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## Regularizing Unpredictable Variation: Evidence from a Natural Language Setting

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### ABSTRACT

While previous sociolinguistic research has demonstrated that children faithfully acquire probabilistic input constrained by sociolinguistic and linguistic factors (e.g., gender and socioeconomic status), research suggests children regularize inconsistent input—probabilistic input that is not sociolinguistically constrained (e.g., Hudson Kam & Newport, 2005, 2009; Singleton & Newport, 2004). The current study extends this research to investigate how children acquire grammatical forms when they are exposed to inconsistent input at the community-wide level by investigating the acquisition of inconsistently produced gender in Fering, a dialect of North Frisian. The results of a gender elicitation task show that some children regularize inconsistently produced features, while others approximated the adult-like probability patterns in their input. Those children who approximated the adult-like patterns were exposed to more Fering input than their peers who regularized gender. These results highlight the importance of input quantity in the context of community-wide inconsistent input, and demonstrate that when given sufficient input, children can acquire inconsistent patterns in the input.

Language acquisition research seeks to determine how children construct adult grammar based on the linguistic input to which they are exposed. Traditionally, such research has focused on questions, such as how frequency influences the rate of acquisition, or whether there is a one-to-one matching between the input a child receives and her linguistic behavior (e.g., Allen & Crago, 1996; Blackwell, 2005; Gathercole, 1986; Goodman, Dale, & Li, 2008; Naigles & Hoff-Ginsberg, 1998). More recently, studies have begun to investigate how different types of language input, including probabilistic input, influence the course of language acquisition. Examining acquisition in the context of different input types (e.g., inconsistent or variable input) across development provides insight into the process of language acquisition more generally.

Past research examining children's acquisition of probabilistic input has focused on variable input and inconsistent input. In the context of these input types, children hear two or more alternating forms to express the same meaning. Variable input is probabilistic input that is contextually dependent and constrained by either linguistic (e.g., syntactic category, phonology) or sociolinguistic factors (socioeconomic status, sex, speech style), or both. Developmental sociolinguistic research has mostly focused on how children acquire the factors constraining variation in adult speech (Foulkes, Docherty, & Watt, 2005; Miller, 2013a; Roberts, 1994; Smith, Durham, & Fortune, 2007, 2009). Fewer studies have investigated how variable input might impact children's acquisition of the target grammar; for example, how variably produced morphological markers are acquired, in comparison

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to how consistently produced morphology is acquired (but see Johnson, 2005; Miller, 2007, 2012, 2013b; Miller & Schmitt, 2010, 2012). Studies on variable input generally investigate children in naturalistic settings by comparing acquisition in different varieties of a language, one variety where a particular morpho-syntactic form is consistently produced in the input and another variety where that form is variably produced.

A related line of research examines the impact of inconsistent input on acquisition, that is, probabilistic input that is not constrained by linguistic or sociolinguistic factors. Hudson Kam and Newport (2009) liken inconsistent input to the input produced by L2 speakers to their children. They note that in the case of inconsistent input, “a form is used some percentage of the time in a particular context, with its occurrence or non-occurrence not predictable on the basis of the context” (p. 32). Research on acquisition of forms that are inconsistently produced in the input has advanced substantially over the last decade through the use of artificial language learning methods (Hudson Kam & Newport, 2005, 2009; Wonnacott, 2011). These studies are especially fruitful because they allow for careful control of the level of inconsistency of a particular form in the input to which children are exposed and, subsequently, they allow for investigating the impact of different levels of inconsistency on acquisition.

Research examining the impact of inconsistent input in a naturalistic setting is uncommon. One context where community-wide inconsistent input may arise, that is perhaps more commonly found in natural language, is in heritage language and language contact situations, where children acquire the minority language from their parents and the majority language from the larger community. In such contexts, it is often the case that contact between the majority and minority language impacts the use of grammatical forms of the minority language, and sometimes this cross-linguistic contact results in inconsistently produced forms. Several examples of this have been reported in the literature on bilingualism, including inconsistent Spanish gender agreement in Spanish-English bilingual children in the U.S. (Montrul & Potowski, 2007), inconsistent mood choice in adult Spanish heritage speakers living in the U.S. (Silva-Corvalán, 1994), inconsistent differential object marking in adult Spanish-English bilinguals in the U.S. (Montrul & Bowles, 2009), and inconsistent gender agreement in Palenquero-Spanish bilingual adults in Colombia (Lipski, 2015). At times, minority language communities attempt to revitalize and/or maintain the minority language in younger generations and, because of this, speakers in these communities begin to use the minority language more often in public settings (e.g., school, governmental services, newspapers, radio). As speakers begin to increase their use of the minority language in hopes of revitalizing it, children’s exposure to community-wide inconsistent input also increases in terms of the number of speakers they hear producing forms inconsistently and how often they encounter inconsistent input.

One example of community-wide inconsistent input is found in Fering, a variety of North Frisian spoken on the island of Föhr in Northern Germany. This population is bilingual, speaking both Fering and German. In Fering, adult speakers produce gender marking inconsistently (Ebert, 1998; Hendricks, 2014; Parker, 1993). Fering has a two-way gender system, in which gender is marked on the determiner (*de* ‘the.MASC’, *det* ‘the.COM’), and not on the noun. The inconsistency in gender marking arises because adult speakers use both the masculine and common determiner interchangeably with the same nouns and the choice between determiners is not contextually dependent. These inconsistent patterns occur both within and across speakers. Thus, children acquiring Fering as a native language are exposed to inconsistent gender across the community, including at home, and from friends and other adult community members.

While there had been a shift toward using German in past generations, because of revitalization efforts, Fering is now spoken at school by teachers, and in other public domains, such as on specialized radio programs and in rural grocery stores and shops, in addition to being spoken at home (Århammar, 2007). As such, children’s exposure to Fering has increased, giving rise to a naturalistic language learning setting in which children must learn grammatical gender marking from inconsistent input. In addition, because children are exposed to both German and Fering in their day-to-day lives, the quantity of Fering input varies depending on their exposure at home from

their parents and outside the home from the larger community, including friends, teachers, and local community members. Thus, investigating the acquisition of gender marking in Fering provides a rich context for extending research on the acquisition of inconsistent input to the community level, as well as increasing our understanding of how the quantity of input influences language acquisition when children are exposed to inconsistent input. The present study draws on this rich empirical context to ask the following questions.

- (i) How do children acquire grammatical distinctions when they are presented with community-wide inconsistent input in a natural language context?
- (ii) How does the quantity of language input influence acquisition under such conditions?

This article is outlined as follows. We first discuss previous research on the acquisition of gender marking and the acquisition of probabilistic input, including both variable input and inconsistent input. Next, we provide a description of the inconsistent gender marking produced by Fering adult speakers. We then present our results and, finally, we discuss how these results relate to previous findings.

