The Effects of Attrition on Grammatical Gender:
A View from North American Icelandic

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ABSTRACT
Heritage grammars have been argued to differ with respect to whether they are an instantiation of divergent attainment or attrition. Attrition and divergent attainment are not mutually exclusive and can even co-exist with respect to the same or different grammatical phenomena, but teasing these apart requires longitudinal studies or carefully selected cross-sectional data (Montrul, 2008; 2016; Polinsky, 2011). In this article we present data from a longitudinal corpus of letters written by a speaker of North American Icelandic over a span of seventy-two years. The earliest letters suggest that the writer acquired Icelandic consistent with the baseline. However, in the last thirty years of writing, non-target forms emerge in the corpus. Morphosyntax, notably grammatical gender and inflectional morphology, is the most affected domain of grammar. In this article we focus on the nature of the changes attested for grammatical gender across time. Our results show that gender assignment does not undergo a systematic re-analysis. However, the non-target gender agreement indicates the overuse of an agreement default, which may reflect a trend towards a systematic reduction of the gender agreement system.

KEYWORDS: *Attrition, Grammatical Gender, Inflection, Icelandic*

INTRODUCTION
Grammatical gender is a language-specific property that is subject to a great deal of cross-linguistic variation (see, e.g., Corbett, 1991). This variation raises the question of how generalizations about gender assignment are formed and maintained in situations of reduced input and use. In this article we address this question through the lens of heritage language speakers, using a longitudinal corpus of North American Icelandic (Björnsdóttir, 2014). The corpus contains writings that span seven decades (1908-1980) of an individual speaker of North American Icelandic.

The first decades of writing indicate that the writer acquired Icelandic in a manner consistent with the baseline.[1] There are no non-target forms attested in the corpus until the last three decades of letter writing. In this article we focus exclusively on changes that affect grammatical gender, since this is one of the morphosyntactic properties that is most affected in the last decades of letter writing. We interpret the late non-target forms as the result of language attrition due to reduced input and use of Icelandic.

Grammatical gender has been argued to be vulnerable in reduced input situations (e.g., Polinsky, 2008; Lohndal & Westergaard, 2016). However, the inter-speaker variability that typically characterizes heritage language populations can make it hard to pinpoint how grammatical

gender in heritage varieties differs from that of the baseline. For instance, Polinsky (2008) reports a systematic re-analysis of the gender system in heritage Russian, whereas Lohndal and Westergaard (2016) argue that there is no systematic pattern in the non-target gender marking attested in a corpus of American Norwegian speech, except that there is a clear trend towards the default gender. As a result, they speculate that the Polinsky (2008) represents the outcome of divergent attainment (Polinsky, 2018), whereas the latter represents the outcome of attrition. In this study, we present longitudinal corpus data from North American Icelandic, as evidence for the effect of attrition on grammatical gender and compare them to previous findings. In particular, we ask whether it is possible to discern a systematic pattern of the non-target gender marking that emerges as a function of time in the longitudinal corpus. The nature of the changes can shed light on what grammatical processes are affected in a situation of language loss.

The article is structured as follows: First, we discuss the challenges of inter-speaker variation in heritage language populations. In addition, we discuss some prior hypotheses regarding the effect of attrition on heritage grammar outcomes. Predictions for the attrited grammar are formulated on the basis of findings from first language acquisition. Next, we discuss prior research on grammatical gender in heritage language situations. A descriptive overview of the gender system in Icelandic is provided, followed by our main research questions and predictions. Subsequently, we present our data and methodology. Finally, we present the results of the corpus analysis and discuss the implications of the findings for our understanding of attrition more generally.

HERITAGE LANGUAGES: OPPORTUNITIES AND CHALLENGES FOR LINGUISTIC RESEARCH
Divergent Attainment versus Attrition
Heritage languages have come to play a more significant role in theoretical linguistics in recent years, as they offer the possibility to study linguistic development in situations of reduced input (Polinsky, 2018; Lohndal et al., 2019): Heritage speakers typically have less exposure to the target language than monolingual speakers and often also have exposure to input that is attrited or somehow divergent from the non-heritage variety of the language, both in childhood and adult life (Sorace, 2014). Therefore, studying heritage languages can shed light on how language experience shapes grammatical competence. Questions in theoretical approaches have centered on which properties of a heritage language are similar or different to those of the baseline.

The goal of research on heritage grammars is, in the broadest sense, to understand how and why speakers of heritage language varieties differ from the baseline. What kind of non-target forms do heritage speakers produce and how robust are they? Investigating the nature of non-target forms is crucial in order to understand what kind of cognitive processes they reflect. Heritage grammars have been argued to differ with respect to whether they are an instantiation of divergent attainment or attrition. Incomplete acquisition, more recently referred to as divergent attainment (Polinsky, 2018), is a first language learning process that is somehow interrupted due to insufficient input and use throughout childhood (see, among many, Montrul, 2008; Montrul & Perpiñan, 2008; O'Grady et al., 2011; Polinsky, 2006; Rothman, 2007). This attainment may result not only in quantitatively less exposure to the minority language, but also a potentially qualitative difference in the composition of the input.

