	1	2
küzer	kürzer	IPG1	1	1	4	1	2
letze	letzte	IPG1	1	2	3	1	1
mainer	meiner	IPG1	1	1	1	1	1
Morgern	Morgen	IPG1	1	1	4	1	1
Munchen	München	IPG1	9	9	1	1	1
nack	nach	IPG1	2	2	1	1	2
Novermber	November	IPG1	1	1	1	1	1
Ruchsack	Rucksack	IPG1	-1	-1	3	1	1
Salzbürg	Salzburg	IPG1	1	1	1	1	2
Schvester	Schwester	IPG1	1	1	1	1	1
seh	sehr	IPG1	3	5	3	1	1
sizten	sitzen	IPG1	2	2	3	1	1
Teppisch	Teppich	IPG1	2	2	2	2	2
Thearterstück	Theaterstück	IPG1	1	1	2	1	1
Theaterstuck	Theaterstück	IPG1	-1	-1	2	1	1
Tiche	Tische	IPG1	1	4	4	1	2
Tockter	Tochter	IPG1	1	1	2	1	1
Trozt	Trotz	IPG1	3	5	4	1	1
Ubrigens	Übrigens	IPG1	1	1	4	1	1
unmobliert	unmöbliert	IPG1	0	0	2	2	2

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
unmoblierte	unmöblierte	IPG1	0	0	2	1	1
vebracht	verbracht	IPG1	1	1	3	1	1
veloren	verloren	IPG1	1	1	3	1	1
vestehe	verstehe	IPG1	1	1	1	1	1
Vie	Wie	IPG1	-1	-1	2	1	1
volgende	folgende	IPG1	0	1	2	1	1
wächt	wäscht	IPG1	1	4	3	1	1
Weld	Welt	IPG1	6	6	3	1	1
wiele	viele	IPG1	0	5	3	1	1
wohe	woher	IPG1	2	5	2	1	1
won	von	IPG1	0	4	1	1	1
zürückkommen	zurückkommen	IPG1	1	1	1	1	1
zwichen	zwischen	IPG1	1	2	3	1	1
Faß	Fass	IPG2	1	6	4	1	1
Fluß	Fluss	IPG2	1	6	4	2	3
gewußt	gewusst	IPG2	1	4	3	1	1
grossen	großen	IPG2	1	3	4	1	2
häßliches	hässliches	IPG2	1	1	2	1	1
heisst	heißt	IPG2	1	4	1	1	1
ißt	isst	IPG2	1	3	1	1	1
muß	muss	IPG2	1	3	3	1	3
Waßer	Wasser	IPG2	1	2	3	1	1
weiss	weiß	IPG2	1	5	34	2	3
Apoteke	Apotheke	IPB1	1	1	4	1	1
auffstehen	aufstehen	IPB1	1	1	1	1	1
Bäkerei	Bäckerei	IPB1	1	1	4	1	1
beginst	beginnst	IPB1	1	5	1	2	2
benemen	benehmen	IPB1	1	1	3	1	1
Briggitte	Brigitte	IPB1	1	1	1	1	1
est	esst	IPB1	1	4	1	1	2
Fahrad	Fahrrad	IPB1	2	2	3	1	1
Färst	Fährst	IPB1	1	8	1	1	1
färt	fährt	IPB1	1	3	1	2	2
Fragge	Frage	IPB1	1	3	1	1	2
Gefält	Gefällt	IPB1	1	1	1	1	1
geffällst	gefällst	IPB1	1	1	1	1	1
gespiellt	gespielt	IPB1	1	1	3	1	2
gewönlich	gewöhnlich	IPB1	1	1	2	2	2
Hauss	Haus	IPB1	1	9	3	1	1
Hochschulehrer	Hochschullehrer	IPB1	1	1	2	1	1
Kanst	Kannst	IPB1	1	8	1	2	2
keinne	keine	IPB1	2	3	1	1	1
keinnen	keinen	IPB1	1	2	1	1	1
komst	kommst	IPB1	1	7	1	1	1
langweillig	langweilig	IPB1	1	2	2	1	1
Östereich	Österreich	IPB1	2	2	2	2	3
plannen	planen	IPB1	1	1	2	2	2
plannt	plant	IPB1	1	1	2	3	4
schenckst	schenkst	IPB1	1	1	1	1	1
schikt	schickt	IPB1	1	2	2	1	1
schlap	schlapp	IPB1	1	2	4	1	1
Schmect	Schmeckt	IPB1	1	2	1	1	1
Schönnes	Schönes	IPB1	1	2	3	1	1
Siest	Siehst	IPB1	3	14	1	4	4
Stüle	Stühle	IPB1	4	6	1	1	1
Wan	Wann	IPB1	1	7	123	3	3
Wonung	Wohnung	IPB1	1	2	1	1	1
zurüchkommen	zurückkommen	IPB1	1	1	1	1	1
zurükkommen	zurückkommen	IPB1	1	1	1	1	1
Bäackerei	Bäckerei	IPN1	1	1	2	2	3

