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# US German Majors' Knowledge of Grammatical Gender

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To receive a degree in a foreign language from an accredited US university, students must demonstrate a high level of language mastery, which includes their ability to communicate effectively in the target language. For majors who are working in a second language, reaching professionally required levels of proficiency is a daunting task. For example, the state of Michigan requires that language teachers score a minimum of Advanced Low on a Simulated Oral Proficiency Examination (SOPI) in order to teach in public high schools. It is important to address the needs of these second language learners by assessing their outcomes upon degree completion and adjusting our programs to optimize this outcome (Carroll, 1967).

Each language confronts the learner with unique learning challenges. Learners of Chinese must master a large number of characters to read a newspaper. Conversely, speakers of some foreign languages find the correct usage of English articles to be an ongoing challenge. For L2 German, one of the greatest hurdles is learning to understand, process, and produce the differing gender, number, and case markings in determiner phrases (DPs) (Bobb, 2008; Delisle, 1985; Desrochers, Wieland, & Cote, 1991; Hopp, 2012; Kuchenbrandt, 2008; Lemhofer, Schriefers, & Hanique, 2010; Reiss, 1999; Rogers, 1987; Sabourin, 2001; Sabourin, Stowe, & de Haan, 2006).

DPs in German always show marking on their non-root parts, i.e., articles and adjectives. In some cases, an indefinite article may not receive overt marking, but the lack of marking does, in fact, provide case and gender information as it is understood within the morphological paradigm. The following example shows how German DPs are marked within sentences. For clarity, DPs are underlined and overt marking is bolded:

***Der*** *alt**e*** *Mann kaufte ein* *neu**es*** *Auto*.
The (masc-nom) old (masc-nom) man bought a (neuter-acc) new (neuter-acc) car.
'The old man bought a new car.'

The marking of case, gender, and number is important, because it provides essential information about the role of the DP in the sentence. Although the above sentence uses standard SVO (Subject-Verb-Object) word order, speakers of German can also use OVS order to emphasize the object, because it is the morphological marking on the DP that provides the role information, not the order of the words:

*Ein* *neu**es*** *Auto kaufte* ***der*** *alt**e*** *Mann*.
A (neuter-acc) new (neuter-acc) car bought the (masc-nom) old (masc-nom) man.
'The old man bought a new car.'

Because of the importance placed on morphology, rather than word order, for role assignment, processing and producing the correct DP morphology are essential to understanding and being understood in German (MacWhinney, Bates, & Kliegl, 1984).

In order for L2 German learners to be able to figure out the correct declensional paradigm for a DP in production, or to assign a thematic role to a DP in comprehension, the learner must almost always possess knowledge about the gender of the noun. Some studies have already investigated the role grammatical gender plays in L2 processing via behavioral (Kempe & MacWhinney, 1998, 1999 ; Sabourin, 2001) and Event-Related Potential (ERP) (Foucart & Frenck-Mestre, 2010; Frenck-Mestre, Foucart, Carrasco, & Herschensohn, 2009; Tokowicz & MacWhinney, 2005) studies. However, these studies have focused on the overall use of the gender/case/number marking, rather than the details of learning gender assignment. Without clear and accurate knowledge of a noun's gender, comprehension becomes labored and production of morphology connected to the noun's determiner and/or adjectival components becomes random (Grüter, Lew-Williams, & Fernald, 2012). Since grammatical gender knowledge of nouns is so important to understanding the thematic role of nouns in an utterance and important for making one's own message clear, remembering the gender of German nouns is a major task facing L2 learners of German. Learners must also grapple with sixteen possible scenarios of gender, number, and case as well as at times homographic and homophonic declension paradigms.

Contrary to learners' assumptions (Delisle, 1985), there is a large set of systematic cues to gender assignment in German (Köpcke, 1982; Köpcke & Zubin, 1984). If learners could understand and apply these cues, they could attain improved accuracy in DP production and comprehension, for both familiar and novel nouns (Presson & MacWhinney, in press). German can be shown to have three categories of gender cues: morphological, phonological, and semantic. These three distinct categories were used in a recent study by Kraiss (2014) who investigated a procedural, hierarchical rule method to instructing German gender. The resulting classification of different cues (although they are referred to as "rules" in Kraiss' study) into one of these three categories derives from the previously mentioned work of Köpcke and Zubin, in addition to a larger body of literature arising from their work (e.g., Levine, 1999; Nelson, 1998; Steinmetz, 1986). First, a morphological cue is one in which a morphological component of the word offers information about the gender of the noun. For example, the presence of the *-heit* morphological ending which transforms adjectives into nouns (e.g., *gleich – die Gleichheit*) is a sure cue to knowing that a noun is feminine. Second, a phonological cue is a part of the noun that provides gender information, but does not change the meaning of the noun as is the case with the morphological cues. For example, multisyllabic nouns ending in *-e* are very often feminine, e.g., *die Schlange*. Third, a semantic cue is one that is based on the referent of the noun. For example, all types of alcoholic beverages except for beer are masculine in German, e.g. *der Wodka*. Whereas some of these cues are always or very nearly always reliable, others are less so. It has been shown that L1 and early child learners of German utilize these cues to organize nouns into their appropriate gender categories (Bewer, 2004; Bittner, 2002a; 2002b; Frigo & McDonald, 1998; Hofmann, 2005; Hohlfeld, 2006; Reiss, 1999; Schwichtenberg & Schiller, 2004; Szagun, Stumper, Sondag, & Franik, 2007).