### **Acquisition of grammatical gender**

The time course of grammatical gender acquisition differs across languages and is affected by various factors, including the presence and reliability of phonological and morphological cues to gender assignment. Gender is acquired very early in languages that contain phonological and morphological cues to gender assignment, and where there is no overlap with other features (see Berman, 1985 for Hebrew; Karmiloff-Smith, 1979 for French, Pérez-Pereira, 1991 for Spanish). In contrast, gender acquisition can take longer in languages where gender marking is opaque, with few phonological and morphological cues to gender assignment, and when gender overlaps with case marking (see Henzl, 1975 for Czech; Szagun, Stumper, Sondag, & Franik, 2007 for German). For example, Dutch gender is acquired particularly late as several factors conspire to make the gender system particularly complex, with children making gender errors until they are 6–10 years old (Blom, Poliřenská, & Unsworth, 2008; Cornips & Hulk, 2008). In German, gender marking overlaps with grammatical case and while phonological, morphological, and semantic tendencies for gender assignment exist, these rules are probabilistic in nature (e.g., Köpcke & Zubin, 1984). Thus, gender is acquired slightly later in German than in French or Spanish, but not as late as in Dutch, with German-speaking children achieving 90% gender assignment accuracy around 3 years of age (Szagun et al., 2007).

### **Acquisition of probabilistic input**

There is relatively little research on the acquisition of variable input, and most of this work has focused on the acquisition of the rules that constrain such variation, rather than the acquisition of categorical rules when the input is variable. Research on the acquisition of variable rules has found that children produce variable forms early in development, although they do not always show complete adult-like knowledge of the rules constraining such variation (Labov, 1989; Miller, 2013a; Roberts, 1994; Smith et al., 2009, 2007). Nevertheless, these same studies indicate that individual children approximate the overall usage of the variant forms found in their own caregiver's speech. For example, when comparing recordings of children speaking with their parents, Smith et al. (2007) found a significant correlation between the overall frequency of the variants used in individual child and caregiver dyads (but see Smith et al., 2009). Moreover, children also replicated the frequency of adult use for individual lexical items (Roberts, 1994; Smith et al., 2007). While child-directed speech sometimes initially differs from the language of the broader community, especially for stigmatized forms (Foulkes et al., 2005), caregivers' language begins to approximate

language use in the larger community as children get older. Additionally, as children get older, they generally spend more time hearing input from a larger group of speakers, including their friends at school and other adult community members.

Research investigating the impact of variable input on the acquisition of grammatical morphology indicates that children require more time to acquire grammatical distinctions when their input is variable (Legate & Yang, 2007; Miller, 2007, 2012, 2013a, 2014; Miller & Schmitt, 2012). For example, Miller and Schmitt (2012) investigated the acquisition of plural morphology in two varieties of Spanish: Chilean Spanish, where the plural marker is variably omitted, and Mexican Spanish, where the plural marker is consistently produced. In Chilean Spanish there is a phonological process of syllable final /s/ lenition which creates a context where the plural marker is sometimes produced and sometimes omitted in the input to children. Importantly, this variation is contextually dependent, constrained by factors such as phonological environment, speech style, and socioeconomic status. In contrast, in Mexican Spanish (of Mexico City) the plural marker is consistently produced on plural nouns, determiners, and adjectives by adult speakers, as there is no /s/lenition process in this variety. Through a series of comprehension tasks, Miller (2012, 2015) found that Mexican children associate the plural marker to a more-than-one interpretation earlier in development than Chilean children, and she concludes that variable input affects the time course of acquisition of grammatical morphology.

Turning to research on the acquisition of inconsistent input, Singleton and Newport (2004) provided an in-depth analysis of the acquisition of morphological markers when a child is exposed to inconsistent input. Singleton and Newport investigated the acquisition of grammatical morphology in a child (Simon) acquiring American Sign Language exclusively from his second language-learning parents, who produced grammatical morphemes inconsistently. Thus, the grammatical morphemes in Simon's input were not predictable from either linguistic or extra-linguistic variables. Singleton and Newport reported that, despite his inconsistent input, Simon performed within the normal native-signing ranges for most forms, appearing to regularize inconsistently produced forms. This case study suggests that children may regularize inconsistent forms in the input.

This initial study gave rise to a number of questions that have driven subsequent research on inconsistent input. One such question is how much and what type of inconsistency children can tolerate before they regularize an inconsistently occurring form. To address this question, studies have used artificial language learning paradigms (e.g., Austin, 2010; Hudson Kam, 2015; Hudson Kam & Newport, 2005, 2009; Wonnacott, 2011). For example, Hudson Kam and Newport (2005, 2009) designed a series of studies using a mini-artificial language in which participants were exposed to differing levels of inconsistency with regard to the presence of determiners in the input. Critically, the presence or absence of a determiner was not predictable by social or linguistic factors. Adults successfully acquired the vocabulary and the consistently produced features of the artificial language. However, for inconsistently produced morphology, adults' responses closely paralleled the distributional patterns in their input. That is, adults who received input where determiners were produced 45% of the time with nouns (and omitted 55% of the time) also produced determiners about 45% of the time. However, children's production of inconsistent determiners did not parallel the distributional patterns in the input to which they were exposed. Instead, children showed systematic production of determiners, either producing the determiner with nouns all of the time or omitting it all of the time (i.e., producing bare nouns). Hudson Kam and Newport (2009) found similar results when the inconsistency stemmed from alternations between different forms of the determiner, rather than the presence versus absence of the determiner. Similar to Hudson Kam & Newport (2005, 2009), Hudson Kam (2015) exposed children and adults to artificial languages with probabilistic input. One of the languages contained probabilistic input that was syntactically constrained. In this language nouns that were subjects were more likely to co-occur with a determiner, while nouns that were objects were less likely to co-occur with a determiner. Adults tended to replicate the distributional patterns in their input regardless of whether or not the input was syntactically constrained. Children's performance, however, differed depending on whether their input contained constrained

variation. Children who were exposed to the language with syntactically constrained variation were less likely to regularize the use of determiners. Perfors (2012) suggested that differences in children's interpretation of task-based pragmatic demands may explain why children regularize inconsistent input. That is, if children view the input as inconsistent, with no underlying pattern to master, regularization is the most efficient response.

In an artificial language acquisition study that more closely parallels our natural language study in Fering, Wonnacott (2011) examined children's performance when they were exposed to artificial languages which contained either consistent or inconsistent noun-particle pairings. In the consistent condition, each noun always occurred with the same participle throughout the input. In the inconsistent condition, each noun occurred interchangeably with each of the two particles. In both conditions one of the particles was more frequent in the child's input. Children in the consistent condition were able to accurately learn which particles occurred with which nouns. Children in the inconsistent condition tended to match the overall input frequency of the particles in their own productions, but did not necessarily produce the same noun-particle pairings that were present in their input. Children in the consistent condition exhibited increased learning of unfamiliar noun-particle pairings that were not part of the training.