Attrition may occur when a heritage speaker did reach age-appropriate proficiency some time in childhood, but later in life their proficiency did not match that of a baseline speaker (Montrul, 2008). Seliger (1991) defined attrition as "the temporary or permanent loss of language ability

as reflected in a speaker's performance or in his or her inability to make grammaticality judgments that would be consistent with native speaker monolinguals of the same age and stage of language development" (p. 661). In this context, language attrition refers to non-pathological language loss in the context of bilingualism and language contact situations. According to de Bot and Weltens (1996), attrition occurs during the first generation of immigration and affects structural aspects of the first language as a result of language shift, or a change in the relative use of the first and second language.

Attrition and divergent attainment are not mutually exclusive and can even co-exist with respect to the same or different grammatical phenomena, but teasing these apart typically requires longitudinal studies or carefully selected cross-sectional data (for a discussion of these issues, consult Montrul, 2008). Understanding how heritage grammars are differently affected by divergent attainment and attrition, respectively, is important to understand what constrains variation in heritage grammars in general.

Attrition and Grammatical Representation

Central questions in research on attrition are: Does attrition involve qualitative changes in the L1 system at the level of representation, or does it involve difficulties with access and control of the linguistic system during performance (Seliger, 1991; Sharwood-Smith & van Buren, 1991)? Implicit to this line of questioning is whether attrition reflects a change in individuals' competence in a language or in their actual performance (cf. Chomsky, 1965).[2] If attrition results in a change in an individual's competence, then we expect systematic re-analysis to occur in the grammar. Conversely, if attrition primarily affects an individual's performance, non-target forms would not reflect the systematicity typically associated with language change, such as the overuse of regular forms at the expense of irregular ones. Rather, they should reflect probabilistic and occasional erroneous use of forms and structures, rather than categorical changes in grammatical representation.

In support of the former view, Seliger (1991) argues for the preservation of unmarked over marked parameter settings and forms in attrition. He argues that reanalysis or "restructuring" typically occurs in the morphosyntax in attrition situations, referring to the deletion of certain grammatical elements of the L1 or the addition of elements of the L2 into the L1. In a similar spirit, Jakobson (1941) formulated the Regression Hypothesis, suggesting that the order of attrition is the reverse of the order of acquisition, would mean that attrition is constrained by the same mechanisms as L1 acquisition. That is, unmarked sounds, features and parameter values that are typically learned early in L1 acquisition should be preserved in attrition. Several researchers have indeed agreed that sequences of L1 acquisition and L1 attrition are related in reverse (Andersen, 1982; Pan & Berko-Gleason, 1982; see Keijzer, 2010, and Polinsky, 2018 (p. 31) for discussion). Therefore, comparing established stages of development and processes in L1 acquisition to attrition data may be a fruitful line of inquiry, cf. Keijzer (2010) and Polinsky (2018).

The Activation Threshold Hypothesis (Paradis 2004, 2007) posits a different approach to attrition, rooted in cognitive neuroscience, which emphasizes the role of inhibition and frequency in bilingual language use. The central claim of the Activation Threshold Hypothesis is that attrition is the result of the "long-term lack of stimulation". Intensive use or exposure to one of the languages in a bilingual environment leads to a lower activation threshold for that language, even in early, fluent, behaviorally balanced bilinguals (Paradis 2004:28). The activation threshold in this context refers to the amount of positive neural impulses required for a linguistic

item to reach its neural substrate. If a linguistic item is inactive due to lack of use, as in heritage language situations, the threshold of activation rises. Conversely, the more a linguistic item is used, the lower the activation threshold. Thus, the Activation Threshold Hypothesis claims that the effects of attrition can be explained in terms of language use (for experimental evidence in favor of this view, consult Hulson, 2000). In a similar vein, Montrul (2008) argues that attrition in adults primarily affects aspects of language performance (retrieval, processing and speed). According to this view, attrition does not lead to incomplete or divergent grammatical representations, as may be found in adult L2 acquisition or child L1 attrition.

Formulating Predictions for Attrited Grammars on the Basis of Findings from L1 Acquisition

A key finding in first language acquisition research is that children draw a categorical distinction between regular and irregular processes in the target language (Pinker, 1999; Clahsen, 1999; Yang, 2016). This distinction has also been argued to be reflected in the nature of the non-target forms that children produce: They extend productive, but not unproductive, patterns to novel items, as is evident from the much higher rate of over-regularization errors in comparison to errors of over-irregularization (Xu & Pinker, 1995). For instance, children acquiring English go through a stage in acquisition where they produce forms like *breaked* and *foots*, even if these forms are unattested in the input. Thus, children somehow come to perceive 'add -*ed*' as a productive rule at a certain stage in their language development. Children's behavior in this respect has been taken as direct evidence of the psychological reality of symbolic linguistic rules in first language acquisition (Pinker & Prince, 1994).

However, the regular-irregular dichotomy has been contested over the years. Rumelhart and McClelland (1986) built an artificial neural network, which had been successfully taught to produce past tense forms of English verbs. Crucially, the network represented and processed both regular and irregular verb forms using the same mechanism, namely neural connections of varying strength. This has been taken as evidence against the psychological reality of symbolic rules, since humans might be able to use the same kind of mechanism for both regular and irregular processes.