L2 learners, on the other hand, utilize fewer of these cues, especially fewer phonological cues, than child learners. In her study of L2 learners' assignment of gender to English loanwords in German, Delisle (1985) found that only a limited number of semantic and morphological cues were being utilized and that learners progressed from an initial, fully semantic focused use of cues to a restricted use of morphological/phonological cues after multiple years of language learning at the university level. It is unclear what type of training students had on these cues to gender, if any, but it is unlikely that any had systematic training on the use of cues based on the results of her exploratory study.

The intersection of the importance of DP morphology with the difficulty it poses for learners makes this a critical area of study for researchers in applied linguistics. With this in mind, the current study investigated the grammatical gender knowledge of L2 learners of German who were graduating from a recognized US degree granting institution offering a Bachelor's degree in German or German studies. The research questions guiding this study are as follows:

1. Given a list of German nouns, how many genders can graduating German majors identify?
2. From the information gathered about these participants' correct and incorrect answers, what can be deduced about their knowledge of gender cues? More narrowly, are there certain cues that learners are not utilizing and what, if any, role does the frequency of words with that cue play in their response patterns?
3. By grouping participants based on their amount of correct responses, are we able to identify different patterns of cue and frequency knowledge in different subgroups of learners?

## Method

### *Participants*

Although many universities in the United States offer courses in German, only some offer degrees in German or German Studies. In addition, the number of students graduating with a degree in German from each of those institutions can be small. To recruit participants we contacted instructors at all of the programs in the US that were listed on germanistik.net as having at least a BA program in German or German Studies. Although, exact statistics on this population are not available, it is likely that the 49 participants who took part in this study make up a large sample of the target population of students graduating with a BA in German. Each participant was asked to verify that:

1. He or she was a senior, graduating after this semester with a BA in German or German Studies from an accredited US university.
2. He or she was at least 18 years of age.
3. He or she considered German as a second language, not as one of his or her first languages.

Because participants were located throughout the country, the study was conducted using online data collection. IRB rules required full anonymity and did not permit the collection of additional demographic data. This has significant impacts regarding the analysis of this data and restricts what conclusions can be made. Because of this restriction, information about the institutions, teaching styles, and experiences of each learner could not be collected. As a result, the analysis of the data lacks information about the participants, which could lead to further insights into different participants' results. So while this method allowed us to collect data from across the country in a relatively short period of time, the trade-off resulted in an inability to capture qualitative data that could have shed light on individuals' performances.

### *Materials*

Data for this study were collected using web pages hosted in our research laboratory. These pages included an agreement and consent form followed by the grammatical gender test.

### *Grammatical Gender Test*

In the grammatical gender test, participants were given 311 German nouns and asked to determine their gender. These 311 words were taken from the CELEX lexical database. This database provides information about the frequency of all the words found in its entire word list which has been drawn from a corpus of 5,400,000 words based on various written texts and previous corpora from Mannheim, Bonn, and Freiburg. Words were selected from this database to provide multiple examples of each of the 33 total cues identified for German Gender. Words with a similar cue were grouped together and given a cue code. For example, P1 was the code given to the first category of phonologically grouped words, M1 for the first morphological cue grouping, and S1 for the first semantic cue grouping. There were 13 phonological cues, 11 morphological cues, and 9 semantic cues. A list of all the cues can be found in Appendix B. After random selection of the nouns, the researchers checked to make sure that each cue contained words from high-, medium-, and low-frequency segments of the database. Words qualified as high frequency appeared over 190 times per million words, medium frequency fell between 18 and 190 appearances, and low frequency were words that occurred fewer than 18 times per million words. For most cues, a minimum of five words was selected, with all three frequency types represented. In some cases, such as the "hot beverage" cue for masculine, there were only three types in the corpus, and therefore this cue did not have a minimum of five words. When a cue was less than 100 percent reliable, a word that seemed to have the cue but did not follow the specified cue pattern was included. For example, the prefix *Ge-* often indicates that the noun has neuter gender, but some more common words, such as *Gefahr* (danger), are feminine. These cue irregularities tend to follow Zipf's law (Zipf, 1949), meaning that a word's frequency is inversely related to its likelihood to follow a cue. In other words, the more often a word occurs, the more likely it is to be an exception to the cue pattern. For a complete word list including their frequency designation, gender, and cue code, please see Appendix C.

### *Procedure*

Once participants agreed to the online consent form, the following page displayed a noun, selected at random from the pool of nouns preselected from the corpus list, and the three genders along with the declined definite articles *der*, *die*, and *das*. Figure 1 shows a screenshot of one test item.

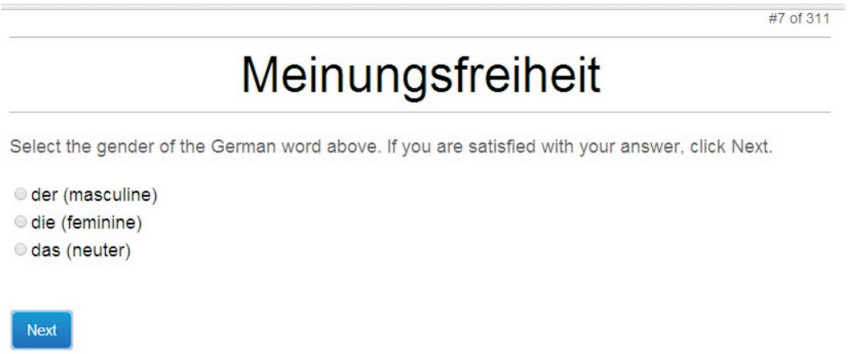


Figure 1. An example from the gender-assignment test.