Wonnacott (2011) also examined children's learning when they are exposed to artificial languages that contain both consistent and inconsistent noun-particle pairings. These languages contained some nouns with consistent noun-particle pairings and some nouns with inconsistent noun-particle pairings. These inconsistent nouns occurred interchangeably with each of the two particles. The languages differed, however, in terms of the frequency of consistent and inconsistent nouns. Both of these languages were more difficult for children to acquire than when the languages contained either all consistent nouns or all inconsistent nouns. However, in both languages, children were able to learn some of the noun-particle pairings. When inconsistent nouns were less common in their input, children were more accurate at learning the consistent pairings than when the inconsistent nouns were more common in the language. Thus, it appears that children can learn consistent noun-particle pairings, even when the language contains some inconsistent pairings. These artificial languages are similar to Fering, in that some nouns in Fering are produced more consistently, thus paralleling the consistent pairings in the artificial languages. At the same time, the task facing Fering-speaking children is more complex in that Fering nouns exhibit a range of inconsistency, while in the artificial language studies each noun is either consistent or inconsistent and all inconsistent nouns occur with one of two particles precisely half of the time.

One model of language acquisition that takes inconsistent input into account is the Variational Learning Model (Yang, 1999, 2002). Although not originally intended for acquisition of inconsistent input, the Variational Learning Model includes a means for dealing with probabilistic input in a quantitative manner. In this model, as children are exposed to input, they determine whether this input supports or conflicts with a hypothesized grammar. If the child's input is inconsistent, acquisition will take longer than when the input consistently favors one potential grammar. The model predicts that consistent input will provide more frequent evidence for a particular grammatical distinction over another, and acquisition will proceed quickly. Inconsistent input, however, provides conflicting information about whether a certain grammar matches the adult target form, and thus, acquisition may require more time or input.

Extending this theory to the acquisition of individual items, rather than grammatical features, Yang (2016) developed the Tolerance Principle, which describes what level of inconsistency speakers will allow before it is no longer advantageous to create a rule. According to the Tolerance Principle, speakers derive a rule based on the most frequent form in their input and then learn exceptions individually. However, when the input includes many exceptions, there is a tipping point when it is no longer efficient for speakers to derive a rule from the input. In these cases, it may require more cognitive resources for speakers to derive a rule than to either produce forms randomly or acquire forms individually. Predictions based on the Tolerance Principle have been tested using child language corpora and experimental tasks (Schuler, Yang, & Newport, 2016; Yang, 2016). Schuler

et al. (2016) found that, as predicted, children derive rules for input when it is efficient to do so and learn items individually when it is not. These studies demonstrate that grammar acquisition is influenced by differences in the reliability of input to which children are exposed. At the same time, these studies have held the quantity of input constant, and examined the reliability of language input independently from quantity of input.

Research, both in usage-based and generativist frameworks, however, demonstrates that the quantity of input children receive is an important factor in language acquisition. Quantity of input refers to the amount of time children are exposed to a language, for example, hours per day. Research on bilingual acquisition, in which by definition children receive less input in each of their two languages compared to monolingual children, shows that the quantity of input influences the rate of acquisition (David & Li, 2008; Unsworth, 2013). In minority language contexts, in which the quantity of input in the minority language is reduced, the quantity of input becomes even more crucial for acquisition (e.g., Gathercole & Thomas, 2009). Understanding how the quantity of input influences acquisition is not limited to usage-based models of language acquisition. Rankin and Unsworth (2016) argue for the importance of accounting for the quantity of language input within generative models of language acquisition as well. With this in mind, the current study seeks to understand whether the quantity of input is similarly important when children are exposed to inconsistent input.

One final consideration pertaining to Singleton and Newport's (2004) analysis of Simon (and arguably for artificial language studies) is that it is not clear what impact the diversity of speakers has on children's acquisition of inconsistently occurring forms. In both Simon's case and in artificial language studies, the number of speech partners is limited. For example, Simon's language input came primarily from his parents. He did not receive input from other signers. As such, the inconsistency in Simon's input was limited to two members of his family. It is unclear whether children would be more likely to acquire inconsistent patterns when they are exposed to these patterns both at home and from the larger community (e.g., school, radio, teachers).

While previous studies have provided important information about children's ability to acquire inconsistently produced grammatical forms, several questions remain unanswered. Such questions include: What is the trajectory of language acquisition when children are exposed to inconsistent input at the community level? How does the quantity of exposure to inconsistent input impact the acquisition of inconsistently produced features?

Studying the acquisition of Fering gender agreement can extend this body of research to address these questions by examining how inconsistently occurring grammatical forms are acquired in a natural language setting where (i) there is inconsistent input throughout the community and children receive input from diverse sources (schools, etc.) and (ii) the quantity of input varies among speakers.

## Fering

Fering, a dialect of North Frisian spoken on the island of Föhr in northern Germany, is one of ten dialects of the North Frisian language. North Frisian is considered an acutely endangered language (Bohn, 2004), even though Fering remains relatively strong compared to the other North Frisian dialects (Århammar, 2007). It is difficult to determine the number of Fering speakers today; current estimates range from 1,500 (Grützmacher, 2012) to 3,500 (Bohn, 2004, Roeloffs, 2012). Bohn reported that there are 1,500 native speakers living on Föhr. Given the limited resources for language revitalization, determining the number of speakers has not been a priority (see Walker, 2001; 2007 for an overview).

Today, children on Föhr have access to different quantities of Fering input and it is spoken alongside German, Low German, and Danish. Some children hear Fering from both parents at home, while others hear Fering from only one or neither of their parents. Further, Fering is spoken more widely in the community in western Föhr than it is in central Föhr, with the least amount of Fering

spoken in the eastern city of Wyk. Therefore, children are exposed to different quantities of Fering in their daily interactions with parents, friends and community members.

### **Fering grammatical gender**

Fering gender is marked on one of two determiners (*de* “the.MASC”, *det* “the.COM”<sup>1</sup>) and not on the noun itself. Therefore, to acquire gender in Fering, children must associate the masculine or common determiner with a given noun. Plural forms are not marked for gender. Table 1 summarizes the modern gender system in Fering. Fering language textbooks used in adult Fering language courses report that gender is marked on adjective endings, possessive pronouns, and subject pronouns (Arfsten & Tadsen, 2009). However, previous investigations have suggested that gender marking beyond definite articles is largely absent in Fering as it is currently spoken. Furthermore, adult and child speakers appear to reanalyze subject pronouns based on animacy and natural gender, rather than grammatical gender (Hendricks, 2014).