Grammatical gender is a fruitful ground for investigating how regular and irregular processes are acquired, since gender systems typically have regularities (for instance, nouns that end in –*a* are most often feminine in Spanish) as well as exceptions that go against these regularities. Gender systems are also typologically diverse and, as such, of interest to heritage language research. Grammatical gender has descriptively been defined as the sorting of nouns into classes, which is reflected in agreement patterns outside of the noun itself (Hockett, 1958;, Corbett, 1991). Typologically, gender systems have been argued to fall into two main groups: 1) semantic systems of gender assignment, and 2) formal systems of gender assignment, depending on whether formal or semantic information is predictive of gender assignment (Corbett, 1991; Kramer, 2015).

Knowledge of a language that encodes gender involves being able to predict which nouns fall into which group or gender class. Children have been shown to generalize gender assignment in their language on the basis of noun endings or suffixes in the nominative singular (Karmiloff-Smith, 1979; Levy, 1983; Mills, 1986 and much subsequent research). However, gender systems differ with respect to how predictive noun endings are to gender assignment. Gender systems with a set of predictive formal cues to gender assignment have been described as transparent, whereas gender systems that have few such cues have been described as opaque

(Slobin, 1977).

These cross-linguistic differences are reflected in children's learning trajectories, with transparency being the main predictor in children's behavior (Rodina & Westergaard, 2012, 2015). For instance, Spanish-learning children, aged 34-42 months, with an estimated vocabulary of only 500 words, have been shown to use gender-marked articles in establishing reference (Lew-Williams & Fernald, 2007). By contrast, the highly opaque Norwegian gender system has been shown not to be in place until around age seven (Rodina & Westergaard, 2015).

However, regardless of whether the gender system is transparent or opaque, the learning task must consist of discovering which linguistic patterns are predictive of gender assignment in the target language. Cross-linguistically, children have problems with the gender assignment of nouns with nominative singular suffixes that are syncretic between two or more genders. For instance, Russian neuter nouns ending with an unstressed *-o* are ambiguous with feminine nouns ending in unstressed *-a,* since they are pronounced in the same way. This gender ambiguity is reflected in late acquisition: these nouns' gender is learned much later than the gender of other noun classes in Russian (Gvozdev, 1961).

To sum up, first language acquisition of grammatical gender seems to be characterized by a search for regular patterns in gender assignment. In light of the above discussion, we ask whether there is a distinction between regular and irregular forms in attrition. If irregular forms are more affected than regular ones, it suggests that regular forms or 'rules' are more resilient to language loss than irregular forms, which presumably must be memorized. The reverse scenario would suggest that attrition could lead to difficulties with mastering rules or regular patterns. Finally, if regular and irregular forms are equally affected in attrition, this suggests that the regular-irregular distinction may be irrelevant in attrition.[3]

Grammatical Gender in Heritage Languages: Prior Research
In general, grammatical gender is an area where heritage speakers struggle (Montrul, 2016). Scontras et al. (2018) show that heritage speakers can restructure their gender system systematically, which is to say that the documented loss of agreement is related to an underlying structural change. Cases of L1 attrition have also been documented by Pelc (2001) and Schmid (2009), demonstrating that grammatical gender can change over the lifespan of L1 speakers under the influence of another language. In the remainder of this section, we consider two cases of grammatical gender restructuring in more depth, involving heritage Russian and heritage Norwegian.

Grammatical Gender in Heritage Russian
Russian is a three-gender system that distinguishes between masculine, feminine and neuter. Polinsky (2008) investigated gender assignment in adult speakers of Russian as a heritage language spoken in the United States. In a production task, participants were asked to use an unambiguous adjective to agree with inanimate nouns in Russian. The results showed that nouns that conform to regular patterns in Russian gender assignment were completely unproblematic for the participants: Masculine nouns that end in an unpalatalized consonant and feminine nouns that take the suffix *-a* in the nominative singular were used as in the baseline. These patterns are acquired early in monolingual situations (Gvozdev, 1961). By contrast, the participants used non-target gender for nouns that are ambiguous in the nominative singular. Thus, stem-stressed neuter nouns (i.e., *bolóto* 'marsh') are ambiguous with feminine nouns in the nominative singular, and these were consistently assigned feminine. In addition, the participants treated

feminine nouns ending in a palatalized consonant (e.g. *postel'* 'bed') as masculine. Thus, the participants produced non-target gender agreement with nouns that do not conform to regular patterns of gender assignment in Russian. These nouns have been shown to be problematic in monolingual acquisition (Gvozdev, 1961).

However, the participants did not behave uniformly as a group in the experiment. Participants' performance correlated with proficiency in Russian, as measured by speech rate. Participants with lower proficiency produced no neuter agreement and thus showed evidence of having a two-gender system. Participants with higher proficiency showed variable neuter assignment without the collapse of neuter as a category per se. It seems that the lower proficiency group had internalized a gender system that differed in systematic ways from that of the baseline, whereas the non-target gender agreement produced by the higher proficiency group did not suggest a systematic structural change.

Grammatical Gender in Heritage Norwegian

Norwegian dialects traditionally distinguish between three genders: masculine, feminine and neuter. However, the dominant written standard in Norwegian, Bokmål, allows a two-gender system consisting of common gender and neuter, since all feminine nouns may be used with masculine agreement (Venås, 1993). Many urban dialects of Norwegian also seem to have developed a two-gender system (some quite recently). The three-gender system is retained in rural dialects. In some dialects that have traditionally been reported to have a three-gender system, an ongoing change is reported, which is characterized by younger speakers collapsing the feminine with masculine, leading to a system of common gender and neuter also in these dialects (Busterud et al., 2019).