Each item was presented one at a time. Participants were not able to return to any word after clicking the "Next" button to move on to the next word. After completing the entire set of 311 words, participants were presented with their results, as shown in figure 2, which provided them with information on which words they answered incorrectly, the correct gender of the word, their answers, and the frequency of the word.

**Items incorrectly classified:**

| Word | Gender | Attempt | Frequency | Cue |
|---|---|---|---|---|
| Motto | n | f | Medium | P1 monosyllabic ending in consonants, masculine |
| Panik | f | m | Medium | P8 /ik/ ending, feminine |
| Logik | f | n | Medium | P8 /ik/ ending, feminine |
| Republik | f | m | High | P8 /ik/ ending, feminine |
| Dogmatik | f | m | Low | P8 /ik/ ending, feminine |
| Mittel | n | f | High | exception to typical P3 /el/ ending, masculine |
| Besuch | m | n | High | No cue. |
| Thematik | f | m | Medium | P8 /ik/ ending, feminine |
| Klo | n | f | Low | P1 monosyllabic ending in consonants, masculine |
| Risiko | n | m | Medium | P1 monosyllabic ending in consonants, masculine |
| Name | m | f | High | exception to typical P1 monosyllabic ending in consonants, masculine |
| Kino | n | f | Medium | P1 monosyllabic ending in consonants, masculine |

Figure 2. Output upon completion of the gender assignment task.

In addition to word by word information, participants also received gender cue information. If a participant got more than four incorrect responses in a particular cue code, they received a message about that particular cue explaining the cue in further detail. Figure 3, below, provides an example of this feedback.

**Some notes on errors you commonly made:**

- P1 monosyllabic ending in consonants, masculine: Many German words that are only one syllable and end in consonants are masculine. As a word of this type becomes less frequent, it follows this pattern more and more (e.g. der Wirt). Very frequent words with this structure are less likely to be masculine (e.g. das Jahr).
- P8 /ik/ ending, feminine: Almost all words that end in –ik are feminine (e.g. die Panik, die Republik).

Figure 3. Example of cue feedback on participants' common errors.

### *Analysis*

Analysis of the data included both an investigation into differences between learners and also differences between and within certain cue codes. Descriptive statistics were run for participants, cues, frequency, and specific words in order to assess participants' knowledge and needs with regard to German gender.

## Results

This section presents the individual participant results first, followed by the results for specific cues, and finally frequency effects.

### *Individual Participants*

Participants (n=49) had quite varied results, with a mean raw score of 232.8 and a standard deviation of 40.9 on the 311 words. The large standard deviation for participants is noteworthy and will be highlighted in the discussion section in reference to the different levels of attainment among these graduates.

### *Words and Cues*

There was also a large amount of variation across the 311 test words. Out of a possible 49 attempts per word, the average correct gender assignments per word was 36.7 with a standard deviation of 9.1. Of the 311 words, 10 were correctly answered by all participants: *Herr* (mister), *Mann* (man), *Vater* (father), *Urgroßvater* (great grandfather), *Stelle* (place), *Hündin* (female dog), *Leserin* (female reader), *Arbeiterin* (female worker), *Arbeiter* (worker), and *Professor* (professor). The 10 least-known words, in reverse order of percent correct were *Salz* (salt) 24.5%, *Schachtel* (small box) 24.5%, *Übel* (evil) 28.6%, *Schönling* (pretty boy) 30.6%, *Gefahr* (danger) 30.6%, *Gesang* (singing)30.6%, *Kachel* (tile) 30.6%, *Silber* (silver)30.6%, *Geduld* (patience) 32.7%, and *Form* (form) 32.7%. The cues that these words represent may tell us much about what cues are more transparent than others and will be considered in more detail in the discussion section.

In addition to individual words, each cue was analyzed to test whether there was a difference in overall knowledge of specific cues to gender. The table in Appendix A shows the results for each cue based on the average scores for the words contained within each category. The results for individual cues varied from nearly perfect for cue S2 to nearly chance performance for cue M10 (chance in German gender assignment is 40%, based on the fact that 40% of German nouns are masculine).

### *Frequency Results*

In addition to the influence of cues, it was also of interest to see whether the overall frequency of the words also had an impact on participants' knowledge of a noun's gender. The following table outlines the number of high, medium, and low frequency words along with the number and percent of correct responses from the total attempts.

Table 1. Word Scores, by Frequency

| *Frequency* | *Total Words* | *Correct* | *Total Possible* | *Correct* |
|---|---|---|---|---|
| High | 131 | 5044 | 6419 | 78% |
| Medium | 85 | 2784 | 4116 | 67% |
| Low | 96 | 3578 | 4704 | 76.7% |

A Chi-squared analysis for goodness of fit revealed a significant difference ($\chi^2 = 246.86$, $df = 2$, $p < .0001$) between performance on high-, low-, and medium-frequency words. The data indicate that there was a significantly lower performance on medium-frequency words than on high- and low-frequency words. One possible reason that medium-frequency words were more frequently incorrect than high- or low-frequency words will be discussed in the next section.