Both corpus data (from interviews) and experimental data indicate that Fering gender is produced inconsistently by adult speakers (Ebert, 1998; Hendricks, *under review*; Parker, 1993). Ebert (1998) indicates that this has been the case for at least the last 100 years and Hendricks (*under review*) found that, among highly-proficient adult native speakers who use Fering on a daily basis, older adult speakers produce gender marking more consistently than younger speakers. This latter finding is in line with previous work on Fering gender marking, and suggests a trend toward higher levels of inconsistency over time (Parker, 1993). Native speakers appear to be largely unaware of inconsistent grammatical gender use and report that the use of inconsistent grammatical gender is not stigmatized in the Fering community.

In a recent study, Hendricks (2014), asked 45 adult native-speakers to rate their own use of the masculine determiner and the common determiner for a set of Fering nouns using a Likert scale, which captured not only which determiner speakers used with a given noun, but also how often they used this determiner. This study found that both inter- and intraspeaker inconsistency in gender marking is common in current Fering. That is, in the self-rating, adults indicated that they do not consistently produce the same gender with any given noun, and, additionally, across speakers there is disagreement as to which determiner should be used.

Turning first to intraspeaker inconsistency, inconsistent gender use was common among the adult speakers, with 80% ( $n = 36$ ) of speakers reporting that they use both genders for at least one of the 54 nouns in the study. Moreover, speakers reported using both genders, on average, for seven of the 54 nouns, with some speakers showing more inconsistent use and others showing less inconsistent use (range across speakers: 0–21 nouns). Appendix A presents the adult survey results for the items included in the current study’s experimental elicitation task (see Hendricks, *under review*, for full results). The percentage of “both masculine and common” responses represents the percentage of adults who report using both genders for a given noun, which reflects the level of intraspeaker inconsistency for each item. Thus, intraspeaker gender inconsistency is not limited to a few highly variable speakers, suggesting that children are exposed to inconsistent gender marking from a range of speakers.

**Table 1.** Modern Fering grammatical gender.

	Singular	Plural
Masculine	<i>de boosel</i> “the.MASC table”	<i>dön boosl-er</i> “the.PL tables”
Common	<i>det wel</i> “the.COM bike”	<i>dön wel-en</i> “the.PL bikes”

<sup>1</sup>Fering also has a series of A-articles (*a* “the.MASC”, *at* “the.COM”). Traditionally, the A-articles are used to indicate general reference, while D-Articles (*de* “the.MASC”, *det* “the.COM”) are used for more specific references (Ebert, 1998). As this distinction has largely been lost in modern Fering, we collapse both series of articles in this article.

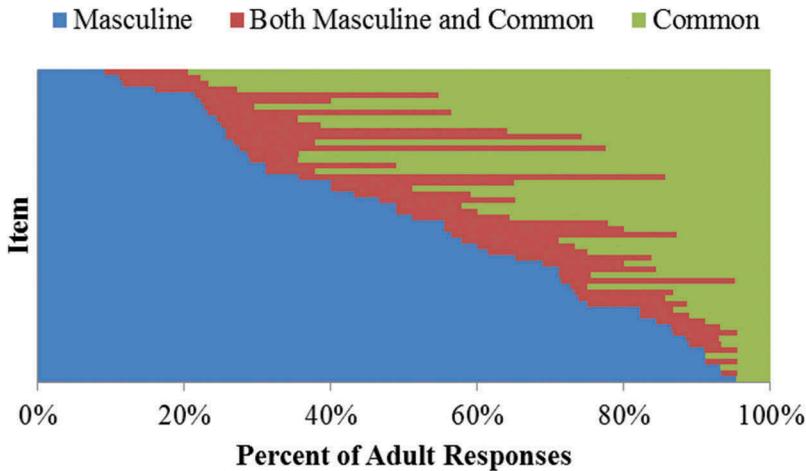


Figure 1. By-item level of grammatical gender consensus from adult survey.

Turning to interspeaker inconsistency, the survey results also indicate that inconsistent gender use is not limited to a few items. All 54 survey items showed some level of interspeaker inconsistency. While gender inconsistency is common across many nouns in Fering, some nouns showed higher levels of inconsistent gender marking than others. Figure 1 illustrates the different levels of consensus for each item included in the adult survey. For example, only 27 of the 45 adult speakers reported using predominately masculine determiners with nouns like *de skreep* “the.MASC purse”. In contrast, gender is produced much more consistently for other nouns, such as *de strun* “the.MASC beach”, where 42 of the 45 adults reported exclusively using masculine determiners (Hendricks, [under review](#)). Higher percentages of masculine or common gender use indicates higher interspeaker consensus.

## Present study

The results of the adult survey revealed two main findings. First, gender is produced inconsistently by adult native speakers of Fering, resulting in inconsistent input for children. Second, there is a lexically determined pattern by which some nouns are more likely to be produced inconsistently than others. This second finding makes it possible to determine whether children have acquired the adult-like gender system in Fering. That is, children who have acquired the adult-like gender system would be expected to not only produce gender inconsistently, but also produce gender following the same lexical probabilities as adult speakers (similar to the pattern seen in Figure 1). These differences in the level of inconsistency across individual lexical items thus allows for distinguishing between several acquisition outcomes: (i) regularization, (ii) random inconsistency, or (iii) adult-like inconsistency. Given the findings of previous studies on children’s acquisition of inconsistent input in artificial language learning experiments (e.g., Hudson Kam & Newport, 2005, 2009), we might predict that children will regularize the inconsistencies in the input, producing only the masculine or only the common determiner with nouns. However, if the inconsistencies are too extensive, we might find, given the predictions of Yang’s (2016) Tolerance Principle, that children will acquire the inconsistent patterns in their own production, either showing random inconsistencies that do not match adult-like patterns or showing adult-like inconsistent patterns. Furthermore, based on the results of Wonnacott (2011), we might predict that children may be able to acquire aspects of the Fering gender system, for example by replicating the adult production patterns for more consistently produced nouns. We address two research questions in this article. First, we investigate whether children produce gender inconsistently when they receive inconsistent input, or whether they regularize the inconsistency in their input, and whether these patterns are modulated

by the quantity of input they receive. Second, we investigate whether children who produce inconsistent gender follow the adult-like patterns of inconsistency.

## Methods

### Participants

Informational packets with consent forms were distributed to all elementary school children in first through fourth grade at both rural elementary schools on Föhr. All elementary school children who returned a signed consent form were invited to participate. Thirty-two children (first grade through fourth grade, age 6;6–10;6, *Mean* = 8;7) completed an experimental gender production task. All children reported exposure to both Frisian and German from birth and that they were exposed to Fering outside the home, in school and in the local community. Thirteen adults, including parents of the elementary school children and additional adult community members, completed the same experimental task to provide adult baseline data for comparison. All adults were compensated for their participation.