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
erkäaltet	erkältet	IPN1	1	2	3	1	1
erzälht	erzählt	IPN1	1	1	3	1	2
fäahrt	fährt	IPN1	1	2	3	1	1
Gescichten	Geschichten	IPN1	2	3	3	1	1
italienisc	italienisch	IPN1	1	1	1	1	1
kaüft	kauft	IPN1	1	1	1	1	1
Scach	Schach	IPN1	2	2	3	1	1
Scläft	Schläft	IPN1	1	1	1	1	1
Screibtisch	Schreibtisch	IPN1	1	1	1	1	2
Screibtische	Schreibtische	IPN1	1	1	1	1	1
Sculze	Schulze	IPN1	2	2	4	1	2
Scwester	Schwester	IPN1	1	1	13	2	2
Verkäauferin	Verkäuferin	IPN1	1	1	2	1	1
zurüuckkommen	zurückkommen	IPN1	1	1	1	2	2
Haüser	Häuser	IPN2	0	2	3	1	1
laüft	läuft	IPN2	0	1	1	4	4
postkarte	Postkarte	IOE1	1	1	2	1	1
gehts	geht's	IOG1	1	3	124	14	26
Wieviel	Wie viel	IOG1	1	1	14	2	2
mittag	Mittag	IOB1	1	1	4	1	1
nacht	Nacht	IOB1	1	1	2	3	3
Morgenabend	Morgen Abend	ION2	-1	-1	4	1	1
ährst	Fährst	II1	0	2	1	1	1
Alfren	Alfred	II1	2	2	1	1	1
Allo	Hallo	II1	1	6	2	1	1
altlen	alten	II1	1	2	3	1	1
Apothek	Apotheke	II1	1	1	2	1	1
Arbeitzsimmer	Arbeitszimmer	II1	1	1	2	1	1
asßerhalb	außerhalb	II1	1	1	3	1	1
asu	aus	II1	1	1	2	1	1
aud	aus	II1	1	2	1	1	1
aufen	laufen	II1	0	2	1	1	1
aufrämen	aufräumen	II1	1	2	2	1	1
Augne	Augen	II1	2	2	3	1	2
aurprobiert	ausprobiert	II1	2	2	3	1	1
ausprrobiert	ausprobiert	II1	1	1	3	1	1
Bänker	Bänken	II1	6	7	3	1	1
Bbend	Abend	II1	0	2	4	1	1
benehmem	benehmen	II1	3	3	3	1	1
benehnmen	benehmen	II1	1	1	3	1	1
Berli	Berlin	II1	1	2	1	1	1
bestimmit	bestimmt	II1	1	3	1	1	1
bleit	bleibt	II1	1	2	3	1	1
Brder	Bruder	II1	1	5	3	1	1
Briem	Brief	II1	2	4	1	1	1
Brigette	Brigitte	II1	1	2	1	1	1
Bruden	Bruder	II1	-1	-1	3	1	1
Burder	Bruder	II1	2	2	3	1	1
bust	bist	II1	11	11	1	1	1
Comptuter	Computer	II1	1	1	1	1	1
ddem	dem	II1	1	1	1	1	1
de	die	II1	-1	-1	1	1	1
de	du	II1	-1	-1	1	1	1
deduscht	geduscht	II1	0	0	3	1	1
deier	deiner	II1	1	3	1	1	1
Derkäuferin	Verkäuferin	II1	0	0	2	1	1
dest	desto	II1	1	5	4	1	1
det	der	II1	1	4	2	1	1
dim	dem	II1	1	3	1	1	1
din	den	II1	3	5	4	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
drigend	dringend	II1	1	1	2	1	1
ds	das	II1	2	5	1	1	1
Duetsch	Deutsch	II1	1	2	3	1	1
edie	die	II1	0	1	2	1	1
efahren	gefahren	II1	0	1	4	1	1
eimal	einmal	II1	1	1	3	1	1
einein	einen	II1	1	1	3	1	1
einien	einen	II1	2	3	1	1	1
Einselzimmer	Einzelzimmer	II1	1	1	4	1	2
erkältety	erkältet	II1	2	2	3	1	1
erzöhlen	erzählen	II1	1	1	3	1	1
Ese	Es	II1	-1	-1	2	1	1
essst	esst	II1	2	3	1	1	1
et	er	II1	-1	-1	1	1	1
eu	du	II1	0	3	1	1	1
eute	heute	II1	0	1	2	1	2
Fage	Frage	II1	2	8	2	1	1
Fahhrad	Fahrrad	II1	1	1	3	1	1
farhren	fahren	II1	1	1	1	1	1
Felin	Fein	II1	1	3	2	1	1
fersehen	fernsehen	II1	1	1	3	1	1
Ferseher	Fernseher	II1	1	1	1	1	1
Fhren	Fahren	II1	2	6	1	1	1
früch	früh	II1	2	2	3	1	1
Fußall	Fußball	II1	2	2	3	1	1
Gartem	Garten	II1	5	5	3	1	1
Geburtstga	Geburtstag	II1	1	1	1	1	1
gegenünber	gegenüber	II1	1	1	4	1	2
gent	geht	II1	2	5	1	1	1
gescholssen	geschlossen	II1	1	2	4	1	1
glaute	glaube	II1	3	4	1	1	1
gluabe	glaube	II1	1	1	1	1	1
gohört	gehört	II1	1	1	1	1	1
gräßer	größer	II1	2	2	3	1	1
großebn	großen	II1	1	1	4	1	2
Großeltenr	Großeltern	II1	0	0	1	1	1
Gsbi	Gabi	II1	2	2	3	1	1
gwinnt	gewinnt	II1	1	1	3	1	1
hane	habe	II1	4	5	1	1	1
Häser	Häuser	II1	1	1	3	1	1
heibe	heiße	II1	4	6	1	1	1
heibßt	heißt	II1	1	1	2	1	1
heriaten	heiraten	II1	2	2	1	1	1
heßen	heißen	II1	2	7	1	1	1
