

Physical manifestations of ungrammaticality

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B.A., University of Zurich, 2020

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF ARTS

Department of Modern Languages
College of Arts and Sciences

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2023

Approved by:

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Abstract

This study investigates the processing and perception of German gender agreement by non-native speakers. Specifically, this study seeks to gather information on physical discomfort felt by non-native speakers when confronted with violations in gender agreement in German. The variables examined are the frequency of the lexical items (high or low frequency), modality (reading silently versus out loud), and grammaticality (correct or incorrect). The results suggest that L2 German learners at an intermediate proficiency level can experience physical discomfort when confronted with ungrammatical language like native speakers. Furthermore, the data suggests that non-native speakers are more likely to notice violations in gender agreement when speaking out loud, and that the physical discomfort is stronger with more familiar lexical items. The data from this study is the first of its kind, offering insight into how language modality affects grammaticality judgments in the second language. With less frequent lexical terms participants expressed another sense of discomfort related to uncertainty. This feeling presented itself differently from the physical discomfort felt when confronted with violations of gender agreement.

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Introduction

The German determiner system poses a unique challenge for L2 learners in that determiners must agree with their respective noun depending on case (nominative, accusative, dative, genitive), number (singular, plural), and gender (masculine, neuter, feminine). Achieving accuracy with determiner-noun agreement is especially difficult for learners whose first language does not have these linguistic traits such as English. For instance, the English word *the* has 16 equivalents in German, each communicating distinct grammatical information.

Case and number follow strict rules and are needed to communicate meaning. Inaccuracies in article agreement due to violations of case or number can lead to subject verb disagreements or confusion as to the relation between subject, direct, and indirect object, resulting in breakdowns in communication. Traditional instruction focuses on memorizing these rules. And having strict rules with little to no exceptions can help to reach accuracy in agreement based on those linguistic traits in a reasonable timeframe through memorization and explicit instruction focusing on communicative qualities (Liamkina & Ryshina-Pankova, 2012). So, while acquiring the structures for case and number is not easy, they do follow logic. A limited set of rules makes those structures attainable through study.

Assignment of grammatical gender to nouns, however, is usually described as an arbitrary, abstract property of nouns that is independent of the nouns meaning (Schriefers & Jescheniak, 1999; Lyons, 1968). The arbitrary nature makes grammatical gender, especially for English-speakers, whose language lacks this linguistic trait, one of the most frustrating and difficult aspects of learning a language that does have grammatical gender (Alarcón, 2011).

Traditional German instruction tries to alleviate this frustration by focusing on certain suffixes that can indicate a noun's grammatical gender (Steckelberg, 1937; Strong, 1979). To this day these strategies are used in German teaching and while there have been attempts to teach noun genders using communicative approaches, even advanced learners are prone to mistakes (Franchescina, 2005; Hopp, 2013). It seems that there have not been novelties to grammar instruction techniques for gender agreement that can alleviate the need for memorization.

This study proposes a potential avenue to support students in acquiring grammatical noun genders by focusing on acceptability judgements. It seeks to assess whether non-native speakers of German can acquire an underlying schema of language which allows them to sense violations of gender agreement when confronted with it. Specifically, this study is interested in the physical sensations speakers experience when encountering ungrammatical language.

Furthermore, the study gathers data on which factors affect a learner's ability to notice ungrammaticality in their L2. The parameters in question are (i) familiarity with the target lexical item and (ii) speech production. The data from this study could inform teachers and students on how language learners perceive and acquire gender agreement in their L2.

The data from this study could also inform new teaching methods for the acquisition of grammatical gender in German as well as other languages. Ideally, these methods could use underlying schema the learners acquire subconsciously when learning a second language and alleviate the need for extensive memorization.

Review of the Literature

Grammatical Gender in Language Acquisition

According to Irma Alarcón (2011) grammatical gender is one of the most frustrating aspects of second language acquisition for many learners. The reason for this can be found in one of the more cited definitions grammatical gender: “The first general point that must be made [about grammatical gender] is that the recognition of gender as a grammatical category is logically independent of any particular semantic association that might be established between the gender of a noun and the physical or other properties of the persons or objects denoted by that noun” (Lyons, 1968, p. 284). Because grammatical gender is arbitrary and independent of the words’ meaning, language learners are often under the impression that they must memorize each item with its article (Chew, 1989).

When it comes to gender agreement between articles, adjectives, and nouns many studies focus on how the availability of gender in the L1 impacts the acquisition and production of the L2 (Carroll, 1989; Franceschina, 2005; Hawkins and Franceschina, 2004; White et al., 2004). One commonly observed phenomenon is that having no grammatical gender in the L1 can negatively affect the accuracy in which the grammatical genders are produced in the L2: “The existing evidence supports the view that learners whose L1s encode gender outperform those whose L1s lack gender” (Dlugosz, 2022, p. 2). Having a system for grammatical gender in the L1 can help the L2 learner grasp the gender system of another language, even if the gender systems are different. This means that learners of German can benefit from knowing another Germanic language like Dutch or Polish or knowing a romance language like Italian, Spanish, or French. However, knowing only a language like English, with a simpler gender system without

gendered articles, is of no benefit to the learners and English speakers often struggle with this task (Montrul Foote & Perpiñan, 2008).

Nevertheless, it has been observed that the presence of gender in the L1 is not a prerequisite to achieve accurate gender agreement in the L2. Learners whose L1s lack gender agreement have shown to be able to have L1-like performance in processing gender agreement between articles, adjectives, and nouns (Tokowicz and MacWhinney, 2005; von Grebmer zu Wolfsturn et al., 2021). Therefore, it can be argued that native speakers of English who learn an L2 with grammatical gender are able to create a system for grammatical gender in the target language.

As might be expected, proficiency is shown to influence the accuracy of gender agreement in language learners (Alarcón, 2004). Having an increased accuracy with higher proficiency is not surprising, but there could be multiple reasons for this improvement. It may be that those who have a higher proficiency in the language tend to have more familiarity with and knowledge of a wider array of lexical items. But there is also some evidence that higher proficiency is tied to having a separate system for the L2 and a diminished need to constantly reference the L1 (Tulock & Ortega, 2017).

There are certain strategies that are commonly deployed when teaching grammatical gender to English-speaking language learners. Most center around a way to combat the above-mentioned arbitrariness. The most straightforward is to highlight the relation between semantic and grammatical information. It is common for languages to link grammatical gender to semantic information along the conceptual split of male/female. In these cases, grammatical gender is no longer abstract and can be called “semantic gender” or “natural gender” (Tight, 2006, p. 150). In German this can be observed in words such as shown in (1):

- (1) *der* *Mann*
 the_{MASC} man_{MASC}
- die* *Frau*
 the_{FEM} Woman_{FEM}

However, it is not as straightforward as these examples suggest, and most rules have their exceptions. In German for example the word for ‘girl’ does not follow the idea of semantic gender as shown in (2):

- (2) *das* *Mädchen*
 the_{NEUT} girl_{NEUT}

The semantic gender of *das Mädchen* is feminine but its grammatical gender is neuter showing the tenuous connection between semantic and grammatical gender.

The previous example also highlights another commonality when it comes to grammatical gender, the importance of morphological information. Example (2) demonstrates how grammatical gender can be governed by morphology over semantics. In German the suffix *-chen* serves as a diminutive and all words ending in *-chen* are neuter. Other examples of this phenomenon in German include *-ung*, *-tät*, *-heit*, and *-keit* to name a few (German words ending in these suffixes are always feminine).

These morphological patterns can also be described as phonological regularities which is why people often describe words as sounding like a certain grammatical gender (Bates et al., 1995). Memorizing these patterns can be useful for language learners but only to a certain extent because, while some suffixes do not have exceptions, many more do (Steckelberg, 1937; Strong, 1976). Words with the endings *-ung*, *-heit*, *-keit*, and *-tät* mentioned above are always feminine but words ending in *-e*, while feminine most of the time, have exceptions like: *der Affe*, *der Junge*, *das Auge* to name just a few.

Another example for a rule for German noun genders based on endings that can help students with accuracy are loanwords ending in *-o*. Most of these words are neuter but not all. See (3). While patterns can reduce the need for memorization to some extent, grammatical gender is ultimately arbitrary, and many scholars and German teachers agree that they have to be memorized. (Desrochers, et. al, 1991; Dias de Oliveira Santos, 2015; Strong, 1976.)

(3)	<i>das</i>	<i>Auto</i>
	the _{NEUT}	car _{NEUT}
	<i>das</i>	<i>Silo</i>
	the _{NEUT}	sil _{NEUT}
	<i>die</i>	<i>Avocado</i>
	the _{FEM}	avocado _{FEM}

This is true for non-native speakers who learn a foreign language later in life, but how does it work for native speakers? Native speakers of languages with gendered articles seem to have an innate ability to judge a noun’s grammatical gender (Bewer, 2004). Evidence from Spanish, French, and German research shows that monolingual children usually acquire near-perfect accuracy in gender agreement between articles and nouns by the age of 3 (Bewer, 2004; Cain, Weber-Olsen & Smith, 1987; Karmiloff Smith, 1978). In this timespan native speakers go through different phases and strategies: first they focus on individual words, gradually moving towards phonological and morphological procedures to match gender to noun endings and ultimately moving towards syntactical connections which allow for more flexibility (Karmiloff-Smith, 1978).

Alarcón (2009) found that there are certain similarities in how gender is processed between native Spanish speakers and English-speaking learners of Spanish. One thing that is similar in both groups is that L1 and L2 speakers are faster and more accurate in judging nouns

with a semantic or natural gender (Alarcón 2009). However, native speakers showed a much higher aptitude towards cues based on morphology and phonology than non-native speakers (Alarcón 2009). This suggests that semantic gender provides a logical connection that allows L2 speakers to process grammatical gender more readily. In the absence of semantic gender cues non-native speakers were not able to use morphological or phonological cues to help their language processing.