Three children were excluded because they did not complete the input questionnaire to determine their quantity of Fering exposure and four children were excluded because they produced more than half of the items in the gender elicitation task without Fering determiners. Responses without Fering determiners included German determiners, indefinite articles and bare stem responses, which were not marked for gender. Thus, these four children did not produce enough responses to confidently determine whether they had regularized gender marking. Of the 25 children included in the final analyses, 17 attended an elementary school in western Föhr, and eight attended an elementary school in central Föhr.

The quantity of Fering exposure was determined using a sub-set of questions from the Utrecht Bilingualism Exposure Calculator (UBiLEC) (Unsworth, 2011). While this questionnaire relies on self-reporting, parent questionnaires have been shown to accurately reflect actual child language input (Gutierrez-Clellen & Kreiter, 2003). The children's parents were interviewed either in person or on the telephone, and when it was not possible to contact the child's parents, the child was consulted (Unsworth, 2011). Following the recommended administration of the UBiLEC, the experimenter asked either the child or the parent how often each partner—the child's father, the child's mother, and the child's friends—spoke Frisian with the child. The experimenter provided a description of a Likert scale, which was adapted for Frisian-German bilinguals based on the UBiLEC:

Hardly ever German, almost always Frisian: 100% Frisian exposure  
 Seldom German, usually Frisian: 75% Frisian exposure  
 About half German, about half Frisian: 50% Frisian exposure  
 Usually German, seldom Frisian: 25% Frisian exposure  
 Almost always German, hardly ever Frisian: 0% Frisian exposure.

Based on the response, the experimenter provided a percentage and asked for confirmation. If necessary, the score was adjusted until the participant agreed on the final percentage of exposure from each partner. An overall percentage of Frisian exposure was then computed based on the percentage of Frisian exposure from the child's mother, father, and friends, with each value weighted equally. The average Frisian exposure was 77.9% (*SD* = 21.8%, *Range* = 33–100%), with similar exposure across all grades (first and second grade: *M* = 76.5%, *SD* = 24%, *Range* = 33–100%; third and fourth grade: *M* = 78.6%, *SD* = 20.4%, *Range* = 33–100%). The range of exposure was similar for both schools, but as expected, children attending school in western Föhr were exposed to slightly more Fering (*M* = 80.3%, *SD* = 20.0%, *Range* = 33–100%) than those attending school in central Föhr (*M* = 72.7%, *SD* = 24.5%, *Range* = 33–100%).

## Materials

Children and adults completed an elicitation task consisting of 24 nouns that differed in their level of gender marking (in)consistency in adult speech, taken from Hendricks (2014). The nouns in Hendricks were selected from the children's book, *My First 1000 Words*, and were judged to be highly frequent and familiar to children learning Fering (Amery, 1998). Additionally, all nouns referred to non-human entities and were non-cognates with German, Low German, nor Northern German Vernacular. The gender of each noun was determined by the adult survey results from Hendricks' survey rather than the gender reported in modern Fering dictionaries, as dictionaries may not reflect current gender use (Hendricks, 2014; Wilts, 2011). Items were categorized as masculine if a majority of the adult speakers in Hendricks reported using masculine gender, and common gender if a majority of the adult speakers from Hendricks reported using common gender (see Appendix A). Half of the items were masculine gender, and half common gender.<sup>2</sup> There was a range of consensus in the survey data for the 12 masculine and 12 common gender items used in the elicitation task.

Previous research has reported mixed findings as to whether Fering gender inconsistency is affected by the gender of a word's German translation. Parker (1993) found that less-proficient Fering speakers may be more inconsistent in gender use for words with conflicting gender across German and Fering. Following this line of reasoning, the gender for the word *table*, which is masculine in both Fering (*de boosel* "the.MASC table") and in German (*der Tisch* "the.MASC table"), would be more likely to be produced consistently than a word with conflicting gender in German and Fering, such as *purse*, which is masculine in Fering (*a skreep* "the.MASC purse") and feminine in German (*die Tasche* "the.FEM purse"). Hendricks (2014) found that this pattern does not extend to highly proficient speakers, as she reported similar levels of gender inconsistency for words with matching gender between Fering and German words with mismatching gender. The stimuli for the current study included nouns containing matching gender between Fering and German in both the masculine category (Match,  $n = 7$ ; Mismatch,  $n = 5$ ) and in the common gender category (Match,  $n = 8$ ; Mismatch,  $n = 4$ ). Nouns were considered to have matching gender if the noun was masculine in Fering and the German translation was masculine or if the noun was common gender in Fering and the German translation was either feminine or neuter.

Table 2 presents the mean level of consensus and range of consensus for masculine and common gender nouns included in the elicitation task (see Appendix A for a complete list of experimental stimuli including the grammatical gender of German translations). Similar to the adult survey, the average level of consensus for the masculine gender items was higher than the level of consensus for the common gender items.

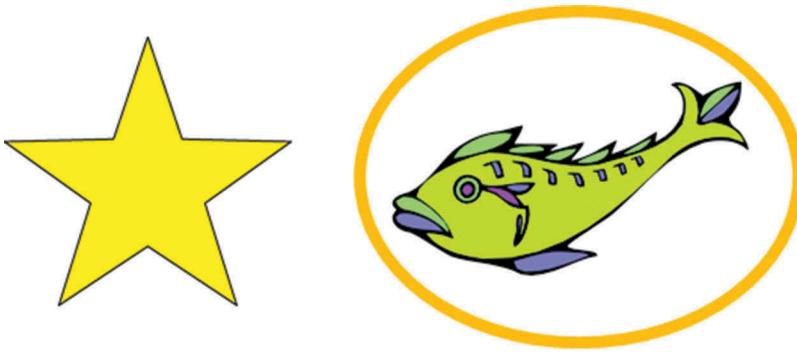
## Procedure

Participants were presented with two images on a computer screen, one of which was circled (see Figure 2). Participants were asked to name both pictures on the screen in order to enter the objects

**Table 2.** Percentage of responses from the adult survey results for items included in the elicitation task (range of percentages for the individual items listed in parentheses).

Survey Grammatical Gender	Masculine Gender Responses	Interchangeable Gender Responses	Common Gender Responses
Masculine	76 (48–96)	8 (0–20)	16 (0–44)
Common	28 (17–40)	6 (0–17)	66 (50–79)

<sup>2</sup>One common gender item included in the elicitation task was not included in the adult survey. For this item, the dictionary gender and community member informants were used to determine the grammatical gender.



**Figure 2.** Sample stimulus for grammatical gender production task.

into the discourse and elicit an indefinite article. Participants were then instructed to tell the researcher, who could not see the pictures, which picture was circled. This procedure allowed for the felicitous use of the definite article in the follow-up question, as seen in the sample wording in 1a-1d. All participants completed three practice trials followed by 24 experimental trials. The experimenter was a native Fering-speaker from the same local area as the children and spoke to the children in Fering during the task.