## Discussion

This study examined the factors impacting knowledge of German gender by students graduating with a degree in German. The three factors considered were gender cues, type and token frequency, and overall levels of learner accuracy.

### *Gender Cues*

The results revealed marked differences in learners' control of the various cues. The cues that were most often correct were those that offered information about the natural gender of the noun. Of the ten most correctly assigned nouns, only one (*Stelle*) does not fall into the category of matching biological and grammatical gender. With regard to the most frequently utilized cues, the top three (S1, biological masculine gender; M10, /-in/ ending for feminine professions; and S2, biological feminine gender) also display a match between biological and grammatical gender. From this evidence, it is highly likely that conceptions of biological gender are a prominent factor in both attention to and memory of word genders. The semantic value of these cues may make both their interpretation and recall more salient for German learners who do not have a grammatical gender system in their L1. The results of this type of gender transfer are evident from studies conducted by Sabourin (2001) and Sabourin et al. (2006), which showed that the learning of grammatical gender in an L2 was easier for those participants whose L1 also had a grammatical gender system. This was the case even if the gender of the word in the L1 and L2 did not match and if the gender systems had a different number of genders, e.g., L1 Dutch learners of German go from a two gender system to a three gender system. They also found that the closer the gender systems were in terms of their function within the language, the easier it was for those learners. The evidence presented in this study corresponds to that notion of gender transfer. Where the natural and grammatical gender cues overlap, there is a higher likelihood of remembering the gender of the noun. On the other hand, those cues that provide only grammatical gender without reference to natural gender may be less likely to be noticed or processed.

Although the transfer of natural gender is to be expected, remaining patterns in the results provide a more refined perspective into what these learners know and where they still need assistance. For instance, it seems clear that certain cues are either easier to pick up or are more often taught than others. Compare the least correctly used cue, the word-final *-ling* masculine cue (which was used correctly only 41.6% of the time) to the similar, but more often identified word-final feminine *-keit* cue, which was correct 93.4% of the time. Both cues assign their respective genders to the noun 100% of the time, so both are extremely reliable. So why is one identified so easily and the other not? One possibility is that the *-keit* ending is much more frequent than the *-ling* ending, both in terms of types and tokens. As a result, this ending may receive more focus in instruction, compared to the less frequent *-ling* ending.

Despite the fact that a number of these cues identify the correct gender of a noun 100% of the time (*-ling, -mus, -ich, -ist, -lein, -ik, -schaft, -tion, -chen, -tät, -heit, -keit, -ei, -ie, -schaft*, directions, types of weather, months, and seasons), in many cases, these advanced learners are simply unaware that the cue exists or are unsure of the reliability of the cue. With regard to cue knowledge, it seems that there is much we can do to help advanced L2 German learners by teaching these cues explicitly.

### *Type and Token Frequency*

In relation to the effects of type and token frequency on gender assignment, the results indicate that there are significantly fewer correct medium-frequency words than high- or low-frequency words. This interesting pattern is the result of the confluence of two factors. The first factor is that recall of the gender of high frequency words is supported by frequent repeated exposure. However, for words of lower frequency, a second factor applies: the impact of Zipf's law on regularity. Zipf's law states that,

> Frequency counts of phonemes, morphemes, and words in samples of written discourse in diverse languages are presented in support of the generalization that the more complex any speech element, the less frequently does it occur. Thus, the greater the frequency of occurrence of words, the less tends to be their average length, and the smaller also is the number of different words (1935).

In other words, frequency is the driving force that causes highly-frequent word to be able to maintain irregular patterns and less frequent words to be more likely to follow a regular pattern. This has been shown for a number of patterns in language, and can also be seen in the word list used in this study. Looking at each cue, it is clear that the majority of irregular gender markings occur when a word has a high frequency. Fewer irregular words appear in the medium frequency group, and almost none appear in the low-frequency group.

For language learners of any age, Zipf's law is important for understanding language development, but this effect may be even more visible for adult learners of a foreign language. For low-frequency words, learners can rely heavily on cues, and for high-frequency words, their frequent occurrence in language use can provide useful repetition for leaners. But for words that appear in the middle of the frequency curve, learners may not have had enough repeated exposure to or use of these words in comparison to the high-frequency words. In addition, they are more likely to be irregular than low-frequency words. For adult learners of a foreign language, then, linguistic patterns that are subject to Zipf's power law may be especially difficult in medium-frequency words. If the effect of Zipf's law on language learning is that medium-frequency words are more difficult with regard to a given linguistic pattern, this could have serious implications for SLA. For example, proficiency tests could use this information to better differentiate between learners at different levels, courses and materials could be leveraged to make the best use of the effect of frequency, and results could provide further evidence that the combination of cue reliability and word frequency are important factors in the learning process. Although this evidence matches some previous work on grammatical gender learning (Delisle, 1985; Frigo & MacDonald, 1998; Kempe & MacWhinney, 1998, 1999), a more extensive investigation of Zipf's law and second language learning may be in order.