There is further research confirming the results discussed above. Hopp (2013, p.34) compares different L1s and L2s and concludes that adult learners of a second language “do not encode abstract syntactic gender features necessary for computing agreement relations unless these features are instantiated in the L1”¹. Other research suggests that L2 grammars do not differ from native grammars fundamentally and that differences in agreement stem from difficulties with lexical retrieval (Prévost & White, 2000). Sa-Leite et. al (2019, pp. 1166-1167) contrast these two main views of bilingual gender representation:

[There are essentially two perspectives:] the integrative versus the autonomous view. Whereas the first one supports an integrated gender system for both languages of the bilingual, and thus predicts cross-linguistic effects during grammatical encoding, the latter expects the opposite—that is, two separate gender systems that do not influence each other.

Both views are represented in the research on gender agreement in non-native speakers and there is supporting data for both. However, the exact languages that are examined does make a difference.

This study seeks to examine this issue for second language acquisition in German. Alarcón’s work focuses on second language acquisition of Spanish and while there are certainly similarities between the acquisition of Spanish and German for English-speaking learners there

¹ See also Hawkins, 2009; Hawkins and Casillas, 2008.

are also differences. For one, English and German evolved from the same Germanic language share certain phonological traits and process phonological information similarly (Goswami et. al, 2005).

When it comes to morphological cues though, English-speaker learners of German do not process them like native speakers (Günther et. al, 2019). There are certain behavioral differences and “[t]hese behavioural differences have been taken to indicate differential language processing and memory representations in these languages” (Günther et. al, 2019, p. 168). The question I am asking then is whether English-speaking learners of German may be able to acquire an underlying system which allows them to process gender agreement using phonological and morphological cues similar to native speakers.

Procedural and Declarative Knowledge

One consideration worth addressing for this study is the distinction between *procedural* and *declarative knowledge* used in cognitive linguistics. The *declarative memory* system focuses on memorizing and using the knowledge about facts and events and can be accessed consciously (Eichenbaum & Cohen, 2001; Mishkin et al., 1984; Squire & Knowlton, 2000). The *procedural memory* system then, focuses on subconscious knowledge, underlying structures and “the control of long established, motor and cognitive ‘skills’ and ‘habits,’ especially those involving sequences” (Ullman, 2006, p. 98).² These two types of memories align with the acquisition of gender agreement in the L2.

Declarative memory covers the traditional approach of memorizing suffix rules and their exceptions as well as learning each lexical item with its determiner. The *procedural memory* is acquired over time and leads towards a habitual memory that can help govern language

² see also: Mishkin et al., 1984; Squire & Knowlton, 2000; Willingham, 1998.

production. It must be mentioned that the formation of *procedural memory* declines with age and acquiring underlying structures in adulthood becomes more difficult but remains possible (Schacter & Tulving, 1994; Squire & Zola, 1996). Ullman (2006, p. 100) summarizes this point for L2 acquisition and claims that “practice should lead to procedural learning and improved performance. Thus, with sufficient experience with L2 the language should become L1-like in its grammatical dependence on the procedural system with the potential for a high-degree of proficiency.” In the context of the acquisition of grammatical gender in the L2 this suggests that advanced learners can develop and use *procedural memory* over *declarative memory*.

Input

One important theory on how these independent systems are formed is the input hypothesis by Stephen Krashen. Krashen claims that comprehensible input, exposure to samples of the target language that are just slightly above the level of the learner, is all that is needed for second language acquisition (1985). While nowadays most linguists criticize Krashen’s claims that comprehensible input is all that is needed, they generally agree “that input is *necessary*: without input, and without understanding the input, there is no acquisition” (Henshaw & Hawkins, 2022, p. 69). In other words, input is necessary alongside other factors like grammar instruction or studying vocabulary.

Another way to look at the role of input in conjunction with other factors for second language acquisition is to differentiate between language learning and language acquisition. Language acquisition usually refers to children acquiring their native language(s) from infancy (Nor & Rashid, 2016). Language acquisition thus has similarities to procedural memory and is based on acquiring underlying structures to build knowledge on. Language learning then usually refers to L2 acquisition beyond childhood and is relying more on memorization and using rules

to structure knowledge (Nor & Rashid, 2016). In that sense it is more closely related to declarative memory. This study seeks to combine these ideas and see if intermediate second language learners make use of their procedural memory in language acquisition.

Other research points towards this possibility. Through enough comprehensible input vocabulary, morphology, and syntax are acquired and ultimately learners can produce language that goes beyond the input (Ellis & Shintani 2014). Furthermore, there are claims that most language acquisition happens implicitly and not through explicit instruction (Ellis & Shintani 2014).

This seems particularly interesting when it comes to the previously discussed issue of native English speakers accurately producing gender agreement in languages like German. Speakers of languages without a system of grammatical gender need to create a new agreement feature when learning a language that has that feature. This study investigates whether English speaking learners of German can develop an instinctual sense, similar to native speakers, to help them with gender agreement between determiners, adjectives, and nouns.

Grammaticality Judgement Tasks

A popular method in L2 research concerning gender agreement are grammaticality judgement tasks. In L2 research there have been many studies using grammaticality judgement tasks to gather data on learners' accuracy and processing (Leow, 1996; Brown, 2020; Sabouring et al., 2006). In those studies, language learners are asked to judge whether samples of language are grammatically correct or acceptable. Grammaticality judgement tasks are usually designed in a way that the grammar violation is located in the same linguistic structure to test the participants' ability to notice ungrammaticality within a certain feature (Plonsky et al., 2020). One aspect that could indicate the possibility for a native-like approach to grammaticality

judgements in terms of gender agreement is the physical sensation of discomfort associated with ungrammatical language

There have been studies using intricate tools to gather data on language learners' physical reflexes while completing grammaticality judgement tasks, including eye-tracking (Klerke et al., 2015), reaction times (Bley-Vroman & Masterson, 1989), pupil dilation (Scherger et al., 2021), skin elasticity, and MRI scans (Wartenburger et al., 2003). However, to my knowledge there is no scholarly research done on the physical discomfort which often accompanies ungrammatical or grammatically unacceptable language. This study seeks to gather data on language learners' perceptions of ungrammaticality and acceptability and their physical sensations while conducting grammaticality judgement tasks.

Modality

Another aspect with lacking data in L2 research is the difference language production modality has on noticing errors. When it comes to noticing incorrect language, we must turn to another discipline than L2 that focuses more on applied techniques to help learners improve their language: writing center research. Writing centers at academic institutions across the globe are there to help learners with their writing skills and improve their clarity, structure, and accuracy in their language (North, 1984). One of the most prominent techniques used in writing centers is having the author read their work out loud and have them identify what needs to be improved. Studies on this technique have shown that in this process, writers often correct “essentially all errors of grammar, spelling, and, by intonation, punctuation” (Olson, 1984, p. 53). This suggests that reading out loud can help writers correct their mistakes.

Furthermore, with the increasing number of international students at universities, writing center research has become more interested in aiding students improve their writing in their

second language. Interestingly, the strategies for noticing errors remains the same and studies have shown that reading out loud also helps non-native speakers notice errors in their work (Severino & Illana-Mahiques, 2019). It remains to be seen whether non-native speakers of German are more likely to notice ungrammaticality in gender agreement when reading out loud versus reading silently.

L2 research on grammatical gender agreement has focused on how the L1 and the knowledge of its grammatical gender (or lack there of) affects the acquisition of grammatical gender in the L2, how adult L2 learners acquire underlying schema that help them produce the target language beyond the input they received, and how different modalities can affect learners ability to notice errors. Many studies in L2 research on gender agreement use grammaticality judgement tasks to gather data on learners' accuracy and processing (Leow, 1996; Brown, 2020; Sabouring et al., 2006). In those studies researchers have focused on the cognitive aspects and certain involuntary physical reactions but not on learners' perceptions of physical manifestations of ungrammaticality.

Methodology

This study contributes to the ongoing discourse on grammaticality judgements in the second language. Specifically, it was designed to answer the following questions: (i) Are non-native speakers of German able to acquire a language schema in their second language that help them identify violations of gender agreement? (ii) Are non-native speakers more likely to notice ungrammatical language when they speak out loud versus reading silently? (iii) Are there physical manifestations in non-native speakers' bodies when encountering ungrammatical language and if so, what are they like?

To answer these questions data collection took place in two parts: (1) a timed reading where participants were asked to decide whether sentences were grammatically correct and (2) an interview in which participants talked to the investigator about a selection of the sentences from part one and discuss their choices in more detail. In part one participants were asked to read an equal number of sentences silently in their head as well as out loud. Comparing the data between grammaticality judgements when reading silently and reading out loud could offer some insight into the physical aspects of language production and their connection to grammaticality judgements.

Grammaticality judgement tests like this are a common tool in linguistics studies that assess what language forms the speakers identify as 'grammatically correct' or 'acceptable' usage. In the discourse on grammaticality judgement tests the terms 'grammaticality' and 'acceptability' are often used interchangeably (Mackey & Gass, 2005). For the purposes of this study, however, these two terms are going to be used differently from one another.

Grammaticality refers to a more prescriptive idea of 'correctness' while acceptability refers to

whether an actual speaker believes something to be within the acceptable usage parameters and is thus more subjective and undefined.