Hiet	Hier	II1	5	11	3	1	1
hilt	hilft	II1	3	6	3	1	1
Hochschullehren	Hochschullehrer	II1	-1	-1	2	1	1
Hofflentlich	Hoffentlich	II1	1	1	4	1	1
ht	hat	II1	1	1	3	1	1
huete	heute	II1	2	5	23	2	2
ihf	ihr	II1	1	3	3	1	1
ihrt	ihr	II1	4	5	1	1	1
IMeine	Meine	II1	0	0	1	1	1
immet	immer	II1	1	1	1	1	1
inhrem	ihrem	II1	1	1	1	1	1
inst	ins	II1	3	3	1	1	1
it	mit	II1	0	4	1	1	1
itanlienisch	italienisch	II1	1	1	1	1	1
itlaienisch	italienisch	II1	1	1	1	1	1
Kartent	Karten	II1	4	5	1	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
Keider	Kleider	II1	2	4	3	1	1
kilngeln	klingeln	II1	1	1	1	1	1
Kindo	Kino	II1	1	4	1	1	2
kingelt	klingelt	II1	1	3	1	1	1
Kinzert	Konzert	II1	1	1	1	1	1
Kirch	Kirche	II1	-1	-1	4	1	1
Kkunde	Kunde	II1	1	1	2	1	1
Klasu	Klaus	II1	2	2	3	1	1
Kno	Kino	II1	4	4	1	1	1
Kommade	Kommode	II1	1	1	3	1	1
kömmen	kämmen	II1	2	3	3	1	1
kommmst	kommst	II1	1	2	1	1	1
könnon	können	II1	1	1	3	1	1
Konzer	Konzert	II1	-1	-1	3	1	1
Kübrigens	Übrigens	II1	0	0	4	1	1
kufen	kaufen	II1	1	3	2	1	1
left	legt	II1	3	4	3	1	1
Leifer	Leider	II1	2	5	2	1	1
leihsen	leihen	II1	2	2	2	1	1
Mahias	Mathias	II1	1	2	3	1	2
Mariz	Maria	II1	1	3	3	1	1
Michal	Michael	II1	-1	-1	1	1	1
Micheael	Michael	II1	1	1	1	1	1
Micheal	Michael	II1	1	2	1	2	2
micht	nicht	II1	0	4	2	1	1
mieinen	meinen	II1	1	1	3	1	1
mire	mir	II1	4	4	4	1	1
mitgebract	mitgebracht	II1	1	1	3	1	1
Mittoch	Mittwoch	II1	1	1	3	1	2
mmer	immer	II1	1	1	3	1	1
moch	noch	II1	0	1	2	1	1
Monkia	Monika	II1	1	1	3	1	1
moregn	morgen	II1	1	1	1	1	1
Müchen	München	II1	5	5	1	1	1
müstte	müsste	II1	1	1	3	1	1
Nachmitttag	Nachmittag	II1	1	1	2	1	1
nacj	nach	II1	1	1	1	1	1
neuea	neues	II1	2	2	3	1	1
Nichet	Nichte	II1	0	2	2	1	1
Nicths	Nichts	II1	1	1	1	1	1
Nme	Name	II1	2	2	2	1	1
Novmeber	November	II1	1	1	1	1	1
Okotber	Oktober	II1	1	1	2	1	2
Parplätze	Parkplätze	II1	1	1	3	1	1
peter	Peter	II1	1	1	1	1	1
Petter	Peter	II1	1	1	1	1	1
Profesor	Professor	II1	1	1	2	1	1
putzs	putzt	II1	1	2	3	1	1
rerissen	gerissen	II1	0	0	4	1	1
reritten	geritten	II1	0	0	4	1	1
Riest	Liest	II1	0	14	2	1	1
Sabin	Sabine	II1	2	5	3	1	1
Salburg	Salzburg	II1	-1	-1	1	1	1
sapzieren	spazieren	II1	1	1	1	1	1
Savine	Sabine	II1	1	2	3	1	1
scheibt	schreibt	II1	1	3	1	1	1
schincken	schicken	II1	1	1	2	1	1
Schlafeb	Schlafen	II1	3	4	1	1	1
Schmenkst	Schmeckst	II1	4	4	1	1	1
schol	schon	II1	5	5	3	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
schreben	schreiben	II1	2	5	1	1	1
schreibee	schreibe	II1	1	3	1	1	1
schreibn	schreibt	II1	4	4	1	1	1
Schreintisch	Schreibtisch	II1	-1	-1	1	1	1
Sefan	Stefan	II1	1	2	3	1	1
seined	seinen	II1	5	6	2	1	1
selzen	selten	II1	2	7	4	1	1
Ser	Der	II1	0	5	1	1	1
sindd	sind	II1	1	1	1	1	1
sit	ist	II1	1	4	3	1	1
Skil	Ski	II1	0	3	1	2	2
sonntg	sonnig	II1	1	3	4	1	1
spaziern	spazieren	II1	1	3	1	1	1
Stadyt	Stadt	II1	1	1	1	1	1
stecjt	steckt	II1	1	2	3	1	1
Stefen	Stefan	II1	9	9	3	1	1
Stehan	Stefan	II1	3	3	3	1	1
stent	steht	II1	1	2	1	1	1
Straaten	Staaten	II1	2	2	1	1	2
Studient	Student	II1	2	3	2	1	1
talienisch	italienisch	II1	0	0	1	1	1
Tanta	Tante	II1	5	5	3	1	1
Tasch	Tasche	II1	2	4	3	1	1
Telefin	Telefon	II1	1	1	1	1	1
Tennin	Tennis	II1	3	3	3	1	1
Tennist	Tennis	II1	1	1	3	1	1
Tennsi	Tennis	II1	1	1	3	1	1
Tischn	Tisch	II1	5	5	3	1	1
treigen	treiben	II1	1	1	4	1	1
Übringens	Übrigens	II1	1	1	4	1	1