Lohndal and Westergaard (2016) considered whether grammatical gender in American Norwegian was vulnerable. Since gender assignment in Norwegian has been argued to be acquired late in monolingual situations (Rodina & Westergaard, 2015), they were particularly interested in how grammatical gender would be retained in a heritage situation. Lohndal and Westergaard predicted that grammatical gender in American Norwegian would be affected by reduced input because of the opacity of the Norwegian gender system. Investigating 50 speakers in the Corpus of American Nordic Speech (CANS), Lohndal and Westergaard found that, even though all three genders were attested in the data, grammatical gender was vulnerable with a considerable amount of non-target gender assignment. The non-target forms were of the following nature.

(1) a. 39% of feminine nouns occur with masculine gender marking
     b. 48.5% of neuter nouns appear with masculine gender marking
     c. 10.4% of neuter nouns appear with feminine gender marking
     d. 0.7% of masculine nouns appear with feminine gender marking

Overall, the general pattern in the corpus seemed to be overgeneralization of the masculine, which has been argued to be the default gender in Norwegian (Trosterud, 2001). Apart from that, however, no systematic patterns were discerned. Therefore, Lohndal and Westergaard concluded that the variation in gender assignment attested in the CANS corpus was best characterized as "general erosion."

Similar to Polinsky (2008), Lohndal and Westergaard could identify trends among the participants: in Group 1, there were four participants for which no conclusions could be drawn, as the production data was too limited. In Group 2, five participants who seemed to have an

intact three-gender system. On the other hand, nine informants in Group 3 who may not have gender at all since they used masculine forms almost exclusively. The fourth group contained the majority of informants (32). This group produced a mixture of forms, and the informants' rate of non-target forms varied greatly.

A confound in the corpus study carried out by Lohndal and Westergaard was that each participant produced a rather limited amount of data, which made it impossible to provide complete linguistic profiles for of each of them. To address this issue, Rødvand (2018) conducted a gender elicitation task on 25 speakers of American Norwegian from the same community as the speakers in the CANS corpus. Her results showed a great deal of inter-speaker variation and a strong tendency for over-generalization of masculine forms, as in Lohndal and Westergaard's study. However, unlike Lohndal and Westergaard, Rødvand argued that the variation attested was not unconstrained. She argued that the alleged un-systematicity in non-target gender agreement only manifested itself at the group level. Analysis at the individual level, however, revealed a systematic pattern in the non-target gender agreement.

To conclude, it seems that heritage speakers can differ from the baseline both in categorical and probabilistic ways. Categorical differences may be the result of divergent attainment, whereby speakers learn a different system due to a quantitative and/or qualitative difference in the composition of the input from that of the baseline. Probabilistic differences, however, may be the result of attrition, whereby the system is consistent with that of the baseline, but imbalanced bilingualism across the lifespan may lead to difficulties in retrieving or maintaining certain linguistic patterns.

The Gender System of Icelandic: A Descriptive Overview
Icelandic has a three-gender system that distinguishes between masculine, feminine and neuter. Typologically, the Icelandic gender system has been classified as formal (Corbett, 1991). Icelandic has rich gender agreement morphology that manifests itself on the definite article, which is a suffix (2a), adjectives (2b), the past participle (2c) and pronouns (2d). Anaphoric pronouns must refer to the formal gender of the referent irrespective of animacy or biological sex.

(2)   a.   Stóll-**inn**,   skál-**in**,   borð-**ið**

             chair-M.DEF, bowl-F.DEF, table-N.DEF

             'The chair, the bowl, the table.'

       b.   Flott-**ur** stóll,   flott-**ø** skál,   flott-**ø** borð

             nice-M chair-M, nice-F bowl-F, nice-N table-N

             'Nice chair, nice bowl, nice table.'

       c.   Stóllinn   er brot-**inn**, skálin   er brot-**in**, borðið   er brot-**ið**

             chair- M.DEF is broken-M bowl-F.DEF is broken-F, table-N.DEF is broken-N

             'The chair is broken, the bowl is broken, the table is broken.'

d.   **Hann**   er brotinn, **hún**   er brotin, **það**   er brotið

     He (the chair)   is broken, she (the bowl) is broken, it (the table) is broken

     'He is broken, she is broken, it is broken.'

The three genders are attested at roughly equal token frequencies in Icelandic: 32% masculine, 38% feminine, and 30% neuter (Helgadóttir et al., 2012).

In addition to gender, Icelandic distinguishes between four cases: Nominative, accusative, dative and genitive. Gender and inflection in Icelandic interact to form *inflection classes*, which are standardly defined as a set of roots that each share the same set of inflectional realizations (Kramer, 2015). Icelandic reference grammars (see, e.g., Kvaran, 2005) have typically followed the lead of Old Norse reference grammars (Noreen, 1903; Iversen, 1922) by stating the correspondence between gender and inflection without discussing specific gender assignment rules. Neuter has traditionally been assumed to be the default gender in Icelandic (Steinmetz, 2000; see also Trosterud, 2006).