This distinction is important for this study because the two parts of this experiment examine the intersection of these two ideas in the way that non-native speakers interpret language, how they make judgements, and how the subjective opinions on acceptability can affect the more prescriptive ideas of grammaticality. Part one, the timed reading, explicitly asks the participants to judge if a sentence is grammatical or not, with no room for differentiated answers. Part two, the interview, then allows participants to give more nuanced answers on how acceptable certain article-noun combinations are and rank their judgements on a scale from 1 to 5.

Participants

We recruited participants from the pool of undergraduate students currently enrolled in German classes at Kansas State University. To qualify, participants had to be non-native speakers of German and had to have passed at least one German class past the four-semester language sequence. The classes beyond the initial four-semester sequence do not focus on explicit language instruction. Rather they employ German as the medium of instruction to engage in discussion on culture, literature, and writing. At these class levels the course content is presented at an intermediate-high level according to the ACTFL proficiency guidelines and expectations for course engagement and participation are set at that level (ACTFL, 2012).

In total there were nine participants: four male, four female, and one non-binary. Participants were all native speakers of English with three having studied some Spanish. They reported their knowledge of Spanish to be minor. Six have completed more than 2 college level German classes past the four-semester language sequence. Six have spent time in a German

speaking country for more than 4 weeks, one has spent time in a German speaking country for less than a week, and two have not spent any time in a German speaking country. The participants were compensated with a \$15 gift card for their time.

Timed Reading

The timed reading, which made up part one of the experiment, was run on the open-source software *OpenSesame* (Mathôt & Theeuwes, 2012). The participants were asked to judge the grammaticality of twenty items. Out of the twenty items, twelve were ungrammatical with a violation of gender agreement between a definite article and a noun in the direct object position of the sentence. Since the participants were asked to judge each sentence twice it came to a total of forty grammaticality judgements, a number that allows us to observe trends without overtaxing participants' attention spans; Mackey and Gass (2005) recommend that this type of task include "no more than approximately 50 sentences" (p. 51). The items all followed the same structure of statement sentences with the word order of subject, verb, object. The ungrammaticality, if any, was always in the gender agreement of the articles and nouns in the second noun phrase of the sentence as illustrated in (4).

- (4) Das Mädchen hat *die rote Stift.
The_{Neut} girl_{Neut} has the_{Fem} red_{Fem} pen_{Masc}
The girl has the red pen.

For this sentence to demonstrate gender agreement, both the article and the adjective should appear in the masculine form to agree with the noun *Stift*. The second noun phrase also always contained an adjective to increase the distance between the article and the noun and to give more context to the sentence. In all items there was no ungrammaticality in noun phrases other than in the direct object position. And there was no ungrammaticality between articles and adjectives. The adjectives in the noun phrase agreed with the definite article. In the example

above, the adjective *rote* agrees with the article *die* but the article *die* and the adjective *rote* do not agree with the noun *Stift*.

The target items include seven masculine, seven neutral, and six feminine nouns. Furthermore, the items were chosen to include more frequently used nouns as well as less frequently used nouns. The high frequency target nouns in this study are: *Stift, Tisch, Hund, Bus, Katze, Pizza, Stadt, Haus, Fenster, and Kind* (pen, table, dog, bus, cat, city, house, window, and child), all of which are part of the first-semester vocabulary of the four-semester language sequence.

The lower frequency target nouns are: *Teppich, Ausbruch, Anhänger, Siegel, Kabinett, Unkraut, Fell, Saison, Avocado, Reibung* (carpet, outbreak, trailer, seal, cabinet, weed, fur, season, avocado, friction). The items *Teppich, Kabinett, and Avocado* relate to the topics of furniture as well as food items which are covered in the four-semester language sequence. Out of those words, only *Teppich* appears in the 5000 most frequently used German words (Tschirner & Mörner, 2020). Thus, it cannot be said with certainty that the participants are totally unfamiliar with these words, but the items are generally less frequently used.

The seven other examples are not explicitly included in the four-semester language sequence. The participants might have encountered the words in other contexts but most likely not with the same frequency as the high frequency ones. The difference between how word frequency affected participants' physical reactions to ungrammaticality will be discussed in the results section.

In addition, the items were chosen so that there were grammatically correct and grammatically incorrect items represented equally in sets A and B.³ In both sets, there were four

³ see appendix A

grammatically correct and six grammatically incorrect sentences. Thus, there was a total of twelve ungrammatical and eight grammatical sentences. The twelve ungrammatical sentences had an equal ratio of four sentences per grammatical gender. The ratio is in favor of the grammatically incorrect sentences because the study is mainly interested in the data related to encountering ungrammaticality. The grammatically correct examples are there to serve as a point of comparison.

Lastly, all 20 items were nouns without relation between semantic and grammatical gender. By avoiding semantic gender, the participants grammaticality judgements had to be based on familiarity with the vocabulary words or morphological or phonological cues.

Interview

The second part of the experiment was an interview. In the interview the participants read twelve of the 20 items again out loud and rated them on how comfortable they feel when pronouncing the sentences out loud.⁴ The sentences were chosen to include items that fit the criteria as seen in table (1).

Table 1: Make up of items chosen for further discussion in the interview

high frequency grammatical	<i>Hund</i>	<i>Haus</i>	<i>Stadt</i>
high frequency ungrammatical	<i>Tisch</i>	<i>Kind</i>	<i>Pizza</i>
low frequency grammatical	<i>Anhänger</i>	<i>Unkraut</i>	<i>Reibung</i>
low frequency ungrammatical	<i>Ausbruch</i>	<i>Kabinett</i>	<i>Avocado</i>

Procedures

Participants were tested individually. Sessions started with a standardized explanation of directions to the participants. The explicit instructions for the timed reading were all delivered

⁴ see appendix C

via the computer screen in English. The participants were also asked to read either silently in their head or out loud at different stages of the timed reading and decide whether the sentences were grammatical or not. During this stage, the participants are unaware of the type of potential ungrammaticality or its location within the sentence.

Before the experiment started there was a practice section with six items designed to familiarize the participants with program, when they should read silently or out loud, and how to enter their answers. The software was run on a laptop and the participants used two slightly modified keys on the laptop keyboard to enter their answers. The keys in question were the “s” key towards the left of the keyboard, which had a red dot stuck to it, and the “l” key towards the right of the keyboard, which had a green dot stuck to it. If the participants thought the sentence was grammatically incorrect, they were asked to press the red button on the left and if the participants thought the sentence to be grammatically correct, they were asked to press the green button on the right.

The timed reading was split into two parts. In part one, participants were asked first to read ten sentences (set: A)⁵ quietly in their head and judge whether they are grammatical or not. Then they were asked to read another ten sentences (set: B)⁶ out loud and judge them in the same way. After they judged all 20 items there was a short break for the investigator to save the data and the participants to fill out a questionnaire about their language learning background.⁷ After that the participants returned to the computer screen for the second timed reading.

In this part the participants were asked to do the same thing again but this time the sentences were inverted. The sentences from set B, which were read out loud in part one, were

⁵ see appendix A

⁶ Ibid.

⁷ see appendix B

now being read silently. Set A, which was read silently in part one, was read out loud in part two. In total there were 20 items the participants were asked to judge on their grammaticality. Since every item was judged twice there is a total of 40 data points on timed readings.

After another short break in which the investigator saved the data, there was an interview. In this part the investigator focused more on the physical discomfort felt by the participants. The participants were asked to rate 12 of the 20 sentences on a scale from one to five on how comfortable – or how uncomfortable – they felt when reading the sentences out loud again, one being very comfortable and five being very uncomfortable.

If the participants described discomfort accompanying the speech production the investigator asked the following follow-up questions: (1) Where in your body are you feeling the discomfort? (2) Is the discomfort tied to being unsure / are you not sure if this example is grammatical? (3) Can you repeat the sentence but use the other possible options for the gendered articles and compare if the discomfort is higher or lower?

Analysis

The data analysis focused on two major aspects: (1) the quantitative data from the timed readings using *OpenSesame* and (2) the qualitative data from the interviews. The data from the timed readings was used to answer research questions one and two: whether non-native speakers of German are able to develop an instinctual sense to help them notice violations of gender agreement and whether they are more likely to do so when reading out loud. The interview offered insight into answering research question three: how does ungrammaticality manifest itself in non-native speakers' bodies? Bringing the two datasets together bridges the gap between grammaticality and acceptability judgments.

The data from the timed readings was coded according to the following parameters: (i) response times, (ii) accuracy in grammaticality judgements, (iii) noun gender, (iv) high and low frequency nouns, (v) reading modality. Using these parameters to compare the data offers insight into how frequency, as it relates to Krashen's input hypotheses, and physical language production affect grammaticality judgements in second language learners (1985).

First and foremost were the response times. It is of little use to compare the average response times between reading silently and out loud because reading out loud naturally takes longer due to the additional need of speech production. However, the data on response times between high frequency and low frequency nouns could offer some insight into how familiarity could affect grammaticality judgements.

Second is a comparison between the accuracy in grammaticality judgements between the two modalities: reading silently versus out loud. Of particular interest here are self-corrections, specifically, instances where participants' answers differ when reading silently as opposed to out loud. This could offer some insight if non-native speakers are more likely to pick up on ungrammaticality when speaking out loud versus only thinking in their head.