un	und	II1	1	5	12	2	2
Urlab	Urlaub	II1	1	1	3	1	1
ut	tut	II1	0	3	1	1	1
vel	viel	II1	1	2	3	1	1
verletzy	verletzt	II1	1	2	3	1	1
verstehn	verstehe	II1	2	3	1	1	1
view	viel	II1	1	2	1	1	1
vorloren	verloren	II1	2	2	3	1	1
Warem	Warum	II1	3	7	3	1	1
werklich	wirklich	II1	2	2	2	1	1
Wis	Wie	II1	4	6	3	1	1
wissien	wissen	II1	1	1	3	1	1
wisssen	wissen	II1	1	1	4	1	2
Wiw	Wie	II1	1	2	1	1	1
Wod	Wo	II1	3	6	1	1	1
wohen	woher	II1	7	7	2	1	1
Wohim	Wohin	II1	1	1	4	1	1
Wonhung	Wohnung	II1	1	1	1	1	1
wuch	euch	II1	0	4	3	1	1
Wwetter	Wetter	II1	1	1	3	1	1
ziegen	ziehen	II1	3	9	4	1	1
3gesund	gesund	II1	-1	-1	4	1	1
anToms	an Toms	II1	0	0	4	1	1
arbeitestdu	arbeitest du	II1	0	0	1	1	1
benehmensich	benehmen sich	II1	0	0	3	1	1
benim.mt	benimmt	II1	1	1	3	1	1
bindu	bin du	II1	0	1	1	1	1
daseinmal	das einmal	II1	0	0	3	1	1
dasEinzelzimmer	das Einzelzimmer	II1	0	0		1	1
dasMusik	das Musik	II1	0	0	2	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
deinBrüder	dein Brüder	II1	0	0	1	1	1
deineAuto	deine Auto	II1	0	0	1	1	1
deineEltern	deine Eltern	II1	0	0	2	1	1
deinemOnkel	deinem Onkel	II1	0	0	1	1	1
demTisch	dem Tisch	II1	0	0	4	1	1
denFilm	den Film	II1	0	0	1	1	1
denKuchen	den Kuchen	II1	0	0	3	1	1
denTisch	den Tisch	II1	0	1	3	4	5
derKopf	der Kopf	II1	0	0	4	1	1
desRegen	des Regen	II1	0	1	3	1	1
diesenHusten	diesen Husten	II1	0	0	4	1	1
dieServietten	die Servietten	II1	0	0	4	1	2
dieTisch	die Tisch	II1	0	1	4	1	1
diewunderschönen	die wunderschönen	II1	0	0	3	1	1
echtlangweilig	echt langweilig	II1	-1	-1	2	2	2
einenKrawatte	einen Krawatte	II1	0	0	1	1	1
esstitalienisch	esst italienisch	II1	0	0		1	1
fahrengut	fahren gut	II1	0	0	1	1	1
findes tdu	findest du	II1	1	4	1	1	1
Fraueinkauft	Frau einkauft	II1	0	0	1	1	1
gegenhat	gegen hat	II1	0	0	1	1	1
geheneinkaufst	gehen einkaufst	II1	0	0	1	1	1
geht' s	geht's	II1	-1	-1	2	1	1
geht 's	geht's	II1	-1	-1	2	1	1
gehtes	geht es	II1	0	2	2	2	2
gerndie	gern die	II1	0	0	3	1	1
habenmit	haben mit	II1	0	0	3	1	1
Ichmuss	Ich muss	II1	0	0	1	1	1
ihr\	ihr	II1	-1	-1	1	1	1
ihrPostleitzahl	ihr Postleitzahl	II1	0	0	2	1	1
imWinter	im Winter	II1	0	0	1	1	1
kanni ch	kann ich	II1	1	1	1	1	1
keineBratkartoffeln	keine Bratkartoffeln	II1	0	0	3	1	1
keineBücher	keine Bücher	II1	0	0	4	1	1
keinen\	keinen	II1	-1	-1	1	1	1
keinenBratkartoffeln	keinen Bratkartoffeln	II1	0	0	3	1	1
Kirchegegenüber	Kirche gegenüber	II1	-1	-1	4	1	1
kostendie	kosten die	II1	0	1	1	1	1
Maierl aufen	Maier laufen	II1	1	2	1	1	1
MaiGeburtstag	Mai Geburtstag	II1	0	0	1	1	1
Mann/	Mann	II1	-1	-1	2	1	1
MeineBruder	Meine Bruder	II1	0	0	1	1	1
Musikist	Musik ist	II1	0	0	2	1	1
Nichteplanen	Nichte planen	II1	-1	-1	2	1	1
nochein	noch ein	II1	0	0	3	1	1
ohnesein	ohne sein	II1	0	0	1	1	1
Radgefahren	Rad gefahren	II1	-1	-1	4	1	1
schonerkälten	schon erkälten	II1	0	0	3	1	1
sehrlangweilig	sehr langweilig	II1	-1	-1	2	1	1
Serviettenauf	Servietten auf	II1	0	0	4	1	2
sitzeunter	sitze unter	II1	0	0	3	1	1
VaterFilme	Vater Filme	II1	0	0	1	1	1
Vaterliest	Vater liest	II1	0	0	1	1	1
verdientGeld	verdient Geld	II1	0	0	1	1	1
vielenTouristen	vielen Touristen	II1	0	0	3	1	1
Wanndu	Wann du	II1	0	0	1	1	1
Warumhast	Warum hast	II1	0	0	3	1	1
wireinkaufen	wir einkaufen	II1	0	0	3	1	1
Zimmer\	Zimmer	II1	-1	-1	2	1	1
zumStrand	zum Strand	II1	0	0	4	1	1