### *Learner Accuracy Levels*

Finally, it is important to examine the results in terms of learners' overall accuracy levels to identify what needs are present for each level of gender knowledge. For the lowest group, it seems clear that explicit information about more cues and their reliability could make a big impact. Because their scores are so low in so many different cue areas and some are barely scoring above chance (40%, if all responses are "masculine"), it is not possible to determine one specific area of trouble. Proficiency in the language may have an impact as well, but because of the nature of data collection, this is only speculation. For the large middle group, results were similar. The above section discussing the cue results bears more fruit in terms of

understanding the results, as participants in this grouping displayed a wide and varied range of grammatical gender knowledge.

There was a clear demarcation between the top four participants and the rest of the participants. For these four participants, there were only 41 total errors. For these participants, there were still some cues and words that seemed to be more difficult than others. Of all 33 cues, errors ocucurred in only made 15 of the cue categories. Interestingly, the phonetic cues seemed to be giving these learners more trouble than the morphological or semantic categories, where 7 of the 15 cue categories that contained errors were phonetic compared to the 4 categories in morphology and semantics. This evidence suggests that adult language learners do not make as ready use of the phonological cues available to them as is the case with child learners of either an L1 or L2 (Frigo & MacDonald, 1998; Szagun et al., 2007). Of the total 41 errors, 7 contained morphological cues, 23 contained phonological cues, and 12 contained semantic cues. Of the seven morphological errors, all but one had a morphological cue that was a miscue (i.e., the *-en* ending in *Ofen* is not a morphological ending, but has the same form ) or had a conflicting cue (e.g., *das Gewerbe* has both the initial *Ge-* cue for neuter and the word final *-e* cue for feminine). This evidence points to the significance that cue strength and cue competition plays in L2 learning, as well as how cues to gender are attended to and utilized differently in an L2.

For the errors that fell into the phonological cues, there were two prominent categories that stood out; the word-final *-el* masculine cue (7/41 total errors) and the monosyllabic final consonant cue (8/41). These two cues accounted for over half (15/23) of the total errors on words with phonological cues. This is significant because both cues are fairly unreliable, and several of the test items were exceptions to the cue. These data strengthen the argument that cue strength plays an integral part in L2 learning.

Finally, for the errors on words containing a semantic cue (12/41), the majority (8/11) fell into the single category of alcoholic beverages. One possible reason for the large number of errors in this category could be a possible conflation with another cue not examined in this study: the tendency to assign loan words to neuter gender. Delisle (1985) found that learners tended to classify loan words as neuter even if another cue was present. Because a number of the alcoholic beverage names appear to be loan words, e.g., *Whiskey, Gin, Wodka*, the neuter gender cue for foreign words may be outcompeting the semantic cue for alcohol. Either these learners are unaware of the masculine alcohol cue, or they do not understand that, when it competes with other cues, it typically wins out. It seems highly likely that a simply stated explicit guideline that all alcoholic beverages are masculine except for beer could easily correct these mistakes. From the errors made by these top performers, it is still evident that they have room for improvement in both learning more about cues to gender and how those cues compete in gender assignment.

## Conclusions

This study examined the control of cues to nominal gender assignment by advanced learners of German. The results indicated that the majority of these learners had not attained complete control over even highly reliable cues. These gaps in learning mirror patterns in gender assignment cues, including lower reliability for cues in the medium frequency range and conflicts between competing cues. Although children are able to make use of these cues from the youngest ages (MacWhinney, 1978), adult L2 learners appear to notice only the most frequent cues, particularly those involving biological gender. Explicit, systematic instruction (Presson, MacWhinney, & Tokowicz, 2012) may be necessary to help students notice and use these cues. Kraiss' (2014) study is one example of how to explicitly instruct cues, and from his

findings, students who received explicit instruction in the procedural, hierarchical model did achieve higher accuracy with gender assignment. Thus, without explicit instruction and help, it seems unlikely that a learner of German will discover all the cues on their own, especially since the most frequently used words tend to be the exceptions to the pattern.

While this study adds to our understanding of how learners deal with cues and the type of attainment they reach upon graduation, this study was limited in its ability to understand the impact of instruction and experience on these learners because of the restrictions regarding the collection of demographic data from participants. Further studies are needed to highlight the link between cue learning and instructional techniques. As this study's aim was to develop a picture of what our graduating German majors know about cues, there are a number of questions that still need to be investigated. Because of the large range in accuracy among participants, we need to investigate which instructional methods help learners become aware of these cues. In relation to the language learning process, how can awareness of these cues aid in the learning of new vocabulary? Further research in this area is also necessary to understand whether knowledge of these cues can enhance online processing and production. In sum, this study has shown that even our graduating majors still struggle with grammatical gender in German. As educators, we need to look for ways to make all of our students successful learners of this integral part of the German language.