The follow-up questions help gain more information on how exactly the discomfort manifests itself in the speakers' bodies. There is also an important distinction to be made between discomfort due the word physically sounding/feeling wrong and a general anxiety and self-doubt about the participants' ability to judge the grammaticality of a maybe less familiar word. Finally, the question to compare the three possible options could provide some data on whether certain combinations of articles and nouns are more disagreeable than others to non-native speakers. The interviews were audio-recorded, and the pertinent portions transcribed.⁸

⁸ see appendix D

Results

Timed Readings

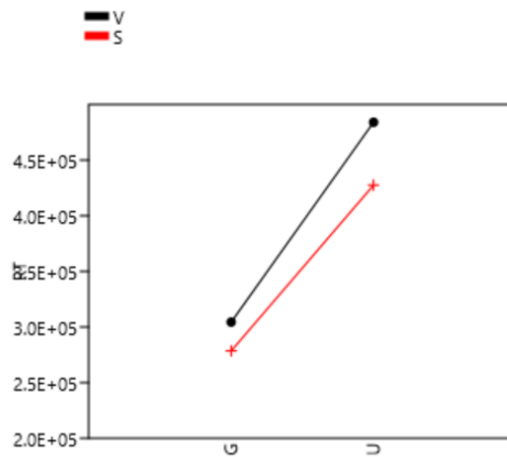
The first dataset to examine are the average response times (RTs). There are a total of 286 recorded RTs. 216 responses correspond to sentences containing ungrammatical items with 108 for both high and low frequency nouns. The data for grammatically correct sentences is made up from 72 responses with 36 each for high and low frequency nouns. RTs more than 2 standard deviations (SDs) above or below the overall means per condition were removed.

This resulted in the removal of 16 RTs leaving the dataset with 270 responses. From the 216 RTs containing ungrammatical language seven exceeded the 2 SDs with three relating to high and four relating to low frequency lexical items. I removed them leaving 209 RTs. For the 72 responses to grammatical language nine exceeded 2 SDs and consequently had to be removed. The make up for these nine was three of the responses relating to low and six to high frequency lexical items.

A two-way ANOVA subject crossing the factor *grammaticality* (high, low) with *modality* (silent, out loud), did not produce a significant effect on reaction times ($F(1,343) = 0.688, p = 0.408$). A second two-way ANOVA was run crossing the factor *noun frequency* (high, low) with *grammaticality* (grammatical, ungrammatical), which also did not yield a significant results ($F(1,343) = 6.279, p = 0.0127$).

Figure 1 shows the relationship between RTs and modality (V for verbal/out loud and S for silent) for the grammatical (G) and ungrammatical (U) sentences. While the results are not statistically relevant but show certain trends that further studies with a larger pool of participants could verify. The trends shown by the data align with the expectations going into the analysis.

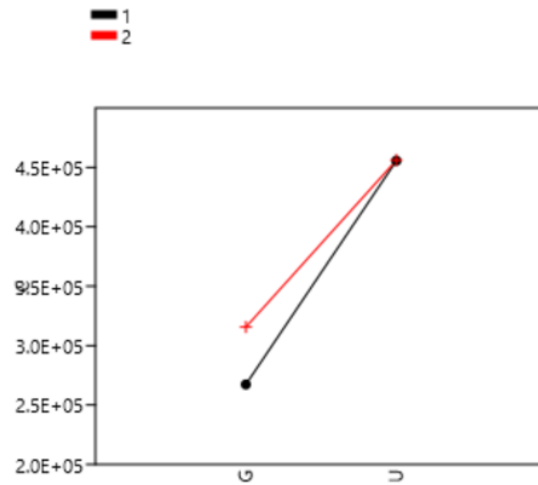
Figure 1 RTs depending on modality and grammatical correctness



As expected, the RTs for grammatical sentences were lower than the RTs for ungrammatical sentences. In addition, also as expected, the RTs for grammaticality judgements when participants read out loud were higher than when they read silently. Grammatical sentences which were read silently had the lowest RTs and reading ungrammatical sentences out loud had the highest RTs.

Figure 2 depicts the relationship between the RTs of grammatical (G) and ungrammatical (U) sentences on the one axis and the frequency of the target lexical items (1 being high and 2 being low frequency lexical items). These results also show the relationship as expected in terms of grammatical sentences containing high frequency lexical items having lower RTs than grammatically correct sentences containing low frequency lexical items. Interestingly, the RTs for the ungrammatical sentences converge at the same point regardless of the frequency of the target lexical items. Further studies are necessary to verify this trend.

Figure 2 RTs depending on frequency and grammatical correctness



Another examined dataset was the relation between accuracy in grammaticality judgments and modality. Particularly interesting are the instances in which the answers of one participant differ between the modalities, especially when participants self-correct their grammaticality judgments from reading silently to reading out loud as can be seen in table 2.

The main take away from this data is that the participants were more likely to notice ungrammatical language when reading out loud as opposed to reading silently. This becomes especially evident in their self-corrections. These refer to the number of participants that incorrectly judged an ungrammatical sentence to be grammatical when reading silently but correctly judged it to be ungrammatical when reading out loud.

Table 2: Judging ungrammatical sentences reading silently and out loud

*Das ist das kleine Tisch	1	0	1
*Das Mädchen hat die rote Stift.	4	1	3
*Die Eltern sehen die kleine Kind	3	2	1
*Die Studentin öffnet den großen Fenster.	6	4	2
*Der Junge füttert das kleine Katze.	2	2	0
*Die Gäste mögen das günstige Pizza.	7	5	2
*Der Handwerker putzt das neue Teppich.	1	0	1
*Die Experten erklären die nächste Ausbruch.	4	1	3
*Der Brief hat die offizielle Siegel.	3	2	1
*Die Frau bestellt die neue Kabinett.	6	4	2
*Die Mannschaft beendet das tolle Saison.	2	2	0
*Das Kind isst das reife Avocado.	6	5	2

Out of the 216 recorded responses to ungrammatical language, the participants incorrectly judged 115 of the sentences to be grammatically correct. Separating these responses into two groups depending on whether the participants were reading the sentences silently or out loud shows 63 instances where participants failed to notice the ungrammatical language and 52 instances where they did.

Taking a closer look at each participants' responses depending on modality shows that reading aloud had participants self-correct 15 out of the 61 instances they failed to notice the ungrammatical language when reading silently. That means that a quarter of the time the participants self-corrected when reading out loud. Also, participants were more likely to self-correct with high frequency words over low frequency words, which suggests that participants are more likely to notice ungrammaticalities with words that are more familiar.

In comparison to that, participants answers differed in the other direction, failing to notice ungrammatical language when reading aloud but correctly identifying when reading silently, 9 out of 55 times. In percentage this means that participants self-correct in this fashion 16% of the time. Table 4 contains this data:

Table 3 Judging grammatical sentences when reading silently and out loud

Die Leute kennen den alten Hund.	1	1	0
Die Schüler nehmen den gelben Bus.	2	4	1
Die Familie kauft das neue Haus.	4	3	1
Die Touristen lieben die große Stadt.	4	3	1
Das Auto zieht den neuen Anhänger.	1	2	0
Das Problem ist die starke Reibung.	4	1	3
Im Garten wächst das schlechte Unkraut.	4	5	1
Das Tier hat das weiche Fell.	3	5	0

Finally, it is worth noting the distribution of genders within the participants incorrect answers. Throughout the experiment, participants were most accurate with masculine nouns. When judging ungrammatical sentences with a violation of gender agreement with a male noun there were a total of 12 instances where participants failed to identify the sentences as ungrammatical. In comparison to that they failed to identify ungrammaticality 30 times with neuter nouns and 31 times with feminine nouns.

There were also more self-corrections with the masculine nouns. A total of 8 self-corrections took place with masculine nouns meaning that there were only 2 instances where participants read an ungrammatical sentence containing a masculine noun out loud and failed to

identify the ungrammaticality. In comparison, there were 6 self-corrections including neuter nouns and 4 including feminine nouns even though there were more chances for self-corrections than with the masculine nouns for both of them since there was larger pool of incorrect answers to correct.

Interviews

The data gathered from the interviews presents participants subjective experiences related to their perceptions of grammaticality, acceptability, and personal physical sensations. There was significant overlap in the participants' responses in terms of differences relating to physical discomfort towards violations in gender agreement, reading silently versus out loud, and familiarity with the lexical items. This section contextualizes quotes from the interviews with the data from the timed readings as well as other participants' responses.

First, all the participants have described some physical discomfort related to saying German sentences with violations in gender agreement out loud. The following are quotes describing these sensations and how the participants perceive them.

Talking about: **Die Gäste mögen das günstige Pizza.*

„*Das Pizza*” doesn't sound right when I say it. [...] I can't really describe how it feels. It just sounds wrong to say that. [...] Probably in my throat. As I am saying it just doesn't feel right.” (Participant 1)

„Personally, it feels like it doesn't flow properly. Just when I said it and I just thought about it for a second it just didn't feel right. [...] For me it is about like the upper chest area right where the neck meets the chest. That is where I feel it the most.” (Participant 7)

Talking about: *Die Touristen lieben die große Stadt.*

„That does not sound right. [...] It's kinda uncomfy” [...] It [the feeling] is kind of moving up like neck area. You tense.” (Participant 2)

Talking about: **Die Eltern sehen die kleine Kind.*

„I don't like saying that. I guess [the feeling is] kind of in my chest, cringy kind of, like upper body, shoulder, push away.” (Participant 3)

„*Kind* is such a basic word. So, like, it is kind of baked in, like *das Kind*. Which would be like *die kleine Kind* sounds wrong because I already know the plural would be, like, [*die*] *Kinder*. [...] I would say it is maybe around like here, sternum to a little below. [...] around the diaphragm

area. [...] It is hard to describe. It's like nausea sounds like a really strong word but, like just the slightest bit of like nausea. Or that sounds wrong or that is not quite [right]." (Participant 4)

„That is uncomfortable. I know it is *das Kind*. And so it is weird to me seeing *die Kind*. And that one I know. Immediately my head jumped to *das Kind* and so it was hard to say *die Kind*." (Participant 5)

Talking about: **Die Frau bestellt die neue Kabinett*.