There are strong correlations between nominative singular morphology and gender assignment in Icelandic, as there are in other fusional languages such as German and Russian (Corbett, 1991). In particular, three nominative singular suffixes are predictive of either masculine or feminine, respectively; see (3) and Table 6:

(3)   a.   Nouns that take the nominative singular suffix *–r* are typically masculine.
        b.   Nouns that take the nominative singular suffix *–i* are typically masculine.
        c.   Nouns that take the nominative singular suffix *–a* are typically feminine.

Table 6

Mappings between Gender and Nominative Singular Suffixes in Icelandic

	–r	*–i*	*–a*
Masculine	sokku-r ('a sock')	burst-i ('a brush')	NA
Feminine	brúðu-r ('a bride')	NA	fat-a ('a bucket')
Neuter	NA	NA	aug-a ('an eye')

While these patterns are robust, they do have exceptions. For instance, a small set of feminine nouns take the nominative singular suffix *–r*. Diachronically, most of these nouns have undergone a gender shift to masculine (Iversen, 1922). In addition, a set of high token-frequency neuter nouns take the nominative singular suffix *–a*. The choice of suffix is the result of morphological selection. The same root may select for more than one suffix to yield a minimal pair, as in (4a). Moreover, some borrowed nouns display variation in the choice of suffix, which in turn has an effect on gender assignment, as shown in (4b) and (4c).

(4)   a.   sæt-**i**, sæt-**a**

            cutie-M, cutie-F

            'Male cutie, female cutie'

b.   djóku-**r**, djók-**ø**

joke-M, joke-N

'A joke'

c.   lúpp-**a**, lúpp-**ø**

loop-F, loop-N

'A loop'

There is no productive nominative singular suffix for neuter nouns. The stem-final sound can consist of any phonotactically licit consonant or, less frequently, a vowel. The absence of an overt inflectional marker is indicated by –ø. Neuter nouns can be either monosyllabic or disyllabic, although they are more frequently monosyllabic.

Most nouns in Icelandic are assigned only one gender. However, nouns without an overt inflectional marker in the nominative singular are the primary targets for variation, as shown in Table 7. These nouns have also undergone gender shifts diachronically (Iversen, 1922).

Table 7

Variable Gender Assignment in Icelandic

Noun	Gender	Meaning
saft-Ø	F, N	'juice'
skúr-Ø	M, F	'drizzle'
föl-Ø	F, N	'light snow'

To conclude, the Icelandic gender system has both regular and irregular patterns of gender assignment. How these patterns are maintained in a situation of reduced input will be our main concern in the rest of the article.

North American Icelandic
Between 1870 and 1914, 14.268 Icelanders emigrated to North America (Kristinsson, 1983). Since the population of Iceland was 70.000 at the time, this means that roughly a fifth of the Icelandic nation emigrated. The Canadian government offered Icelanders land by Lake Winnipeg in Manitoba, and an Icelandic colony, Nýja Ísland ('New Iceland') was officially founded in 1875. Icelandic was the official language of the new colony (Arnbjörnsdóttir, 2006, pp. 18-19). The first-generation immigrants emphasized the importance of maintaining the Icelandic language and cultural traditions associated with Iceland. Even though Icelandic was the default language of communication within the Icelandic immigrant communities, children received formal schooling in English.

There seems to have been a positive attitude toward bilingualism in the first decades after immigration, and most second-generation Icelandic immigrants were literate in both Icelandic

and English. This trend seems to have declined during the Second World War, when emphasis was laid on Canadian national unity, and hostility towards foreigners and minorities increased. As a result, many second and third generation Icelandic immigrants learned Icelandic only to a limited extent or did not learn it at all (Arnbjörnsdóttir, 2006, p. 44).

North American Icelandic has been argued to have emerged as a dialect in the years between 1915 and 1975 when contact with Iceland was reduced (Svavarsdottir, 2013). It is likely that North American Icelandic became a heritage language in this time period. There is no comprehensive descriptive account of the grammar of North American Icelandic, which may be due to the great inter-speaker variation that is typically attested in heritage language populations. As a result, the status of North American Icelandic as a dialect has been debated (see Arnbjörnsdóttir, 2006 for a discussion) and there is no recognized 'baseline' variety of North American Icelandic. However, it is well known that North American Icelandic has retained some properties that the homeland variety has lost entirely. In particular, phonological variation that was stigmatized in the homeland variety has been preserved and developed further in North American Icelandic (Arnbjörnsdóttir, 2006).

Research on heritage grammars typically consider how a heritage variety of a language differs from the baseline variety. However, establishing what exactly constitutes the baseline is not always straightforward. In this article, the baseline refers to the language spoken in the latter half of the 19th century in Iceland by first-generation Icelandic immigrants. This was the input to subsequent generations of Icelandic immigrants. Grammatical gender and inflectional morphology have generally been subject to minimal diachronic changes in Icelandic. Changes in inflectional morphology have mainly involved variable use of the genitive and variation in the plural formation of nouns that belong to rare inflection classes (Svavarsdóttir, 1993). It is therefore plausible to assume that the gender system of 19th century Icelandic is identical or very similar to the system attested in the modern language.