- (1) 1a) Assistant: *Wat schochst dü heer?*  
“What do you see here?”
- (2) b) Child: *een stäär an een fask*  
“a star and a fish”
- (3) c) Assistant: *Sai Alison, wat heer umkreist as.*  
“Tell Alison what is circled.”
- (4) d) Child: *Alison, de fask as umkreisert.*  
“Alison, the.MASC fish is circled.”

All items appeared twice, once as the target item and once as the distractor item. The target item position (left or right), and whether an item appeared first as a target or a distractor item was counterbalanced across four lists. Participants were randomly assigned to one of the four lists. Participants were given corrective feedback if they did not produce the expected form, meaning a full noun phrase (NP) including the definite article. However, no feedback was given regarding the accuracy of the noun or its article. As long as the participant produced a definite article and noun, they were always given positive feedback. Sessions were audio recorded for later transcription and coding of responses.

### **Coding responses**

Responses were transcribed by a native speaker of Fering and then coded by the first author. Responses were coded as either correct word responses or vocabulary errors. The following types of responses were coded as vocabulary errors: (1) German translations of the Fering word, such as the German word *Tasse* “cup” in place of the Fering word *kop* “cup”, (2) phonologically adapted borrowings, such as *Tass* “cup”, based on the German form, *Tasse* “cup”, (3) other Fering words for similar concepts, such as *skütel* “small bowl” in place of the expected form *dask* “large bowl”, and (4) German words that were not translations of the target item, such as *Feuerzeug* “lighter” for the Fering word *swaavelstock* “match”. There were a small number of responses that did not fit into

these four categories, including other language responses, such as Low German. Plural responses were categorized based on the singular form, for example *tes* “teeth” was counted as a correct vocabulary response, if the singular form *tus* “tooth” was the correct word. The elementary school students produced vocabulary less accurately ( $M = 55.5\%$ ,  $SD = 12.7\%$ ,  $Range = 29\text{--}79\%$ ) than adults ( $M = 83.3\%$ ,  $SD = 8.2\%$ ,  $Range = 67\text{--}100\%$ ):  $t(36) = -7.181$ ,  $p < .001$ . While vocabulary accuracy is not the focus of this paper, given the differences between children and adults, the gender analyses controlled for vocabulary accuracy, as described separately for each analysis below.

All responses were coded for gender, either masculine gender or common gender. Responses that included either of the masculine gender definite determiners, *de*, or *a*, were considered masculine gender responses and responses that included either of the common gender definite determiners, *det* or *at*, were considered common gender responses.

## Results

### Regularization

To test for regularization, the number of children who regularized gender was counted. Following Hudson Kam and Newport (2005, 2009), a strict criterion for regularization was used. Children who used the same gender for “all responses” or for “all but one response” were categorized as having regularized the input (Regularized Masculine Gender Marking or Regularized Common Gender Marking). For example, if a child produced 23 of the 24 items on the elicitation task with masculine gender, she was placed in the Regularized Masculine Gender Marking group. All other participants were considered to have produced gender inconsistently (Inconsistent Gender Marking).

To examine whether participants used only one determiner throughout the entire experiment, all responses with a Fering determiner (*de*, *det*, *a*, or *at*), including responses that involved vocabulary errors, factored into this analysis. Responses with *de*, *det*, *a*, or *at* were considered Fering articles regardless of whether the actual noun provided was a Fering or German word. This means that if a vocabulary error response contained a Fering determiner, such as *de skütel* “the.MASC little bowl” in place of the target word *de dask* “the.MASC large bowl”, this was included as a masculine response.

The results show that some children, but not all of them, regularized gender marking and that regularization favored the masculine determiner. As seen in Table 3, 10 elementary school children regularized Fering gender, while 15 produced gender inconsistently. An independent samples *t*-test revealed that children who produced gender inconsistently had, on average, more Fering exposure from their parents and friends ( $M = 86.5\%$ ;  $SD = 14.7\%$ ;  $Range = 33\text{--}100\%$ ) than those who regularized gender ( $M = 64.8\%$ ;  $SD = 25.9\%$ ;  $Range = 58\text{--}100\%$ ;  $t(12.9) = 2.41$ ,  $p = .032$ ), as based on the average percentage of Frisian exposure calculated from participants’ responses on the UBILEC questionnaire.

### Adult-like inconsistency of grammatical gender

The next question is whether children who were inconsistent in their own gender marking showed adult-like patterns of inconsistency. Recall that some nouns in Fering exhibit greater inconsistency in adult speech than others (Appendix A). If children producing inconsistent gender marking have acquired adult-like patterns, they should show similar patterns as adults across individual nouns.

**Table 3.** Number and percentage of regularized and inconsistent speakers by group.

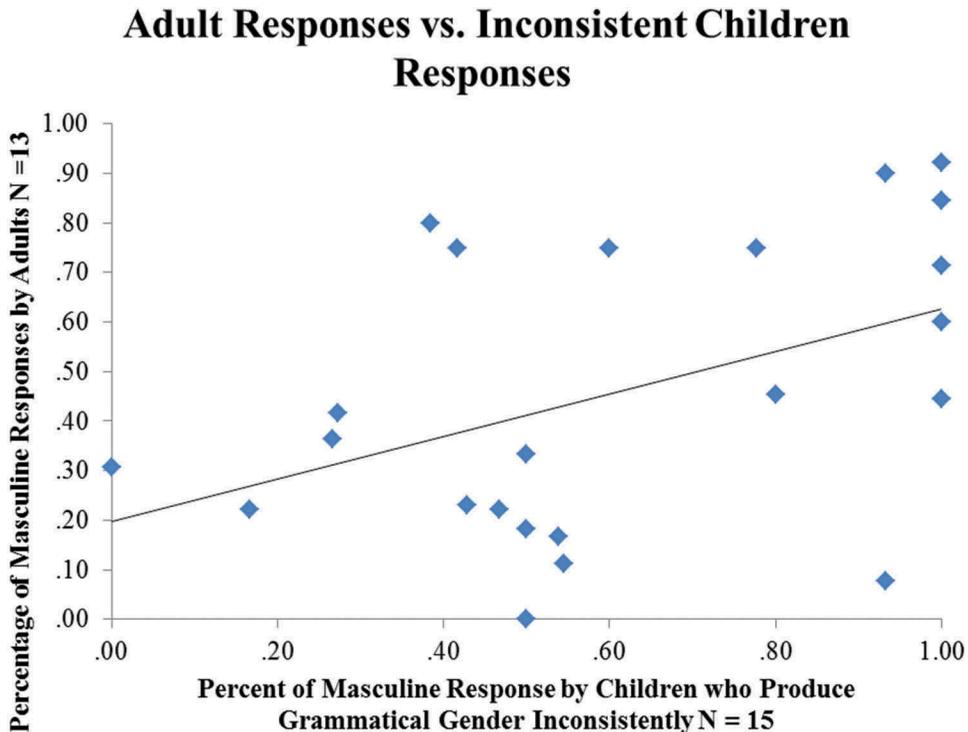
Home Language	Regularized Masculine Gender Marking	Regularized Common Gender Marking	Inconsistent Gender Marking
Adult $N = 13$	0 (0%)	0 (0%)	13 (100%)
Children $N = 25$	9 (36%)	1 (4%)	15 (60%)

Thus, if children show adult-like inconsistency across items, then they should produce mostly masculine gender on precisely the same items for which adults produce mostly masculine gender and, conversely, they should produce mostly common gender on precisely the items for which adults produce mostly common gender.