“I always get in the small of my back like right in the back. [...] And that one made me more uncomfortable because of *die* and *Kabinett*.. There are certain words – and I am horrible with *der*, *die*, *das* – but there are certain words that just feel wrong with the article that they are given.” (Participant 6)

„I don't like that. [...] “Probably around like my lungs, I guess. Like around throat or lungs.” (Participant 9)

Talking about: **Die Familie kauft das neue Haus*.

“It was in my throat because that is where you are speaking from” (Participant 8)

Following expectations, each participant described their sensations differently from others. Their personal physical sensations are idiosyncratic. It is also important to note that the physical discomfort was not reserved for sentences which have a violation of gender agreement but whether the participant perceive there to be a violation. This suggests that the sensation has to do more with acceptability than grammaticality. The quote in (5) may aid to illustrate this fact. Participant 3 was describing the sensation when reading the grammatical sentence *Die Leute kennen den alten Hund*:

- (5) „It seems wrong to me, so, I don't super like it but, I am also not positive.”
[it is the same upper body and shoulder feeling] “just to a lesser extent.”

Even though the sentence is grammatically correct, the participant's perception of it being ungrammatical prompts the same response as reading a sentence which was ungrammatical. However, this happened less often and participants usually said that it was either less pronounced, they were unsure, or both, similar to the example above.

Another trend that emerges from the interviews, is this sense of uncertainty related to the familiarity with the lexical items. The data suggests that lower familiarity with the lexical items

prompts a less intense physical response as well as sometimes a different type of discomfort related to anxiety, second guessing, or general uncertainty. (6) contains a selection of quotes from the interviews on this phenomenon:

- (6) “It is in the chest, where anxiety usually forms.” (Participant 2)
- “I am just unsure. I have no idea whether this is correct or not. [...] I guess [the feeling is] in my head.” (Participant 3)
- “I think it has to do with the familiarity of the words. I get more of the strong cringe if I am really comfortable with the word. [...] Those are where I cringed the hardest because I know those articles for sure in my head, I think. So, these [less familiar nouns] it was initially, oh I don’t know the words and so that gave me more of the stomach nervous of ‘I don’t know.’ I don’t like being wrong.” (Participant 5)
- „It felt fairly normal. But it is almost as if when I finished the sentence that I was second guessing it almost. Because I wasn’t 100% it was correct once I completed it. [...] I didn’t really feel it that time it was more of a mental thing, [...] less physical, definitely.” (Participant 7)
- “Your brain just knows that what you said is wrong [...] At least in my experience you develop it more on some of the more, you know, everyday words that you hammer in since German 1.” (Participant 8)
- “It feels fine. Not exactly uncomfortable. I guess uncertain.” (Participant 9)

Lastly, the interview data offers insight into how speaking out loud affects the extent to which language learners experience physical discomfort when confronting violations of gender agreement in German. The data from the interviews confirms the trends observed in the timed reading task that participants are more likely to notice ungrammaticality in gender agreement when reading out loud as opposed to silently. The selection of quotes in (7) illustrates this point:

- (7) “I can’t really describe how it feels. It just sounds wrong to say that. [...] Probably in my throat. As I am saying it just doesn’t feel right.” (Participant 1)
- “I don’t know if this helps. Right now looking at it on paper. Even though I am saying it out loud my brain is looking at the letters. [...] So, auditory I think my brain is like no there is something wrong there it’s *die*. But then when I see it fully written and I am really focusing on the written then I am like: ‘I think it is right.’” (Participant 6)
- “I mean, saying it my head I think I understand it. I think I know what the words are and I am understanding it properly. But saying it actually gives it a bit more clarity I think. That is just me though” (Participant 7)

It is also worth mentioning at this point that while the locations on the body were different for each participant there was a trend for participants locating the discomfort in areas associated with speech production such like, lungs, chest, diaphragm, lower palate, jaw, or throat. Participants described a sense of obstruction accompanying the physical production of phrases they perceived to contain ungrammatical language as seen in (8):

- (8) “It was hard to say *die Kind*.” (Participant 5)
 “It makes me want to like stop.” (Participant 9)
 “For me it is about like the upper chest area right where the neck meets the chest. That is where I feel it the most.” [Q: It is like hard to get out?]
 “Exactly.” (Participant 7)

The interview data offers further insight into how non-native speakers of German perceive gender agreement in German and how their perceptions affect grammaticality judgements. Once the participants were aware of their physical responses, having them compare the three possible options of article and noun combinations showed that they are able to use their own acceptability judgments to self-correct and achieve higher accuracy. Example (9) shows participants 1 and 5 self-correct:

- (9) *Die Frau bestellt die neue Kabinett:
 The_{Fem} woman_{Fem} orders the_{Fem} new_{Fem} cabinet_{Neut}
The woman orders the new cabinet.

„I don’t know for sure that they are right but they sound right. [after comparing all options] *Das* sounds more correct. [...] Saying *das* just rolls of the tongue more easily than the other two. It just makes it more comfortable to say. It sounds more correct.” (Participant 1)
 “*die neue Kabinett*. It doesn’t sound super right. [...] My brain doesn’t let me accept it very easily. [after comparing all options] “To me *das* sounds the most natural. (Participant 5)

While the examples above show participants being able to use their physical discomfort to rule out all incorrect answers it also happened that participants were only able to rule out one of the three with certainty. One example for this was participant 8 talking about the sensation when reading the sentence depicted in (10)

- (10) *Die Experten erklären die nächste Ausbruch.
The_{Pl.} experts_{Pl} explain the_{Fem} next_{Fem} outbreak_{Masc}
The experts explain the new outbreak.

“And then that one. I know it probably wasn’t *das*. But I just didn’t know if *Ausbruch* was male or female. [...] [*das nächste Ausbruch*] sounds more wrong than *die* or *der*.”

While it was not always possible to narrow it down to one possibility participants were able to eliminate one of the three possibilities more often because it sounded distinctly worse than the other two options.

Discussion

In this study, we investigated how English-speaking learners of German process and judge local gender agreement in German. The study design focused on answering three questions: (i) Are non-native speakers of German able to acquire a language schema in their second language that helps them identify violations of gender agreement? (ii) Are non-native speakers more likely to notice ungrammatical language when they speak out loud versus reading silently? (iii) Are there physical manifestations in non-native speakers' bodies when encountering ungrammatical language, and if so, what are they like? To our knowledge this is the first study that looks at language learners' perceptions of physical manifestations of ungrammaticality.

While the data from the timed readings is not statistically relevant due to the small size of participants, the observed trends point towards answers for the above questions. Furthermore, the trends align with the qualitative data collected in the interviews. The data from both parts of the experimental task point to the conclusions that: (i) English-speaking learners of German are able to acquire an underlying schema to help them decide on the acceptability of the gender agreement between articles and nouns, (ii) violations of gender agreement between articles and nouns provoke a physical response of discomfort, (iii) this discomfort is more pronounced when the learners say an ungrammatical sentence out loud and (v) the utterance contains a high frequency lexical item the speakers are more familiar with.

The finding that non-native speakers are more likely to notice ungrammaticality when speaking out loud is new to the field of second language acquisition. It could prove beneficial to

second language acquisition research to look at findings from writing center studies when it comes to acceptability judgements. Especially studies concerned with multilingual writers.⁹

The data also presents another, unexpected conclusion, namely, that (vi) non-native speakers of German experience another type of physical discomfort in conjunction with grammaticality judgements of gender agreement in German: an anxiety related to uncertainty. However, this sensation is different than the physical discomfort associated with noticing a violation of gender agreement. In general, this sensation is less localized to one body part and participants described it as a more general sense of uncertainty.

The overall trends offer insight into possible underlying structures or similarities that English-speaking learners of German share but during the timed readings and the interviews there were a couple lexical items that gave participants more trouble than others and merit further discussion.

The first sentence in question is in example (11):

- (11) *Die Frau bestellt die neue Kabinett
The_{Fem} woman_{Fem} orders the_{Fem} neue_{Fem} cabinet_{Neut}.
The woman orders the new cabinet.

The target lexical item *Kabinett* is a low frequency item but a cognate to its English translation. Thus, the participants can understand the meaning of it but are probably not familiar with its grammatical gender in German. The expected results with this type of item were a lower accuracy, longer RTs, and different approaches and thought processes in the decision making of the grammaticality judgement tasks.

⁹ see for example: Naydan, 2016; Severino & Shih-Ni, 2016.

The data reflects these expectations. All nine participants failed to notice the ungrammaticality in this sentence when reading silently. They judged the gender agreements to be acceptable. When reading out loud, participants 2 and 4 corrected themselves and accurately identified the sentence to be ungrammatical. When asked to read this sentence out loud again in the interviews, multiple other participants were able to use their physical reactions to make more informed and accurate grammaticality judgements of this item. The following quotes in (12) offer insight into the participants' thought processes.

- (12) “*Das* sounds more correct. [than *der* or *die*]. [...] Saying *das* just rolls off the tongue more easily than the other two. It just makes it more comfortable to say. It sounds more correct.” (Participant 1)
- “The article and the adjective ending agree but then when you get to the noun. It is usually the endings of the nouns that tip me off [...] and [...] it just doesn't sound right; *die* with *-nett*.” (Participant 2)
- “That one made me more uncomfortable because of *die* and *Kabinett*. There are certain words – and I am horrible with *der*, *die*, *das* – but there are certain words that just feel wrong with the article that they are given. [...] But then words like *Kabinett* to me, if somebody put like *das* in front of it, I would feel more comfortable.” (Participant 6)
- „I feel like it is not a *die* word because it doesn't end like maybe some of the other *die* words that I know. So, it makes me question it.” (Participant 5)
- „I don't like that. Is it *der Kabinett*?” [...] Starting with a *K*- and just how the word looks it doesn't feel like it is a *die* word it feels more masculine.” (Participant 9)

This example illustrates how English-speaking learners of German use various strategies in grammaticality judgements for gender agreement in German. The four quotes above illustrate how those intermediate learners use phonological and morphological cues in their decision-making processes. Based on the sound of the endings, or the initial phoneme, the participants compared it to their previous knowledge of other words in the target language and used those references in their judgement.