Data and Method
The Data: A Longitudinal Corpus of North American Icelandic
The data consist of a longitudinal corpus of letters (82,000 word tokens), written by a speaker of American Icelandic in Canada over the span of 72 years (1908-1980). The data are unique in the sense that it is rare to find so much linguistic output from a single individual over such a long period. The writer was a second-generation immigrant, born to Icelandic parents who had emigrated to Canada four years earlier. Therefore, it seems plausible to assume that the parental input was consistent with the homeland variety.
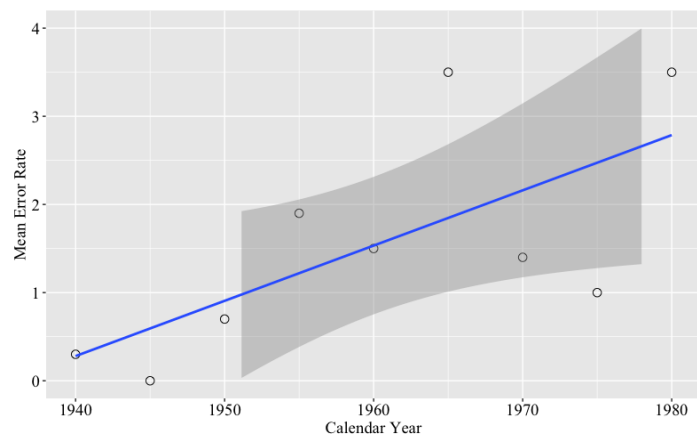
The writer was clearly proud of her identity and visited Iceland a couple of times during her lifetime. The letters demonstrate high proficiency in Icelandic in spite of no formal schooling in the language. The earliest letters were written when the writer was in her teens. These early writings indicate that she acquired Icelandic in a way that was consistent with the baseline. She reported that Icelandic was the only language used in her childhood home. However, in adult life her domestic language was exclusively English. She discussed her reduced use of Icelandic in adulthood in the letters and admitted that she was often unsure of "how to say things in Icelandic."

The last letter was written when she was in her late eighties. In the last three decades of letter writing (1950-1980), non-target forms start to appear in the corpus. Figure 1 shows the distribution of non-target forms by calendar year. The first decades are not included since no

such forms were attested in that period. Mean error rate corresponds to mean (%) occurrence of non-target tokens for every 1000 words of text written in a given period of time.

Figure 1

Mean Number of Non-Target Tokens by Calendar Year

The effect of calendar year on mean error rate was significant (r=0.92) as measured by a simple regression model. The writer was 57 years old in 1950. From that point in time, the increase is roughly gradual, with a sharp peak in the last five years of writing.

The question is what kind of process of language loss the data reflect. Are they evidence of language attrition due to imbalanced bilingualism across the lifespan, or do they reflect cognitive aging and deficits in memory? Since the attrition peaks when the speaker is older, we cannot rule out that the non-target forms observed in later years reflect cognitive aging rather than imbalanced bilingualism.

Preliminary evidence from Icelandic suggests that cognitive aging and imbalanced bilingualism across the lifespan affect language in different ways. Magnúsdóttir et al. (2018) tested three populations of speakers; thirty native speakers of Icelandic over the age of 70, thirty speakers of North American Icelandic over the age of 70, and 30 young native speakers of Icelandic. Participants were tested on their comprehension of short and long passives, *wh*-questions with patient focus, clefts with patient focus and topicalized sentences in a sentence-picture matching task. The results showed that both populations of older speakers differed from the young speakers in that their comprehension of sentences with moved constituents was impaired. However, the heritage speakers differed from the older non-heritage speakers in that they did not make use of case marking as a cue when interpreting thematic roles, like the subject of a passive sentence. Instead, they seemed to rely on word order for thematic role assignment irrespective of case marking. This is consistent with findings from heritage Russian (Benmamoun, Montrul, & Polinsky, 2013).

The older heritage speakers patterned together as a group, whereas the older native speakers displayed a great deal of individual variation. This difference may suggest that morphology is affected by attrition specifically, while sentence comprehension may be affected more generally by cognitive aging. However, additional research that compares heritage speakers and first language forgetters is needed in order to tease these two processes apart (see, e.g., the discussion

in Polinsky and Scontras, 2020).

In what follows, we focus exclusively on the last three decades of letter writing (roughly 50% of all word tokens) and the non-target gender agreement that emerges in that period. Generally speaking, nominal morphology is the aspect of grammar that is most affected by attrition in the corpus, while syntax (including verb second) is resilient throughout the entire time of letter writing, which is similar to what we see across heritage languages (cf. Polinsky, 2018). Grammatical gender and inflectional morphology are similarly affected. Overall, the non-target forms attested in the later years of letter writing are characterized by a great deal of variation, notably probabilistic use of morphological forms.

Research Questions
Research investigating the effect of reduced input on grammatical gender has resulted in divergent findings and different conclusions. We seek to contribute to the ongoing discussion by providing answers to the following questions:

- Is grammatical gender in North American Icelandic vulnerable to attrition?
- Are regular and irregular patterns equally or differentially affected?
- Can a systematic pattern be detected in the non-target gender agreement in the corpus?

Finally, we consider the way in which our findings can contribute to our understanding of attrition more generally.