To test whether the pattern of gender production among children who produce gender inconsistently reflects adult-like inconsistency, we tested whether there was a significant correlation between the adult responses for each item on the elicitation task and the responses for each item by the children who produced gender inconsistently ( $n = 15$ ). In order to directly compare children's gender production and adult gender production on the same lexical items and the same task, all vocabulary errors were excluded from this analysis. The percentage of masculine responses by item was the dependent variable. For each item, we calculated the average percentage of speakers who produced a masculine gender response on the elicitation task. If children's responses correlate significantly with adults' responses, this provides evidence that the children produce gender with adult-like inconsistency. If children's responses do not correlate with adults' responses, this provides evidence that the children produce gender with random inconsistency.

Correlation coefficients were calculated using Spearman's rho, comparing the percentage of masculine gender responses for each item across the subset of 15 children who produced gender inconsistently to the percentage of masculine gender responses for each item in the adult group. [Figure 3](#) shows the scatterplot of the percentage of masculine responses for children who produced gender inconsistently compared to adults' responses for the same item. There was a significant correlation between the children's and adults' responses ( $r_s = .45$ ,  $N = 23$ ,  $p = .032$ ).

As seen in [Figure 3](#), despite the significant correlation, for some items, there is a substantial difference between the frequency of masculine gender responses produced by the children and the adults. [Appendix A](#) provides the by-item results for the elicitation task with the percentage of



**Figure 3.** Scatterplots of percent of masculine responses for each item on the elicitation task between adults and children who produced grammatical gender inconsistently.

masculine gender responses for the 15 children who produced gender inconsistently, adult responses, as well as the difference between adults' and children's responses. Importantly, the adult responses on the elicitation task closely parallel the adults responses from the online survey, although there were slight differences that are likely due to the difference in the task methodologies. Note in [Appendix A](#) that the items that have the same grammatical gender across Fering and German do not appear to pattern differently than those with mismatching gender. Of the 15 items with the same gender in Fering and German, the average difference between children's responses and adult's responses was 21% (*Range*: 1–50%), compared to 33% (*Range*: 11–79%) for the 9 items with different genders across languages.<sup>3</sup>

In contrast, the children and adult responses appear to pattern most closely for items that had high levels of consensus on the adult survey. There were five items for which 80% or more of the adult speakers in the survey reported that they always use the same grammatical gender. For these five items, the children who use gender inconsistently closely parallel the adult responses in the production task, with an average difference of 7% (*Range* 1%-14%). Note that these five items are masculine gender and that there are no common gender items that reached this level of consensus in the adult survey. Items that had lower levels of consensus on the adult survey show greater variability in the pattern of child versus adult responses in the production task (Mean difference: 31%, *Range*: 6–79%). A higher proportion of children's responses were masculine gender overall, with children producing masculine gender more often than the adults for all but four items. However, it is important to note that even though children produced masculine gender more often than the adults, some children still produced common gender for these same items.

## Discussion

The goal of the present study was to investigate how children acquire grammar from inconsistent input by focusing on the acquisition of gender in a natural language setting. Together, the regularization results and the by-item correlations with adult responses revealed that some children regularized gender when they were exposed to inconsistent input, and that those that did were exposed, on average, to less Fering than those who produced gender inconsistently. Further, among those children who produced gender inconsistently, their pattern of gender production approximated adult use.

The finding that some children regularized gender marking supports and replicates results from previous research involving artificial languages (Hudson Kam & Newport, 2005, 2009; Wonnacott, 2011), case studies (Singleton & Newport, 2004) and corpus studies (Schuler et al., 2016). Thus, under some circumstances, the hypothesis that children produce language that is more systematic than their parents' language appears to generalize to inconsistent input at the community level.

At the same time, children with more exposure to Fering produced patterns which were similar to the adult pattern of responses, which suggests that these children are well on their way to acquiring the adult pattern of grammatical gender use. Unlike their peers with less exposure to Fering, who exclusively used one grammatical gender, these children have learned to use both masculine and common gender. Similar to the children learning an artificial language in Wonnacott (2011), these children have begun to acquire the adult-like patterns for some items, as seen by the similar rates of masculine gender responses between the children and adults on the production task for items with a high level of consensus on the adult survey. There was more variability in response patterns between children and adults for items with lower levels of consensus on the adult survey. Thus, it appears that these children have not yet fully acquired the adult probability patterns for all items. The current data cannot speak to why children approximate adult usage patterns more closely for some items than others. Critically, even when children did not closely parallel adult use, they continued to use both common and masculine genders, suggesting that they are not regularizing masculine gender,

<sup>3</sup>For one item with matching grammatical gender children did not produce any correct vocabulary responses.

even for these items. Future research should investigate the production of grammatical gender among older Fering-speaking children to determine whether children are able to acquire the full adult-like probability patterns through additional cumulative exposure over time.

One explanation for these findings is that increased exposure to Fering may provide more opportunities to observe “exceptions” in the input, in line with the Tolerance Principle (Yang, 2016). Children who have more exposure to Fering, both at home and in the local community, have more opportunities to hear exceptions to a masculine default rule (i.e., over-regularization to masculine)—more opportunities both in terms of overall quantity of input and in terms of the variety of speakers they hear producing exceptions. The Tolerance Principle predicts that when the exceptions are low, the rule becomes productive. This is what we find in our children who were exposed to lower levels of Fering, and is in line with the findings from previous studies on inconsistent input (Hudson Kam & Newport, 2005, 2009; Wonnacott, 2011), and Simon who was exposed to inconsistent input in a natural language context from his two parents, but not the broader community. On the other hand, the Tolerance Principle predicts that when exceptions are too high, over-regularization does not occur. We believe that this explains the adult-like inconsistent gender marking found in the children who were exposed to higher amounts Fering, both in overall quantity and speakers, at home and in the community.