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## Appendix A. Gender Cue by Mean Score

| Table. Gender Cue, by Mean Score | | | | |
|---|---|---|---|---|
| *Cue Code* | *Cue Definition* | *Number Correct* | *Total Possible* | *Mean* |
| M10 | -ling | 102 | 245 | 0.416 |
| P13 | -mus | 140 | 294 | 0.476 |
| S4 | mineral | 135 | 245 | 0.551 |
| P3 | -el | 588 | 1029 | 0.571 |
| P5 | -nis | 28 | 49 | 0.571 |
| S7 | hot drink | 84 | 147 | 0.571 |
| S5 | alcohol | 268 | 441 | 0.608 |
| P12 | -ich | 182 | 294 | 0.619 |
| M4 | Ge- | 785 | 1225 | 0.641 |
| P0 | none | 257 | 392 | 0.656 |
| P7 | -tum | 162 | 245 | 0.661 |
| P4 | -ist | 66 | 98 | 0.673 |
| M11 | -lein | 135 | 196 | 0.689 |
| P8 | -ik | 310 | 441 | 0.703 |
| P2 | -e | 1961 | 2744 | 0.715 |
| M1 | -en verb to noun | 249 | 343 | 0.7256 |
| P10 | -o | 333 | 441 | 0.755 |
| S9 | direction | 189 | 245 | 0.771 |
| S6 | weather | 267 | 343 | 0.778 |
| M6 | -schaft | 158 | 196 | 0.806 |
| S8 | seasons | 198 | 245 | 0.808 |
| S3 | months | 238 | 294 | 0.810 |
| P11 | -tion | 585 | 686 | 0.853 |
| P1 | monosyllabic ending in consonant | 503 | 588 | 0.855 |
| M8 | -chen | 262 | 294 | 0.891 |
| M5 | -er | 787 | 882 | 0.892 |
| P9 | -tät | 219 | 245 | 0.894 |
| M2 | -ung | 450 | 490 | 0.918 |
| P6 | -ie/ei | 360 | 392 | 0.918 |
| M7 | -heit | 136 | 147 | 0.925 |

| | | | | |
|---|---|---|---|---|
| M3 | -keit | 183 | 196 | 0.934 |
| S1 | male natural gender | 375 | 392 | 0.957 |
| M9 | -in, female occupation | 426 | 441 | 0.966 |
| S2 | female natural gender | 238 | 245 | 0.971 |

## Appendix B. Cue Codes and Definitions

P= phonological, S=semantic, M=morphological,
if there is an x, then the word does not follow the cue, e.g. P1x

| | |
|---|---|
| P0 | no discernible cue |
| P1 | monosyllabic ending in consonants, masculine |
| P2 | dualsyllabic ending in /e/, feminine |
| P3 | /el/ ending, masculine |
| P4 | /ist/ ending, masculine |
| P5 | /nis/ ending, neuter |
| P6 | /ie/ or /ei/ ending, feminine |
| P7 | /tum/ ending, neuter |
| P8 | /ik/ ending, feminine |
| P9 | /taet/ ending, feminine |
| P10 | /o/ ending, neuter |
| P11 | /tion/ ending, feminine |
| P12 | /ich/ ending, masculine |
| P13 | /mus/ ending, masculine |
| S1 | masculine natural gender |
| S2 | female natural gender |
| S3 | months, masculine |
| S4 | minerals, masculine |
| S5 | alcohol, masculine |
| S6 | weather, masculine |
| S7 | hot drinks, masculine |
| S8 | seasons, masculine |
| S9 | cardinal directions and winds, masculine |
| M1 | /en/ ending, verb to noun, neuter |
| M2 | /ung/ ending, feminine |
| M3 | /keit/ ending, feminine |
| M4 | /Ge/ beginning, neuter |
| M5 | /er/ ending, masculine |
| M6 | /schaft/ ending, feminine |
| M7 | /heit/ ending, feminine |
| M8 | /chen/ ending, neuter |
| M9 | /in/ ending, feminine |
| M10 | /ling/ ending, masculine |
| M11 | /lein/ ending, neuter |