Method
The original letters are stored in the National Archives of Iceland in Blönduós, Iceland (Héraðsskjalasafn Austur Húnavatnssýslu, n.d.). They were photographed and typed into a text editor. Nouns were extracted from letters written between 1950-1980 and coded for gender, number, case and nominative singular suffix. Since this paper is focused on gender, our analysis is confined to singular nouns, the vast majority of noun tokens in the corpus (78%), as noun pluralization in Icelandic conflates gender and declension. Icelandic has no indefinite article, and a bare noun in isolation carries no information about what gender a speaker has assigned to it. Therefore, gender agreement was taken to reflect gender assignment. In cases of non-target gender agreement with a noun, the syntactic context and type of agreement form was coded (e.g. DP-internal adjectival agreement).

RESULTS
In the last three decades of letter writing, we find non-target gender agreement that was unattested in earlier stages of the corpus; see (5) for an example of this development:

(5)   a.   Lauga   er **falleg-ø**   **kona**. (1924)

          Lauga-F is beautiful-F   lady-F

          'Lauga is a beautiful lady.'

      b.   Lauga er **leiðinlegt**. (1957)

          Lauga-F   is boring-N

'Lauga is boring.'

c.   Lauga   er **farinn**. (1972)

Lauga-F is gone-M

'Lauga is gone.'

In the last 30 years of letter writing, 1% of noun tokens occurred with non-target gender agreement. Masculine and neuter were equally affected by attrition. Overall, feminine nouns had the highest rate of non-target forms. Table 8 shows the distribution of target and non-target forms across genders in the letters.

Table 8

Distribution of Target and Non-Target Gender Agreement Tokens across Genders

	Masculine	**Feminine**	**Neuter**
Target tokens	98.6% (1602)	97% (2042)	99% (1610)
Non-target tokens	1.4% (22)	3% (64)	1% (14)
Target types	97.9% (240)	94.2% (378)	98% (262)
Non-target types	2.1% (6)	5.8% (22)	2% (5)
Total (tokens)	100% (1624)	100% (2106)	100% (1624)

The difference in the percentages of the non-target forms between the three genders was statistically significant (p=0.047), as measured by a generalized linear model, with gender as a fixed effect and lexical identity as a random effect. Therefore, the feminine gender is most affected by attrition in the corpus.

All possible agreement targets (adjectives, verbal past participles and pronouns) were affected. Table 9 shows their numerical distribution:

Table 9

Numerical Distribution of Non-Target Gender Agreement Tokens across Agreement Targets

	Pronoun	**DP-internal**	**Adj. predicate**	**Verbal predicate**
% non-target forms	163 (3%)	66 (3%)	33 (2.7%)	28 (3.5%)
Total number of forms	5459 (100%)	2203 (100%)	902 (100%)	780 (100%)

A generalized linear model with agreement target as a fixed effect and lexical identity as a random effect revealed no significant difference between the type of agreement target and mean error rate (p=0.23).

While the agreement targets were equally affected numerically speaking, the forms that were produced instead of the targets patterned differently depending on the agreement target. Neuter was consistently generalized to pronouns and verbal and adjectival predicates, as shown in (6). In (6a) the writer produces target-like feminine DP-internal adjectival agreement (*góð kona*), but non-target neuter agreement on the referential pronoun and the adjectival predicate.

(6) a. Imba er **góð kona**   en **það** er svo **ráðalaust**.

    Imba-F is nice-F lady-F   but it-N is so helpless-N

    'Imba is a nice lady, but she is so helpless.'

   b. Þeim heiðri   sem þér hefur verið **sýnt**.

    that honor-M that you have been shown-N

    'The honor that you have been shown.'

   c. Hún er svo **íslenskt**.

    She is so Icelandic-N

    'She is so Icelandic.'

Therefore, it appears that the writer considered neuter as default agreement in the case of referential pronouns, adjectival and verbal predicates.

Neuter agreement was also the statistically predominant form in DP-internal agreement, although there is some non-target masculine agreement as well. Feminine agreement was never overgeneralized. (7) provides a few examples of non-target DP-internal adjectival agreement in the corpus.

(7) a. það sje svona **mikill   hatur**

    there be so   much-M hate-M

    'There be so much hate.'

   b. Imba er **guðhrætt kona**

    Imba is god-fearing-N woman-F

    'Imba is a god-fearing woman.'

   c. Hún er svo **mikill   trúkona**

    she is   so   much-M religion.woman-F

    'She is such a religious woman.'

   d. þegar jeg hugsa um allt **þá lengd**

    when I think about all-N this-N length-F
    'When I think about the great distance.'

Of the 66 non-target agreement forms within this category, 42 involved non-target neuter and 22 masculine agreement. Thus, neuter is almost twice as often overgeneralized as masculine in this context, which further suggests that the writer resorted to neuter agreement as a default.

The nature of the non-target gender agreement in the corpus seems to be characterized by an over-use of neuter agreement and a reduction of feminine agreement. However, we have yet to establish whether regular and irregular patterns of gender assignment are affected equally by this process. There are two regular patterns for masculine: Nouns that end in –*r* or –*i*. In addition, there is one regular pattern for feminine assignment: Nouns that end in –*a* are feminine. If the attrition attested in the corpus involves difficulties with retrieving irregular patterns as opposed to regular patterns, then we expect nouns that do not conform to these three regular patterns to be most affected. Conversely, we expect regular patterns to be more affected than irregular patterns, if attrition involves impairment in maintaining regular patterns. Table 10 shows the numerical distribution of masculine nouns by suffix and target forms.