Some participants showed higher acuity and used this to a higher effect than others. Participants 1 and 2 were able to identify the correct noun gender based on the sound and others

using the sound to at least rule out the feminine**die Kabinett*. This example shows that English-speaking learners of German can develop an underlying schema of their target language in addition to their native language and use morphological and phonological cues to make grammaticality judgements in their target language.

(13) is another example to illustrate this point:

(13) Das Problem ist die starke Reibung.
 The_{Neut} problem_{Neut} is the_{Fem} strong_{Fem} friction_{Fem}
 The problem is the strong friction.

This example stands out because it had the highest number of self-corrections from incorrectly judging it to be ungrammatical when reading silently to being deemed acceptable when reading out loud. Four participants judged it to be ungrammatical when reading silently with three of them correcting themselves when reading out loud.

German nouns ending in *-ung* are always feminine. In language teaching these endings are sometimes explicitly taught and learners can use this to their advantage (Strong, 1976). However, none of the participants in this study brought this up during the interview, suggesting that perhaps they are unaware of this rule. Nonetheless, 3 out of 4 participants self-corrected their grammaticality judgement when reading out loud. Once again, the results are limited by the small sample size, but the trends suggest that even if the learners are not explicitly aware of a rule associated with a word ending, they show a higher acuity to recognize violations, or the lack of them, in gender agreement when reading out loud. The fact that the participants were able to improve their accuracy when speaking out loud without being aware of the rule associated with the suffix *-ung* supports the hypothesis that intermediate learners develop underlying schema that help them use phonological cues for acceptability judgements.

The last example that warrants closer inspection follows in (14):

- (14) *Das Kind isst das reife Avocado.
The_{Neut} child_{Neut} eats the_{Neut} ripe_{Neut} avocado_{Fem}
The child eats the ripe avocado.

We chose this lexical item because it combines various aspects that can cause difficulties for non-native speakers in terms of gender agreement. The lexical item *Avocado* contains the suffix -*o* which is not present in Germanic languages and generally “any word completely foreign to German is used with the neuter determiner for want of an established gender” (Hickey, 2000, 648). However, this particular item defies expectations, and its grammatical gender is feminine, *die Avocado*. It is also an English cognate and a low frequency lexical item which means that participants should be able to understand its meaning but are likely not familiar with its grammatical gender. With this item we expected lower accuracy, higher RTs, and different answers as to the judgement process during the interview.

Once again, the data aligns with the expectations. During the timed reading, six participants did not notice the ungrammaticality when reading silently and five when reading out loud. While there were two self-corrections (Participants 6 & 9) there was also one participant (Participant 3) who correctly noticed the ungrammaticality when reading silently but failed to notice it when reading out loud.

During the interview, it was this item that brought attention to the different source of discomfort associated with uncertainty. During the interview most participants did not identify *das Avocado* as leading to physical discomfort associated with violations of gender agreement and they judged it to be acceptable. However, they still ranked it a 3 out of 5 in terms of discomfort due to general uncertainty. The selection of quotes in (15) provides more details over the participants’ thought processes about this item:

- (15) “I can’t explain exactly why *das* fits more other than *Avocado* seeming than such a non-German word. [...] It’s not really German but it is [...] like a translation. *Das* seems to fit a lot more with it not being German. (Participant 9)

“It is kind of like unsure. So, it is little more up there [towards the head] You know, I am not sure. There is a lot of things that go through my head. When I see words that are very close to loan words or might just be loan words out right. [...] It is higher, more around the upper chest. It sounds wrong or potentially right. It is more of an unsure [feeling]. (Participant 4)

Participants 4 and 9 both show awareness of the rule that loan words with endings which are not typically German are generally neutral. While they are not able to identify the grammatical gender with certainty they use morphological information in their decision-making. Participant 4 also describes a feeling of physical discomfort but clarifies that “it is higher, more around the upper chest” and that “it is more of an unsure feeling” unlike the feeling they described for when they are certain of the violation in gender agreement, which manifests itself “in the sternum or a little below” for them.

Other participants also described this sense of uncertainty but were able to use their physical discomfort to either rule out one incorrect option or choose the correct option, *die Avocado*. (16) below summarizes their answers:

- (16) „They all sound okay. [...] *Der* seems a little bit more wrong but *das* and *die* both sound fine.” (Participant 3)

„I don’t think it sounds right but again I am not certain because I am not familiar with that word. [...] [trying all options out loud] “*die Avocado, der Avocado*. Personally, I think *die Avocado* sounds the best”. (Participant 5)

These examples illustrate that even if the participants were not familiar with the target lexical item, they were able to use phonological cues to identify ungrammaticalities in their L2.

Particularly interesting is participant 5 who demonstrated multiple times that they were able to

correctly identify the correct grammatical gender for nouns they were unfamiliar with. In (17) are two additional excerpts from the interview with participant 5, which illustrate this:

Talking about: **Die Frau bestellt die neue Kabinett.*

“It doesn’t sound super right. [...] My brain doesn’t let me accept it very easily. [...] *die neue Kabinett, der neue Kabinett, das neue Kabinett.* To me *das* sounds the most natural. [...] I feel like it just doesn’t end like maybe some other *der* words that I know.”

Talking about: **Die Experten erklären die nächste Ausbruch.*

“It is kind of the same I don’t use it a lot and so I am not sure. Am I allowed to say them out loud to see? *das nächste Ausbruch / der nächste Ausbruch. Der Ausbruch* sounds the most normal.”

These self-corrections by participant 5 serve as an example of possible applications of this study. The results of this study suggest that language learners can use their instinctual judgement to improve their accuracy with gender agreement in German. However, it is important to make the learners aware of this sensation and how to use it effectively. Most learners were not aware of this sensation or did not trust it to be a valuable tool to help them in their judgement. Especially the fact that saying it out loud increases the uncomfortable sensation is an important realization for language learners who want to practice this method.

Participant 7 put it best. When asked about whether reading out loud led to a stronger reaction they answered: “I mean, saying it my head I think I understand it. I think I know what the words are and I am understanding it properly. But saying it actually gives it a bit more clarity, I think. That is just me though” (Participant 7). Especially important in this quote is the last phrase. The participant was under the impression that this sensation was personal to them. However, as this study shows, intermediate language learners share this physical discomfort when confronted with ungrammatical language and raising awareness of this fact could offer a basis for teaching methods that focus on instinct and acceptability judgements and alleviate the need for memorizing each lexical item with its article.

Conclusion

This study provides some initial data on intermediate German language learners ability to sense physical discomfort when confronted with violations of gender agreement in the target language. The results suggest that native English speakers can develop an underlying schema that prompts involuntary physical responses to ungrammatical language in their second language. These responses manifest themselves differently in each participant but can generally be described as a sense of discomfort or cringe.

The results also suggest that this discomfort is more pronounced when the language learners read the ungrammatical language out loud as opposed to silently. The act of physically producing the language leads to a more noticeable discomfort and helps language learners to notice ungrammatical language.

One unexpected finding was that language learners often have a second type of physical discomfort caused by doubt in their knowledge of the target language. This sensation is different from the cringe feeling when language is identified as incorrect though and more similar to a general sense of anxiety.

A possible application of these findings is making language learners aware of their ability to develop this sense. Through enough exposure to the target language it is possible to make informed judgements based on the physical discomfort associated with ungrammaticality. Helping learners to raise their awareness of this sense could empower them to feel more confident in their second language and reduce the need for memorization of the gender of each noun.

Finally, this study was limited by its low number of participants and to gain more conclusive evidence, further studies with higher participant numbers are necessary. Nonetheless

this study shows certain trends that indicate the potential of acceptability judgements as a tool in second language acquisition. Future studies may use the finding that learners' perception of acceptability can be clouded by self-doubt and be conscious of it in their study design.

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Appendix A - Timed Reading Sets

Set A:

- *Das ist das kleine Tisch.
- *Das Mädchen hat die rote Stift.
- *Der Handwerker putzt das neue Teppich.
- Das Auto zieht den neuen Anhänger.
- Die Familie kauft das neue Haus.
- *Die Eltern sehen die kleine Kind.
- *Die Frau bestellt die neue Kabinett.
- Die Touristen lieben die große Stadt.
- Das Problem ist die starke Reibung.
- *Das Kind isst das reife Avocado.

Set B:

- Die Leute kennen den alten Hund.
- Die Schüler nehmen den gelben Bus.
- *Die Experten erklären die nächste Ausbruch.
- *Die Studentin öffnet die große Fenster.
- Im Garten wächst das schlechte Unkraut.
- *Der Brief hat die offizielle Siegel.
- Das Tier hat das weiche Fell.
- *Der Junge füttert das kleine Katze.
- *Die Gäste mögen das günstige Pizza.
- *Die Mannschaft beendet das tolle Saison.

Appendix B – Participant Personal Information Sheet

- 1) For how long have you studied German? (Years in Highschool and/or semesters at University)

- 2) Do you speak German outside of the classroom? Do you have German speaking friends or family?

- 3) Do you speak other languages besides English and German? If yes, which ones?