Misspelling	Target Word	EC[a]	Po[b]	Le[c]	Gr[d]	St[e]	En[f]
Abden	Abend	II2	0	1	3	1	1
Arztehen	Arzt gehen	II2	0	1	4	1	1
begginst	beginnst	II2	0	0	1	1	1
bigt	gibt	II2	0	5	3	1	1
derigend	dringend	II2	0	0	2	1	1
gefahrenenn	gefahren denn	II2	0	1	4	1	1
häaalich	hässlich	II2	0	0	2	1	1
Liest=t	Liest	II2	0	0	2	1	1
s\du	du	II2	0	0	3	1	1
Sellel	Sessel	II2	0	0	1	1	1
Sussane	Susanne	II2	0	0	3	1	1
Tiche	Tasche	II2	0	4	4	1	1
Wesster	Wetter	II2	0	3	3	1	1
Won\her	Woher	II2	0	0	1	1	1

Note. [a]EC = Error category. I = Competence, II = Performance, L = Lexical, P = Phonological, M = Morphological, O = Orthographic, E = Interlingual, G = Intralingual, B = Ambilingual, N = Paralingual, 1 = Single violation, 2 = Multiple violation. Examples: IMG2 = Competence, Morphological, Intralingual, Multiple violation, II1 = Performance, Single violation. [b]Po = Position of target word in spell checker's correction list. 1 or higher = position of target word in list, 0 = misspelling uncorrected, -1 = misspelling undetected. [c]Le = Length of spell checker's correction list. 0 or higher = list length, -1 = misspelling undetected (i.e., no list). [d]Gr. = Subgroup(s) in which the misspelling occurred. 1 = Beginner build-a-sentence, 2 = Beginner translation, 3 = Intermediate build-a-sentence, 4 = Intermediate translation. [e]St = Number of students who produced the misspelling, [f]En = Number of times the misspelling was produced.