## Appendix C. Word List and Genders

| | | | |
|---|---|---|---|
| M1 | Leben | n | High |
| M1 | Kapitalverbrechen | n | Low |
| M1 | Nimmerwiedersehen | n | Low |
| M1 | Skilaufen | n | Low |
| M1 | Sodbrennen | n | Low |
| M1 | Andenken | n | Medium |
| M1 | Versprechen | n | Medium |
| M10 | Flüchtling | m | High |
| M10 | Schönling | m | Low |
| M10 | Weichling | m | Low |
| M10 | Häftling | m | Medium |
| M10 | Sterling | m | Medium |
| M11 | Bändlein | n | Low |
| M11 | Sprüchlein | n | Low |
| M11 | Stämmlein | n | Low |
| M11 | Würmlein | n | Low |
| M2 | Bevölkerung | f | High |
| M2 | Beziehung | f | High |
| M2 | Entscheidung | f | High |
| M2 | Entwicklung | f | High |
| M2 | Meinung | f | High |
| M2 | Regierung | f | High |
| M2 | Grundbedingung | f | Low |
| M2 | Kompromisslösung | f | Low |
| M2 | Reifeprüfung | f | Low |
| M2 | Umweltverschmutzung | f | Low |
| M3 | Möglichkeit | f | High |
| M3 | Gleichmässigkeit | f | Low |
| M3 | Mächtigkeit | f | Low |
| M3 | Unbeweglichkeit | f | Low |
| M4 | Gebiet | n | High |
| M4 | Gesetz | n | High |
| M4 | Gespräch | n | High |
| M4 | Gebäck | n | Low |
| M4 | Gedröhn | n | Low |
| M4 | Geheul | n | Low |
| M4 | Gelenk | n | Low |
| M4 | Gemüt | n | Medium |
| M4 | Gepäck | n | Medium |
| M4 | Geschlecht | n | Medium |
| M4 | Gestein | n | Medium |
| M4 | Getränk | n | Medium |
| M4 | Gewand | n | Medium |
| M4 | Gewitter | n | Medium |
| M4, Px | Gebäude | n | High |
| M4, Px | Gebirge | n | Medium |
| M4, Px | Gehäuse | n | Medium |
| M4, Px | Geschrei | n | Medium |
| M4, Px | Gewerbe | n | Medium |
| M4x | Gefahr | f | High |
| M4x | Gewalt | f | High |
| M4x | Geduld | f | Medium |
| M4x | Gesang | m | Medium |
| M4x, M2 | Gewährung | f | Medium |
| M4x, M7 | Geschlossenheit | f | Medium |
| M5 | Arbeiter | m | High |
| M5 | Autor | m | High |
| M5 | Minister | m | High |
| M5 | Professor | m | High |
| M5 | Fernseher | m | Low |
| M5 | Grenzgänger | m | Low |
| M5 | Helfershelfer | m | Low |
| M5 | Klempner | m | Low |
| M5 | Reisebegleiter | m | Low |
| M5 | Reiseführer | m | Low |
| M5 | Schleicher | m | Low |
| M5 | Vektor | m | Low |
| M5 | Computer | m | Medium |
| M5 | Kater | m | Medium |
| M5 | Ritter | m | Medium |
| M5x | Fenster | n | High |
| M5x | Wetter | n | High |
| M5x | Zimmer | n | High |
| M6 | Wissenschaft | f | High |
| M6 | Liegenschaft | f | Low |
| M6 | Reisegesellschaft | f | Low |
| M6, M4x | Gesellschaft | f | High |
| M7 | Freiheit | f | High |
| M7 | Meinungsfreiheit | f | Low |
| M7 | Schlauheit | f | Low |
| M8 | Madchen | n | High |
| M8 | Kerlchen | n | Low |
| M8 | Meerschweinchen | n | Low |
| M8 | Ständchen | n | Low |
| M8 | Veilchen | n | Low |
| M8 | Wülstchen | n | Low |
| M9 | Hündin | f | Low |
| M9 | Inhaberin | f | Low |
| M9 | Leserin | f | Low |
| M9 | Stotterin | f | Low |
| M9 | Urenkelin | f | Low |
| M9 | Arbeiterin | f | Medium |
| M9 | Köchin | f | Medium |
| M9 | Kellnerin | f | Medium |
| M9 | Wirtin | f | Medium |
| P0 | Arbeit | f | High |
| P0 | Besuch | n | High |
| P0 | Erfolg | m | High |
| P0 | Monat | m | High |
| P0 | Prozent | m | High |
| P0 | Zukunft | f | High |
| P0 | Zucker | m | Low |
| P0 | Ofen | m | Medium |
| P1 | Aufgabe | f | High |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| P1 | Frage | f | High | P2 | Mensch | m | High |
| P1 | Lage | f | High | P2 | Plan | m | High |
| P1 | Sache | f | High | P2 | Punkt | m | High |
| P1 | Seite | f | High | P2 | Satz | m | High |
| P1 | Stelle | f | High | P2 | Schritt | m | High |
| P1 | Strasse | f | High | P2 | Sinn | m | High |
| P1 | Stunde | f | High | P2 | Staat | m | High |
| P1 | Woche | f | High | P2 | Stein | m | High |
| P1 | Halskette | f | Low | P2 | Tag | m | High |
| P1 x | Auge | n | High | P2 | Tod | m | High |
| P1 x | Ende | n | High | P2 | Weg | m | High |
| P1 x | Name | m | High | P2 | Werk | m | High |
| P10 | Auto | n | High | P2 | Wunsch | m | High |
| P10 | Radio | n | High | P2 | Trimm | m | Low |
| P10 | Tempo | n | High | P2 | Waid | m | Low |
| P10 | Klo | n | Low | P2 | Wirz | m | Low |
| P10 | Kilo | n | Medium | P2 | Rock | m | Medium |
| P10 | Kino | n | Medium | P2 | Salz | n | Medium |
| P10 | Motto | n | Medium | P2 | Schach | m | Medium |
| P10 | Risiko | n | Medium | P2 | Scherz | m | Medium |
| P10 | Veto | n | Medium | P2 | Schluck | m | Medium |
| P11 | Opposition | f | High | P2 | Schwanz | m | Medium |
| P11 | Imitation | f | Low | P2 | Stab | m | Medium |
| P11 | Implikation | f | Low | P2 | Topf | m | Medium |
| P11 | Intuition | f | Low | P2 | Zoll | m | Medium |
| P11 | Kernreaktion | f | Low | P2x | Art | f | High |
| P11 | Konfusion | f | Low | P2x | Bild | n | High |
| P11 | Modifikation | f | Low | P2x | Ding | n | High |
| P11 | Novemberrevolution | f | Low | P2x | Form | f | High |
| P11 | Perfektion | f | Low | P2x | Geld | n | High |
| P11 | Reorganisation | f | Low | P2x | Haus | n | High |
| P11 | Strangulation | f | Low | P2x | Jahr | n | High |
| P11 | Stratifikation | f | Low | P2x | Kind | n | High |
| P11 | Umorganisation | f | Low | P2x | Kraft | f | High |
| P11 | Kalkulation | f | Medium | P2x | Land | n | High |
| P12 | Querstrich | m | Low | P2x | Macht | f | High |
| P12 | Rippenstich | m | Low | P2x | Stück | n | High |
| P12 | Sittich | m | Low | P2x | Stadt | f | High |
| P12 | Torfstich | m | Low | P2x | Tier | n | High |
| P12 | Rettich | m | Medium | P2x | Uhr | f | High |
| P12 | Stich | m | Medium | P2x | Wahl | f | High |
| P13 | Imperialismus | m | High | P2x | Welt | f | High |
| P13 | Sozialismus | m | High | P2x | Wort | n | High |
| P13 | Alpinismus | m | Low | P2x | Zahl | f | High |
| P13 | Nihilismus | m | Low | P2x | Zeit | f | High |
| P13 | Symbolismus | m | Low | P2x | Ziel | n | High |
| P13 | Optimismus | m | Medium | P2x | Bar | f | Medium |
| P2 | Ball | m | High | P2x | Rohr | n | Medium |
| P2 | Blick | m | High | P2x | Wurst | f | Medium |
| P2 | Brief | m | High | P3 | Artikel | m | High |
| P2 | Grund | m | High | P3 | Spiegel | m | High |
| P2 | Kampf | m | High | P3 | Giebel | m | Low |
| P2 | Kopf | m | High | P3 | Kleiderbügel | m | Low |
| P2 | Krieg | m | High | P3 | Kochlöffel | m | Low |