- 4) Have you spent an extended period in a German speaking country? (Traveling or study abroad) If yes, where, and how long did you stay?

Appendix C – Interview Handout

1) Die Familie kauft **das** neue Haus.

Very comfortable
1 2 3 4 very uncomfortable
5

2) Die Gäste mögen **das** günstige Pizza.

Very comfortable
1 2 3 4 very uncomfortable
5

3) Die Frau bestellt **die** neue Kabinett.

Very comfortable
1 2 3 4 very uncomfortable
5

4) Die Experten erklären **die** nächste Ausbruch.

Very comfortable
1 2 3 4 very uncomfortable
5

5) Das Auto zieht **den** neuen Anhänger.

Very comfortable
1 2 3 4 very uncomfortable
5

Appendix D – Interview Transcriptions

The transcript focuses on the information pertinent to the research questions. The participants' answers are typed in quotation marks. Questions and interjections by the investigator are paraphrased, indented, and in **bold**.

Participant 1:

Talking about: (2) **Die Gäste mögen das günstige Pizza.*

“*Das Pizza* just doesn't sound right when I say it. [...] I can't really describe how it feels. It just sounds wrong to say that.”

Where in your body do you feel the discomfort?

“Probably in my throat. As I am saying it just doesn't feel right.”

Talking about: (3) **Die Frau bestellt die neue Kabinett.*

„I don't know for sure that they are right but they sound right.”

It is not *die Kabinett*. Can you try saying the other two options and see which one feels best?

“*Das* sounds more correct. [than *der* or *die*] [...] Saying *das* just rolls of the tongue more easily than the other two. It just makes it more comfortable to say. It sounds more correct.” [...]

Do you have the same obstruction in your throat?

“Kind of. [Saying] *den* more than *die* because obviously, like, I thought that that one was right but then after saying the other ones I realized it's not.”

Talking about: (6) **Die Eltern sehen die kleine Kind.*

“It is the same [feeling in the throat]. Because it doesn't sound right and I also just know it isn't right.”

Talking about: (9) *Im Garten wächst das schlechte Unkraut.*

“That is also uncomfortable.”

Is it in the same area?

„Yeah.“

Talking about: (12) **Das ist das kleine Tisch.*

“That sounds wrong and I know it is wrong”

Participant 2:

Talking about: (3) **Die Frau bestellt die neue Kabinett.*

“[that is] less comfy [than the first two]. [...] The article and the adjective ending agree but then when you get to the noun. It is usually the endings of the nouns that tip me off. [...] and I don’t know it just doesn’t sound right *die* with *-nett*.”

Where in your body do you feel the discomfort?

“It is in the chest, where anxiety usually forms. [...] It is more like when you have like a feeling on your skin that is like: oh, that is not right, that’s uncomfy. It’s not like that I am necessarily unsure. For some reason there is this little tickling that doesn’t sound right.”

Talking about: (4) **Die Experten erklären die nächste Ausbruch*.

“That also sounds wrong to me. But less so wrong. I am gonna put a three.”

Where in your body do you feel the discomfort?

“Also in the chest but less pronounced”

Talking about: (6) **Die Eltern sehen die kleine Kind*.

„No, just absolutely [not]. [...] And I don’t actually feel that one I just know it. And so, I don’t know. It is not as uncomfortable but I know its very wrong.”

Where in your body do you feel the discomfort?

[not the same chest feeling] “It’s more of a just like ‘hey that’s wrong.’”

Talking about (10) *Die Touristen lieben die grosse Stadt*.

„That does not sound right. Even if it is. It doesn’t sound right. It’s kinda uncomfy. [...] It [the feeling] is kind of moving up like neck area. you tense. [...] “It feels good until you reach Stadt. [...] It could be anything. So, until you finish the sentence: *die grosse* ... something that works. But then when you get to the noun then it’s like ‘no, that’s wrong’, so it is like after the fact.”

Can you say the other two options out loud and compare how they feel?

“*Die Touristen lieben der grosse Stadt*. Sounds right to me even though it is wrong. It sounds right to me.”

“*Die Touristen lieben das grosse Stadt*. Does not sound right. It [the feeling] is more like the chest. Kinda just ‘no I don’t think so’”

Talking about (11) **Das Kind isst das reife Avocado*.

„I wouldn’t say that one necessarily sounds worse. But my instinct is to also go to *der*. Just because you know a little bit of Spanish background when I think of Avocado ending with an -o. I think -o masculine. So, I don’t know if that’s why I would go with *der* over *die*.

Is there a difference in discomfort between *der reife Avocado* and *die reife Avocado*?

“Not between *die* and *der*.”

What if I tell you that *die reife Avocado* is correct?

“I mean if I were to not be given an article I would still go with *das* because it just sound the most correct.”

Talking about: (12) **Das ist das kleine Tisch*.

„No, that is wrong. That is very wrong. [...] I get the neck thing. Just like ‘ope’.”

Participant 3

Talking about: (4) **Die Experten erklären die nächste Ausbruch.*

“I am just unsure. I have no idea whether this is correct or not. So, somewhere in the middle.”

Where in your body do you feel the discomfort?

“I guess in my head.”

Talking about: (6) **Die Eltern sehen die kleine Kind.*

„I don't like saying that. But because I know it is wrong I feel less anxious in my head.”

Where in your body do you feel the discomfort?

“I guess kind of in my chest, cringy kind of, like upper body, shoulder, push away kind of.”

Talking about: (7) *Die Leute kennen den alten Hund.*

„It seems wrong to me so I don't super like it but I am also not positive.”

Is it the same feeling in the upper body and the shoulders?

“Yep, just to a lesser extent.”

Talking about: (10) *Die Touristen lieben die grosse Stadt.*

„Yeah, same cringy kinda thing.

Talking about: (11) **Das Kind isst das reife Avocado.*

„They [*der, das, and die Avocado*] all sound okay.“

Does one sound worse than the others?

„*Der* seems a little bit more wrong but *das* and *die* both sound fine.”

Participant 4

Talking about: (3) **Die Frau bestellt die neue Kabinett.*

„It sounds a little off. I think it could be *der* but *die* sounds just fine. [...] I feel like it could go either way on that one.”

Talking about: (4) **Die Experten erklären die nächste Ausbruch.*

“I couldn't remember if it was feminine or masculine but it sounds right to me”

Talking about: (6) **Die Eltern sehen die kleine Kind*

“*Kind* is such a basic word. So, like, it is kind of baked in, like *das Kind*. Which would be like *die kleine Kind* sounds wrong because I already know the plural would be, like, [*die*] *Kinder*.”

Where in your body do you feel the discomfort?

“I would say it is maybe around like here, sternum to a little below. [...] around the diaphragm area. [...] It is hard to describe. It's like nausea sounds like a really strong

word but, like just the slightest bit of like nausea. Or that sounds wrong or that is not quite.”

Talking about: (11) **Das Kind isst das reife Avocado.*

“It is kind of like unsure. So, it is little more up there [towards the head] You know, I am not sure. There is a lot of things that go through my head. When I see words that are very close to loan words or might just be loan words out right.

Where in your body do you feel the discomfort?

“It is higher more around the upper chest. It sounds wrong or potentially right. It is more of an unsure [feeling].”

Talking about: (12) **Das ist das kleine Tisch.*

“That is also another one that falls into the realm of like, I know that like I know that Tisch is *der*. Maybe like a day one word in Highschool. So, since I know it so well it feel very wrong to say *das Tisch*. It is pretty much the same area [the diaphragm].”

Participant 5

Talking about: (2) **Die Gäste mögen das günstige Pizza.*

“I am just unsure because I don’t use the word pizza a lot”

Where in your body do you feel the discomfort?

“maybe my stomach a little bit”

Talking about: (3) **Die Frau bestellt die neue Kabinett.*

„I feel like it is not a *die* word because it doesn't end like of of the other *die* words that I know. So it makes me question it.”

Where in your body do you feel the discomfort?

“*Die neue Kabinett*. It doesn’t sound super right. [...] My brain doesn’t let me accept it very easily.”

Can you try saying the other options out loud?

“*die neue Kabinett, der neue Kabinett, das neue Kabinett* [...] To me *das* sounds the most natural [...] I feel like it just doesn’t end like maybe some other *der* words that I know.”

Talking about: (4) **Die Experten erklären die nächste Ausbruch.*

“It is kind of the same I don’t use it a lot and so I am not sure. Am I allowed to them out loud to see?

Of course.

“*das nächste Ausbruch. Der nächste Ausbruch. Der Ausbruch* sounds the most normal.”

Where in your body do you feel the discomfort?

“I feel like I have to pause to make it work [*die Ausbruch*]. Or when I think of *die* words they all end with like an *-e* or an *-en* or like, they are a plural. And this one just feels more like its... it just doesn’t sound good together and so I just get confused when I read

it. And it just doesn't. My stomach is a little like nervous reading it. [...] Because I am unsure I am a little nervous reading it”.

Talking about: (5) *Das Auto zieht **den** neuen Anhänger.*

“I am a little more comfortable that it is a *der* word because of how it ends.”

Talking about: (6) **Die Eltern sehen die kleine Kind.*

„That is uncomfortable. I know it is *das Kind*. And so, it is weird to me seeing *die Kind*. And that one I know. Immediately my head jumped to *das Kind* and so it was hard to say *die Kind*.”

Talking about: (8) *Das Problem ist die starke Reibung.*

„To me it doesn't feel like it should be a *die* word. It makes me stop and question it. [...] *die Reibung, das Reibung, der Reibung*. It sounds off to me. But again, I am not sure but it sounds off to me.”

Is it as bad as *das Pizza*?