Table 10

Numerical Distribution of Masculine Nouns by Suffix and Target Forms

	-*r* (Regular)	-*i* (Regular)	-*Ø* (Irregular)
Target tokens	98% (705)	97% (1122)	97% (200)
Non-target tokens	1.9% (14)	2.9% (34)	3% (7)
Target types	95% (94)	96% (132)	97% (54)
Non-target types	5% (5)	4% (5)	3% (2)
Total (tokens)	100% (719)	100% (1156)	100% (207)

A generalized linear model with suffix type as a fixed effect and lexical identity as a random effect revealed no significant difference between suffix and mean non-target gender agreement (p=0.32). Therefore, regular and irregular patterns were equally affected for masculine nouns.

Feminine nouns were subjected to the same kind of analysis. Table 11 shows the numerical distribution of feminine nouns by suffix and target forms.

Table 11

Numerical Distribution of Feminine Nouns by Suffix and Target Forms

	-*a* (Regular)	-*ø* (Irregular)
Target tokens	97% (684)	96% (1167)
Non-target tokens	5.6% (23)	4% (48)
Target types	93.4% (122)	94.2% (420)
Non-target types	6.6% (8)	5.8% (21)
Total	100% (707)	100% (1215)

A generalized linear model with suffix type as a fixed effect and lexical identity as a random effect revealed no significant difference between suffix and mean non-target gender agreement (p=0.17). Therefore, there was no evidence that regular and irregular patterns were affected

differently for either feminine or masculine nouns. Since neuter nouns have no regular ending, they were not subjected to this kind of analysis.

DISCUSSION

We had three research questions for our study, repeated here:

1. Is grammatical gender in North American Icelandic vulnerable to attrition?
2. Are regular and irregular patterns equally or differentially affected?
3. Can a systematic pattern be detected in the non-target gender agreement in the corpus?

Regarding our first research question, our investigation showed that grammatical gender underwent changes over time in the corpus. Overall, however, the gender system was maintained, albeit with changes, as only around 1% of all noun tokens had non-target gender agreement. Admittedly, the analysis is based on written output, which means that the speaker may have had more time to plan their language than in real-time spoken production. In the absence of studies that compare written and spoken production data, it is impossible to exclude the possibility that the writer's gender system was more attrited than her written output suggests.

Our second research question concerned regular and irregular patterns in the Icelandic gender system and asked whether the non-target gender agreement reflected difficulties with irregular patterns or vice versa. The results of the corpus analysis indicate that regular and irregular patterns were equally affected. Therefore, the data suggest that gender assignment rules did not undergo a systematic re-analysis whereby irregular patterns regularize. The probabilistic erroneous pattern in non-target gender agreement may suggest difficulties with lexical access or retrieval.

Finally, our third research question was whether a systematic pattern in the non-target gender agreement emerged in the corpus. The writer consistently over-generalized neuter as default agreement on pronouns, adjectival and verbal predicates. In the case of DP-internal agreement, both masculine and neuter were over-generalized, although neuter was used twice as often as masculine. Therefore, the non-target gender agreement mainly involved the over-generalization of neuter as an agreement default. Feminine agreement was virtually never over-generalized to either masculine or neuter agreement, which indicates that feminine agreement was more affected by attrition than masculine. Hence, the non-target gender agreement suggests the over-generalization of an agreement default. Overall, this pattern may reflect a trend towards a systematic reduction of the gender agreement system characterized by the loss of feminine.

It is, of course, impossible to determine with certainty which cognitive factors are responsible for the changes attested in the study. However, a study that compared older native Icelandic-speakers with heritage speakers suggested that the latter group had significantly more difficulties making use of morphosyntactic cues in sentence comprehension (Magnúsdóttir et al., 2018). Therefore, difficulties in the maintenance of morphological patterns in the minority language seem to result from imbalanced bilingualism rather than cognitive aging per se.

The nature of the variation attested in heritage grammars has been debated with divergent findings and conclusions. Prior studies have reported different populations within heritage speaker communities. This suggests that heritage grammars may be affected differently depending on which cognitive processes are involved. Our results suggest that attrition may result in probabilistic erroneous production in the case of morphosyntax. The nature of the non-

target forms, however, is not unconstrained, but rather characterized by a preference for default forms.

SUMMARY

In this article, we provided a longitudinal corpus case study, based on written output, of changes in the gender system across the lifespan in a situation of imbalanced bilingualism. The gender system was resilient to change until the last three decades of letter writing when non-target gender agreement started to appear in the corpus. The non-target forms did not suggest a systematic re-analysis of gender assignment rules in Icelandic since there was no evidence that regular and irregular rules were affected differently. In other words, it seemed arbitrary which noun classes were affected. The non-target gender agreement mainly involved the over-generalization of neuter as an agreement default. Overall, this may reflect a trend towards a systematic reduction of the gender agreement system characterized by the loss of feminine.

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NOTES

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1. In this article the baseline is assumed to be the language of the first-generation Icelandic immigrants in the USA and Canada, who emigrated between 1860-1914.

2. This dichotomy can be interpreted in different ways. For a discussion of four possible interpretations, see Phillips (1995).

3. Whether there is a categorical distinction between regular and irregular processes is one of the major ongoing questions in linguistic research. The objective of this corpus study is not to lend support to either side of the dispute. Rather, our point is that it can be informative to compare heritage speaker errors with child language errors to see whether they are constrained in the same way.