Appendix D: Spell Checking Results for Proficiency Level and Task Type

Table D:1 Spell Checking: Competence vs. Performance Errors for Beginners and Intermediates

Error category	Spell checking result								
	Corrected		Uncorrected		Undetected		Total		
				Beginners					
									/560
Competence	274	69%	108	27%	17	4%	399	100%	71%
Performance	94	58%	50	31%	17	11%	161	100%	29%
Total	368	66%	158	28%	34	6%	560	100%	100%
				Intermediates					
									/518
Competence	222	58%	140	36%	24	6%	386	100%	75%
Performance	85	64%	41	31%	6	5%	132	100%	25%
Total	307	59%	181	35%	30	6%	518	100%	100%

Table D:2 Spell Checking: Linguistic Subsystem and Language Influence for Beginners

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		/399
Lexical	74	51%	62	43%	9	6%	145	100%	36%
Interlingual	3	18%	12	71%	2	12%	17	100%	4%
Intralingual	-	-	3	75%	1	25%	4	100%	1%
Ambilingual	4	57%	2	29%	1	14%	7	100%	2%
Paralingual	67	57%	45	38%	5	4%	117	100%	29%
Morphological	71	62%	38	33%	5	4%	114	100%	29%
Interlingual	-	-	-	-	-	-	-	-	-
Intralingual	67	64%	35	33%	3	3%	105	100%	26%
Ambilingual	3	50%	1	17%	2	33%	6	100%	2%
Paralingual	1	33%	2	67%	-	-	3	100%	1%
Phonological	125	92%	8	6%	3	2%	136	100%	34%
Interlingual	57	95%	2	3%	1	2%	60	100%	15%
Intralingual	31	82%	5	13%	2	5%	38	100%	10%
Ambilingual	28	100%	-	-	-	-	28	100%	7%
Paralingual	9	90%	1	10%	-	-	10	100%	3%
Orthographic	4	100%	-	-	-	-	4	100%	1%
Interlingual	1	100%	-	-	-	-	1	100%	0%
Intralingual	2	100%	-	-	-	-	2	100%	1%
Ambilingual	1	100%	-	-	-	-	1	100%	0%
Paralingual	-	-	-	-	-	-	-	-	-
All ling. subs.	274	69%	108	27%	17	4%	399	100%	100%
Interlingual	61	78%	14	18%	3	4%	78	100%	20%
Intralingual	100	67%	43	29%	6	4%	149	100%	37%
Ambilingual	36	86%	3	7%	3	7%	42	100%	11%
Paralingual	77	59%	48	37%	5	4%	130	100%	33%

Table D:3 Spell Checking: Linguistic Subsystem and Language Influence for Intermediates

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		/386
Lexical	31	49%	22	35%	10	16%	63	100%	16%
Interlingual	4	31%	5	38%	4	31%	13	100%	3%
Intralingual	3	75%	-	-	1	25%	4	100%	1%
Ambilingual	3	43%	2	29%	2	29%	7	100%	2%
Paralingual	21	54%	15	38%	3	8%	39	100%	10%
Morphological	94	43%	114	52%	10	5%	218	100%	56%
Interlingual	-	-	-	-	-	-	-	-	-
Intralingual	88	42%	114	54%	8	4%	210	100%	54%
Ambilingual	6	75%	-	-	2	25%	8	100%	2%
Paralingual	-	-	-	-	-	-	-	-	-
Phonological	94	93%	4	4%	3	3%	101	100%	26%
Interlingual	40	95%	2	5%	-	-	42	100%	11%
Intralingual	38	90%	1	2%	3	7%	42	100%	11%
Ambilingual	9	100%	-	-	-	-	9	100%	2%
Paralingual	7	88%	1	13%	-	-	8	100%	2%
Orthographic	3	75%	-	-	1	25%	4	100%	1%
Interlingual	-	-	-	-	-	-	-	-	-
Intralingual	2	100%	-	-	-	-	2	100%	1%
Ambilingual	1	100%	-	-	-	-	1	100%	0%
Paralingual	-	-	-	-	1	100%	1	100%	0%
All ling. subs.	222	58%	140	36%	24	6%	386	100%	100%
Interlingual	44	80%	7	13%	4	7%	55	100%	14%
Intralingual	131	51%	115	45%	12	5%	258	100%	67%
Ambilingual	19	76%	2	8%	4	16%	25	100%	6%
Paralingual	28	58%	16	33%	4	8%	48	100%	12%