The results of this study also parallel research on the acquisition of sociolinguistically and linguistically constrained probabilistic input, which shows that children require more input to acquire grammatical features from probabilistic input (Legate & Yang, 2007; Miller, 2012, 2015; Miller & Schmitt, 2012, 2014; Requena, Román-Hernández, & Miller, 2015). Similar to the children in such sociolinguistic studies, only children with more input in the current study were able to produce gender according to the same lexical probabilities as adult speakers, underscoring the need for more input when acquiring linguistic features that may be variably or inconsistently produced in the input. At the same time, the present findings extend previous work on the acquisition of variably produced linguistic features by highlighting that even in the absence of sociolinguistic rules to help guide acquisition, children who receive sufficient input may be able to approximate adult patterns of an inconsistently produced grammatical feature. At the same time, we acknowledge that this conclusion is limited by the design of our study, which did not allow us to examine whether children produce gender inconsistently for the same nouns across multiple productions. That is, our data can only speak to interspeaker inconsistency at the community level and not intraspeaker inconsistency at the individual speaker level. Future research is needed to determine the relationship between interspeaker and intraspeaker inconsistency.

Importantly, the current study also extends the body of research on the acquisition of probabilistic input to a bilingual context. Much of the research on sociolinguistically constrained variation has been conducted in monolingual contexts (Miller, 2013a; Miller & Schmitt, 2010), but less research has investigated how bilingual children acquire grammar from probabilistic input (see Miller & Hendricks, 2014). Bilingual children are exposed to two or more languages and, thus, receive less input in each of their languages as compared to monolingual children. Despite this, some children in the current study were able to acquire a complex and probabilistic grammatical feature. On one hand, this finding underscores the impact that the quantity of input has on acquisition, while on the other it demonstrates that even children who do not have input from exclusively one language can faithfully acquire probabilistic features of the target language. In line with the large body of research documenting children’s ability to successfully acquire multiple languages (e.g., Golberg, Paradis, & Crago, 2008; Paradis, Nicoladis, Crago, & Genesee, 2011), the current study further demonstrates that bilingual children can successfully acquire a minority language, where exposure to the language may be more limited relative to the majority language, even when they are faced with more complex circumstances, such as acquisition in the context of inconsistent input.

Artificial language learning methods are advantageous in that they can control the level of inconsistency in the input, as well as the amount of exposure to the language each child receives. Nevertheless, investigating acquisition of inconsistent input in a natural language setting is also

crucial for understanding how input-type impacts language acquisition. Comparing findings from multiple settings is important for the sake of triangulation, as different factors may arise in natural language settings than in lab settings. For example, Fering children were exposed to inconsistent gender marking on a daily basis and were acquiring a language that could be used to communicate within their community. Such differences may account for why some children in this study were able to acquire the inconsistent patterns—which differs from previous work in lab settings. Thus, we believe minority language communities are an ideal context for further examining the acquisition of inconsistent input. The findings reported here not only support those from artificial language learning studies, but also suggest that, upon enough exposure from both family and community members, children can acquire inconsistently produced grammatical forms in an adult-like way. Together, the results of current study suggest that, similar to lab settings, some children regularize inconsistently produced grammatical features. However, when children are given additional linguistic input, they can approximate adult-like probabilities. This study underscores the importance of accounting for the quantity of language input, alongside other variables, such as age of acquisition and reliability of input in language acquisition studies. More broadly, this research shows that minority languages and bilingual populations are a fruitful resource for investigating how linguistic input influences language acquisition and, potentially, language change (Miller & Hendricks, 2014). By expanding research on language acquisition to include less commonly studied languages, such as minority languages, researchers can address questions that might otherwise be difficult to answer through the investigation of more commonly studied languages. In this vein, the present study represents a first step in this direction and highlights the ways in which future research on the acquisition of minority languages can inform a diverse range of research questions in the field of linguistics.

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## Appendix A: By-item responses on adult survey and adult and child responses on the elicitation task

Item	Elicitation Task Category	Fering Dictionary Gender	German Gender	Adult Survey Responses				Elicitation Task Responses		Difference between Child and Adult productions
				Masc	Common	Both Genders	Children who use gender inconsistently (n = 15; Percent of Masculine Responses)	Adults (n = 13; Percent of Masculine Responses)		
<i>de riem</i> "the.MASC belt"	Masc	Masc	Masc	96%	0%	4%	NA <sup>1</sup>	83%	NA <sup>1</sup>	
<i>de boesel</i> "the.MASC table"	Masc	Masc	Masc	96%	4%	0%	93%	85%	9%	
<i>de tus</i> "the.MASC tooth"	Masc	Masc	Masc	96%	0%	4%	93%	90%	3%	
<i>de fask</i> "the.MASC fish"	Masc	Masc	Masc	92%	4%	4%	93%	92%	1%	
<i>de basel</i> "the.MASC brush"	Masc	Masc	Fem	88%	12%	0%	89%	75%	14%	
<i>de dask</i> "the.MASC bowl"	Masc	Masc	Fem	80%	16%	4%	100%	60%	40%	
<i>de brag</i> "the.MASC bridge"	Masc	Com	Fem	68%	20%	12%	54%	31%	23%	
<i>de kwaast</i> "the.MASC paintbrush"	Masc	Masc	Masc	68%	12%	20%	100%	80%	20%	
<i>de stäär</i> "the.MASC star"	Masc	Com	Masc	67%	17%	17%	33%	75%	42%	
<i>de skreep</i> "the.MASC purse"	Masc	Masc	Fem	64%	24%	12%	60%	44%	16%	
<i>de brek</i> "the.MASC pants"	Masc	Masc	Fem	52%	44%	4%	60%	0%	60%	
		/Com								
<i>de sees</i> "the.MASC cheese"	Masc	Masc	Masc	48%	40%	12%	42%	22%	19%	
<i>det hōös</i> "the.COM stocking"	Com	Com	Masc	40%	52%	8%	25%	71%	46%	
<i>det reiluk</i> "the.COM curtain"	Com	Com	Masc	38%	54%	8%	57%	45%	12%	
<i>det schört</i> "the.COM shirt"	Com	Com	Neut	33%	67%	0%	17%	22%	6%	
<i>det skaab</i> "the.COM closet"	Com	Com	Masc	33%	50%	17%	87%	8%	79%	
<i>det riiv</i> "the.COM rake"	Com	Com	Fem	32%	68%	0%	44%	36%	8%	
<i>det ruus</i> "the.COM flower"	Com	Masc/Com	Fem	29%	63%	8%	83%	33%	50%	
<i>det kop</i> "the.COM cup"	Com	Com	Fem	24%	76%	0%	60%	17%	43%	
<i>det triihuk</i> "the.COM triangle"	Com	Masc	Neut	24%	68%	8%	64%	42%	23%	
<i>det wel</i> "the.COM bicycle"	Com	Com	Neut	20%	76%	4%	40%	18%	22%	
<i>det knif</i> "the.COM knife"	Com	Com	Neut	17%	79%	4%	54%	23%	31%	
<i>det bleed</i> "the.COM newspaper"	Com	Com	Fem	17%	79%	4%	0%	11%	11%	
<i>det pokluad</i> "the.COM pencil"	Com	Com	Masc	Not tested			86%	75%	11%	

<sup>1</sup> Children did not produce any correct vocabulary responses for this item