| | | | |
|---|---|---|---|
| P3 | Lockvogel | m | Low |
| P3 | Schlägel | m | Low |
| P3 | Urenkel | m | Low |
| P3 | Wirtel | m | Low |
| P3 | Apfel | m | Medium |
| P3 | Bummel | m | Medium |
| P3 | Gürtel | m | Medium |
| P3 | Kittel | m | Medium |
| P3 | Klingel | m | Medium |
| P3 | Nagel | m | Medium |
| P3 | Sattel | m | Medium |
| P3 | Speichel | m | Medium |
| P3x | Mittel | n | High |
| P3x | Kachel | f | Low |
| P3x | Übel | n | Medium |
| P3x | Schachtel | f | Medium |
| P4 | Impressionist | m | Low |
| P4 | Synkretist | m | Low |
| P5 | Verhältnis | n | High |
| P6 | Partei | f | High |
| P6 | Polizei | f | High |
| P6 | Monographie | f | Low |
| P6 | Reiterei | f | Low |
| P6 | Synergie | f | Low |
| P6 | Brauerei | f | Medium |
| P6 | Ironie | f | Medium |
| P6 | Tragödie | f | Medium |
| P7 | Wachstum | n | High |
| P7 | Skriptum | n | Low |
| P7 | Urchristentum | n | Low |
| P7 | Yankeetum | n | Low |
| P7 | Faktum | n | Medium |
| P8 | Bundesrepublik | f | High |
| P8 | Republik | f | High |
| P8 | Dogmatik | f | Low |
| P8 | Hektik | f | Low |
| P8 | Synonymik | f | Low |
| P8 | Grammatik | f | Medium |
| P8 | Logik | f | Medium |
| P8 | Panik | f | Medium |
| P8 | Thematik | f | Medium |
| P9 | Aktivität | f | High |
| P9 | Universität | f | High |
| P9 | Zelebrität | f | Low |
| P9 | Intensität | f | Medium |
| P9 | Souveränität | f | Medium |
| S1 | Herr | m | High |
| S1 | Mann | m | High |
| S1 | Präsident | m | High |
| S1 | Vater | m | High |
| S1 | Marineoffizier | m | Low |
| S1 | Urgrossvater | m | Low |
| S1 | Opa | m | Medium |
| S1 | Prophet | m | Medium |
| S2 | Frau | f | High |
| S2 | Schwester | f | High |
| S2 | Tochter | f | High |
| S2 | Krankenschwester | f | Medium |
| S2 | Schwiegermutter | f | Medium |
| S3 | Februar | m | High |
| S3 | Januar | m | High |
| S3 | Juli | m | High |
| S3 | Juni | m | High |
| S3 | März | m | High |
| S3 | Mai | m | High |
| S4 | Rubin | m | Low |
| S4 | Diamant | m | Medium |
| S4 | Silber | m | Medium |
| S4x | Gold | n | High |
| S4x | Aluminium | n | Medium |
| S5 | Rum | m | Low |
| S5 | Whiskey | m | Low |
| S5 | Alkohol | m | Medium |
| S5 | Gin | m | Medium |
| S5 | Rotwein | m | Medium |
| S5 | Schnaps | m | Medium |
| S5 | Wodka | m | Medium |
| S5 | Liquor | m | S |
| S5x | Bier | n | High |
| S6 | Regen | m | High |
| S6 | Schnee | m | High |
| S6 | Sturm | m | High |
| S6 | Wind | m | High |
| S6 | Blitz | m | Medium |
| S6 | Donner | m | Medium |
| S6 | Nebel | m | Medium |
| S7 | Kaffee | m | High |
| S7 | Malzkaffee | m | Low |
| S7 | Tee | m | Medium |
| S8 | Frühling | m | High |
| S8 | Herbst | m | High |
| S8 | Sommer | m | High |
| S8 | Winter | m | High |
| S8 | Spätherbst | m | Low |
| S9 | Nord | m | High |
| S9 | Ost | m | High |
| S9 | Süd | m | High |
| S9 | West | m | High |
| S9 | Föhn | m | Low |