Table D:4 Spell Checking: Linguistic Subsystem and Target Modification for Beginners

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
									/145
Lexical	74	51%	62	43%	9	6%	145	100%	100%
SV	74	93%	2	3%	4	5%	80	100%	55%
MV	-	-	60	92%	5	8%	65	100%	45%
									/114
Morphological	71	62%	38	33%	5	4%	114	100%	100%
SV	71	95%	-	-	4	5%	75	100%	66%
MV	-	-	38	97%	1	3%	39	100%	34%
									/136
Phonological	125	92%	8	6%	3	2%	136	100%	100%
SV	121	93%	6	5%	3	2%	130	100%	96%
MV	4	67%	2	33%	-	-	6	100%	4%
									/4
Orthographic	4	100%	-	-	-	-	4	100%	100%
SV	4	100%	-	-	-	-	4	100%	100%
MV	-	-	-	-	-	-	-	100%	-

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
									/399
Total	274	69%	108	27%	17	4%	399	100%	100%
SV	270	93%	8	3%	11	4%	289	100%	72%
MV	4	4%	100	91%	6	5%	110	100%	28%

Table D:5 Spell Checking: Linguistic Subsystem and Target Modification for Intermediates

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
									/63
Lexical	31	49%	22	35%	10	16%	63	100%	100%
SV	30	81%	1	3%	6	16%	37	100%	59%
MV	1	4%	21	81%	4	15%	26	100%	41%
									/218
Morphological	94	43%	114	52%	10	5%	218	100%	100%
SV	93	92%	1	1%	7	7%	101	100%	46%
MV	1	1%	113	97%	3	3%	117	100%	54%
									/101
Phonological	94	93%	4	4%	3	3%	101	100%	100%
SV	87	94%	3	3%	3	3%	93	100%	92%
MV	7	88%	1	13%	-	-	8	100%	8%
									/100
Orthographic	3	75%	-	-	1	25%	4	100%	100%
SV	3	100%	-	-	-	-	3	100%	75%
MV	-	-	-	-	1	100%	1	100%	25%
									/100
Total	222	58%	140	36%	24	6%	386	100%	100%
SV	213	91%	5	2%	16	7%	234	100%	61%
MV	9	6%	135	89%	8	5%	152	100%	39%

The spell checking results for beginners and intermediates that consider the target modification of all misspellings are displayed in Table 5:6 on page 83.

Table D:6 Spell Checking: Competence vs. Performance Errors for Build-a-Sentence and Translation

Error category	Spell checking result								
	Corrected		Uncorrected		Undetected		Total		
			Build-a-Sentence						
									/722
Competence	324	63%	174	34%	16	3%	514	100%	71%
Performance	140	67%	58	28%	10	5%	208	100%	29%
Total	464	64%	232	32%	26	4%	722	100%	100%
			Translation						
									/337
Competence	158	63%	70	28%	23	9%	251	100%	74%
Performance	40	47%	33	38%	13	15%	86	100%	26%
Total	198	59%	103	31%	36	11%	337	100%	100%

Table D:7 Spell Checking: Linguistic Subsystem and Language Influence for Build-a-Sentence

Error category	Spell checking results								/514
	Corrected		Uncorrected		Undetected		Total		
Lexical	60	61%	32	33%	6	6%	98	100%	19%
Interlingual	6	75%	1	13%	1	13%	8	100%	2%
Intralingual	1	50%	-	-	1	50%	2	100%	0%
Ambilingual	3	60%	1	20%	1	20%	5	100%	1%
Paralingual	50	60%	30	36%	3	4%	83	100%	16%
Morphological	124	46%	136	51%	7	3%	267	100%	52%
Interlingual	-	-	-	-	-	-	-	-	-
Intralingual	118	46%	134	52%	7	3%	259	100%	50%
Ambilingual	5	100%	-	-	-	-	5	100%	1%
Paralingual	1	33%	2	67%	-	-	3	100%	1%
Phonological	138	94%	6	4%	3	2%	147	100%	29%
Interlingual	58	98%	1	2%	-	-	59	100%	11%
Intralingual	42	88%	3	6%	3	6%	48	100%	9%
Ambilingual	26	100%	-	-	-	-	26	100%	5%
Paralingual	12	86%	2	14%	-	-	14	100%	3%
Orthographic	2	100%	-	-	-	-	2	100%	0%
Interlingual	-	-	-	-	-	-	-	-	-
Intralingual	2	100%	-	-	-	-	2	100%	0%
Ambilingual	-	-	-	-	-	-	-	-	-
Paralingual	-	-	-	-	-	-	-	-	-
All ling. subs.	324	63%	174	34%	16	3%	514	100%	100%
Interlingual	64	96%	2	3%	1	1%	67	100%	13%
Intralingual	163	52%	137	44%	11	4%	311	100%	61%
Ambilingual	34	94%	1	3%	1	3%	36	100%	7%
Paralingual	63	63%	34	34%	3	3%	100	100%	19%