“No, it is kinda like my familiarity with the word. I don't even know what *Reibung* means. [It doesn't sound super good] but I don't know how it should sound. [more in the stomach] nervous answering the question more than thinking too deeply about it.”

Talking about: (9) *Im Garten wächst das schlechte Unkraut*

“That doesn't sound bad to me but I am not certain.”

Where in your body do you feel the discomfort?

“I think it is more nervous answering the question because I am not sure but it doesn't make me cringe and I think I could move on without noticing.”

Talking about: (11) **Das Kind isst das reife Avocado.*

„I don't think it sounds right but again I am not certain because I am not familiar with that word. *die Avocado, der Avocado*. Personally, I think *die Avocado* sounds the best”.

Talking about: (12) **Das ist das kleine Tisch.*

„I know it is either *das* or *der*. [my initial response was:] “I really don't think it is *das Tisch*. [...] I really don't think *das Tisch* sounds right. I think it is *der Tisch*.”

Why can you tell it is not *das Tisch* even though you are not sure?

“I think it has to do with the familiarity of the words. I get more of the strong cringe if I am really comfortable with the word. like I know it is *das Haus*. So, or like there was one where I was certain: *der Hund, das Kind*. Those are where I cringed the hardest because I know those articles for sure in my head, I think. So, these [less familiar nouns] it was initially, oh I don't know the words and so that gave me more of the stomach nervous of I don't know I don't like being wrong. And I remember *die neue Kabinett* and something about it didn't sound like it flowed together. It kind of makes my brain question if that is correct.”

Participant 6

Talking about: (3) **Die Frau bestellt die neue Kabinett*

„The gender feels right. but I think it is honestly just the adjectives. [...] It feels wrong like a non-native speaker”

Where in your body do you feel the discomfort?

“I always get in the small of my back like right in the back. [...] It is kind of a second guessing, and it is almost like an alertness. And I think that is why I get it in the small of my back. It is like when someone calls your attention you go like that [straightens her spine]. It is [the small of the back]. And that one made me more uncomfortable because of *die* and *Kabinett*.. There are certain words – and I am horrible with *der*, *die*, *das* – but there are certain words that just feel wrong with the article that they are given. [...] But then words like *Kabinett* to me... if somebody put like *das* in front of it I would feel more comfortable.”

Are you just unsure or do you get physical discomfort in your body when you say *die neue Kabinett*?

“It is like it shoots kind of up my back. It starts kind of in the lower back again that like ‘I am aware’ but yeah it is all in the back. [...] it was more that like, I think I am still at a point where I am learning and if they said another incorrect sentence I would be at a 5: ‘mhmh that is wrong stop, stop.’”

Talking about: (6) **Die Eltern sehen die kleine Kind*.

„I know this is wrong”

Where in your body do you feel the discomfort?

“In the lower back and it shoots up my spine.”

Talking about: (9) *Im Garten wächst das schlechte Unkraut*.

“I think the ‘r’ and the ‘t’ sounds, sound more masculine. And it kind of throws me off.”

Talking about: (10) *Die Touristen lieben die große Stadt*.

“Gut said it was wrong but then if I think about it, I am like no its right. And once again I think it is the ‘t’ sounds.”

Talking about: (11) **Das Kind isst das reife Avocado*.

“I don’t know if this helps. Right now looking at it on paper. Even though I am saying it out loud my brain is looking at the letters. And so I am like *das* and then and -o sound, like that feels right. That is right. but then when I was reading it. My brain was like: ‘it is *die Avocado*’. So, auditory I think my brain is like no there is something wrong there it’s *die*. But then when I see it fully written and I am really focusing on the written then I am like I think it is right.”

Participant 7

Talking about: (2) **Die Gäste mögen das günstige Pizza*.

“Personally, it feels like it doesn’t flow properly. Just when I said it and I just thought about it for a second it just didn’t feel right.”

Where in your body do you feel the discomfort?

“For me it is about like the upper chest area right where the neck meets the chest. That is where I feel it the most.”

It is hard to get out?

“Exactly”

Talking about: (3) **Die Frau bestellt die neue Kabinett.*

„It felt fairly normal. But it is almost as if when I finished the sentence that I was second guessing it almost. Because I wasn’t 100% it was correct once I completed it.”

Where in your body do you feel the discomfort?

“I didn’t really feel it that time it was more of a mental thing [...] less physical, definitely.”

Talking about: (4) **Die Experten erklären die neue Ausbruch.*

„Definitely the back end of the sentence felt wrong to me. And that again, same feeling; upper chest, lower throat.”

Talking about: (5) *Das Auto zieht den neuen Anhänger.*

“Physically felt fine but mentally kinda second guessing myself.

Talking about: (6) **Die Eltern sehen die kleine Kind.*

„That one again, came out very clean. It just felt okay. [...] No physical discomfort but definitely some mental discomfort.”

Talking about: (9) *Im Garten wächst das schlechte Unkraut.*

„No physical discomfort but after I said it feels a little weird but I still believe it is correct.”

Talking about: (10) *Die Touristen lieben die große Stadt.*

„That one I don’t think is correct. I am under the believe that it is *der Stadt*. There is not a whole lot of physical discomfort. But my head is I just felt it.”

Talking about: (11) **Das Kind isst das reife Avocado*

„That one felt right. [...] Just some uncertainty.”

Talking about: (12) **Das ist das kleine Tisch*

„It just didnt feel right when I said a few times. And I can’t explain it. And it just felt really weird.

Where in your body do you feel the discomfort?

“Right in the chest”

Follow Up:

“I did feel a bit more confident saying things out loud. [...] After part one I was like unsure where I was standing. And then going through part two I knew, it feels better now.”

Was it because you judged them a second time (saw them the second time) or reading them out loud?

“Definitely reading it in my head [versus] like saying it out loud. I mean, saying it my head I think I understand it. I think I know what the words are and I am understanding it properly. But saying it actually gives it a bit more clarity I think. That is just me though.”

Participant 8

Talking about: (1) *Die Familie kauft das neue Haus.*

You said this felt a little bit uncomfortable, why?

„It is more like an uncertainty with the article. [...] A lot of times after I learn the vocabulary it is not immediately, like unless the article is not immediately apparent it is a bit harder for me to be confident if the article I am saying is actually right. If I heard someone say it [*das neue Haus*] I wouldn’t think anything of it.”

Where in your body do you feel the discomfort?

“It was in my throat because that is where you are speaking from, [but I was] just unsure.”

Talking about: (2) **Die Gäste mögen das günstige Pizza.*

“It is even more so with *das günstige Pizza*. [...] I am also unsure but *das Pizza* sounds wrong.”

Talking about: (4) **Die Experten erklären die nächste Ausbruch.*

“And then that one. I know it probably wasn’t *das*. But I just didn’t know if *Ausbruch* was male or female.”

Can you try saying the other options out loud?

“*der nächste Ausbruch, das nächste Ausbruch*“ [*das nächste Ausbruch*] sounds more wrong than *die* or *der*.”

Does *das nächste Ausbruch* give you the feeling in the throat_

“yes”

Talking about: (12) **Das ist das kleine Tisch.*

„That is like one of the more, that one is a lot easier to pick up on”

Why is that?

“Your brain just knows that what you said is wrong.”

Where in your body do you feel the discomfort?

“It starts in your brain but then it is kind of like after the fact it is just in your head.”

Follow Up:

“This [gender agreement] is definitely something that I am bad at so it would be cool to do some research on it”.

When do you get the feeling that a noun has the wrong article?

“[With words like] *Die Stadt*. If someone said **der Stadt* or like **das Stadt* or something like that. [...] At least in my experience you develop it [the sense that something is wrong] more on some of the more, you know, every day words that you hammer in since German 1.”

Participant 9

Talking about: (3) **Die Frau bestellt die neue Kabinett*.

„I don't like that. Is it **der Kabinett*?”

Why do you think it is **der Kabinett*?

“I guess it is kind of my ‘guess’ of how the gender pairings work. Like it is *der Schrank* right. And it is not exactly the same word but it is pretty close. Starting with a *k* and just how the word looks it doesn't feel like it is a *die* word it feels more masculine.”

Why not **die Kabinett*?

“*die Kabinett* is more that simply I just don't like it.”

Where in your body do you feel the discomfort?

“Probably around like my lungs I guess. Like around throat or lungs”.

Talking about: (4) **Die Experten erklären die nächste Ausbruch*.

“*Ausbruch... bruch* feels more masculine.”

Is it the same physical discomfort as with **die Kabinett*?

“It is more just me double guess myself.”

Where in your body do you feel the discomfort?

“I guess kind of around my jaw.”

Talking about: (6) **Die Eltern sehen die kleine Kind*.

„It makes me wanna use *Mädchen* instead. [...] It makes me want to actually fix it. [...] It makes me want to like stop”.

Where in your body do you feel the discomfort?

“[I feel it] in the jaw or the lower palate.”

Talking about: (11) **Das Kind isst das reife Avocado*.

„It feels right. *Das Avocado*”

If you compare it to *der* or *die* Avocado do they sound worse?

“I can't explain exactly why *das* fits more other than *Avocado* seeming than such a non-German word. [...] It's not really German but it is still like a translation. *Das* seems to fit a lot more with it not being German.”

When you compare *der Avocado* and *die Avocado* does one sound worse than the other?

“I think *der* feels worse.”

Is it in the same place on your body?

„Around the lungs, yeah.”

Talking about: (12) **Das ist das kleine Tisch.*

„I guess it would be more like *der kleine Tisch.*”

Where in your body do you feel the discomfort?

“It feels fine. Not exactly uncomfortable. I guess uncertain.”