Table D:8 Spell Checking: Linguistic Subsystem and Language Influence for Translation

Error category	Spell checking results								/251
	Corrected		Uncorrected		Undetected		Total		
Lexical	44	41%	49	46%	14	13%	107	100%	43%
Interlingual	1	5%	13	68%	5	26%	19	100%	8%
Intralingual	3	43%	3	43%	1	14%	7	100%	3%
Ambilingual	4	44%	3	33%	2	22%	9	100%	4%
Paralingual	36	50%	30	42%	6	8%	72	100%	29%
Morphological	30	60%	15	30%	5	10%	50	100%	20%
Interlingual	-	-	-	-	-	-	-	-	-
Intralingual	26	62%	14	33%	2	5%	42	100%	17%
Ambilingual	4	50%	1	13%	3	38%	8	100%	3%
Paralingual	-	-	-	-	-	-	-	-	-
Phonological	79	90%	6	7%	3	3%	88	100%	35%
Interlingual	36	90%	3	8%	1	3%	40	100%	16%
Intralingual	29	85%	3	9%	2	6%	34	100%	14%
Ambilingual	11	100%	-	-	-	-	11	100%	4%
Paralingual	3	100%	-	-	-	-	3	100%	1%
Orthographic	5	83%	-	-	1	17%	6	100%	2%
Interlingual	1	100%	-	-	-	-	1	100%	0%
Intralingual	2	100%	-	-	-	-	2	100%	1%
Ambilingual	2	100%	-	-	-	-	2	100%	1%
Paralingual	-	-	-	-	1	100%	1	100%	0%

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		/251
All ling. subs.	158	63%	70	28%	23	9%	251	100%	100%
Interlingual	38	63%	16	27%	6	10%	60	100%	24%
Intralingual	60	71%	20	24%	5	6%	85	100%	34%
Ambilingual	21	70%	4	13%	5	17%	30	100%	12%
Paralingual	39	51%	30	39%	7	9%	76	100%	30%

Table D:9 Spell Checking: Linguistic Subsystem and Target Modification for Build-a-Sentence

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
									/98
Lexical	60	61%	32	33%	6	6%	98	100%	100%
SV	60	88%	2	3%	6	9%	68	100%	69%
MV	-	-	30	100%	-	-	30	100%	31%
									/267
Morphological	124	46%	136	51%	7	3%	267	100%	100%
SV	123	95%	1	1%	5	4%	129	100%	48%
MV	1	1%	135	98%	2	1%	138	100%	52%
									/147
Phonological	138	94%	6	4%	3	2%	147	100%	100%
SV	132	96%	3	2%	3	2%	138	100%	94%
MV	6	67%	3	33%	-	-	9	100%	6%
									100%
Orthographic	2	100%	-	-	-	-	2	100%	100%
SV	2	100%	-	-	-	-	2	100%	100%
MV	-	-	-	-	-	-	-	100%	-
									/514
Total	324	63%	174	34%	16	3%	514	100%	100%
SV	317	94%	6	2%	14	4%	337	100%	66%
MV	7	4%	168	95%	2	1%	177	100%	34%

Table D:10 Spell Checking: Linguistic Subsystem and Target Modification for Translation

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
									/107
Lexical	44	41%	49	46%	14	13%	107	100%	100%
SV	43	88%	1	2%	5	10%	49	100%	46%
MV	1	2%	48	83%	9	16%	58	100%	54%
									/50
Morphological	30	60%	15	30%	5	10%	50	100%	100%
SV	30	91%	-	-	3	9%	33	100%	66%
MV	-	-	15	88%	2	12%	17	100%	34%
									/88
Phonological	79	90%	6	7%	3	3%	88	100%	100%
SV	73	89%	6	7%	3	4%	82	100%	93%
MV	6	100%	-	-	-	-	6	100%	68%

Error category	Spell checking results								
	Corrected		Uncorrected		Undetected		Total		
									/6
Orthographic	5	83%	-	-	1	17%	6	100%	100%
SV	5	100%	-	-	-	-	5	100%	83%
MV	-	-	-	-	1	100%	1	100%	17%
									/251
Total	158	63%	70	28%	23	9%	251	100%	100%
SV	151	89%	7	4%	11	7%	169	100%	67%
MV	7	9%	63	77%	12	15%	82	100%	33%

The spell checking results for build-a-sentence and translation that consider the target modification of all misspellings are displayed in Table 5:8 on page 87.

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