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Grammatical aspect in heritage and monolingual Greek, Russian and Turkish

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In Greek, Russian, and Turkish, grammatical aspect is realized in different ways. The grammars of heritage varieties of the three languages show interesting dynamics regarding aspectual constructions and preferences. This study discusses cross-linguistically the aspect realization in heritage and monolingual populations' production data, investigating the extra-linguistic factors of formality and mode in several communicative situations. In line with previous literature, it was found that under language contact, markedness alongside formality, mode, and narration task impact speakers' choice of aspectual forms. However, these effects are not universal cross-linguistically and especially for the languages under the scope of the present study. Our contribution provides results from an advanced statistical analysis on large-scale cross-linguistic data and contributes to the discussion about novel perspectives in this unexplored field of heritage languages.

Keywords: grammatical aspect, heritage languages, Greek, Russian, Turkish

1 Introduction

Aspect has been extensively explored across various languages and has been intensively investigated in studies dedicated to heritage languages (Cuza et al. 2013, Laleko 2010, Montrul 2002, Montrul & Perpiñán 2011). Commonly, the literature distinguishes between lexical aspect (Aktionsart, situation aspect, or inherent meaning of situations) and grammatical aspect (aspect per se or viewpoint aspect) (Comrie 1976). Grammatical aspect, henceforth "aspect", is distinct from

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lexical aspect and pertains to the various ways of perceiving the temporal constituency of a situation. Aspect is the internal temporal quality of a situation, distinct from the situation's external time, known as tense.

Grammatical aspect can be categorized into imperfective and perfective. Imperfective aspect canonically conveys an ongoing, repetitive, or continuous event or state.[1] Conversely, perfective aspect indicates that an event has ceased without any reference to its timing, essentially signifying that the event is temporally bounded. These categories encompass several subcategories that may vary between languages (Gagarina 2000). The two forms, perfective and imperfective, can be morphologically either marked or unmarked. There are different views on the notion of markedness. In the present study, the notion of markedness that is discussed and analyzed further for the relevant languages relates solely to morphological exponence. The "morphologically less complex form" corresponds to the unmarked form, while the morphologically extra material or additional exponents on the verbal forms corresponds to the marked one, which often is the perfective one (Comrie 1976: 114).

Grammatical aspect is claimed to be among the most susceptible features when languages come into contact, particularly in languages featuring complex fusion-based morphology, such as Greek and Russian, or in agglutinative languages like Turkish with multifunctional tense, aspect and mood morphemes (Polinsky 2008). The fragility and adaptability of aspect alterations within heritage grammars render this phenomenon captivating for study.

Scholars argue for a separate treatment of the Perfect due to its distinct characteristics in different languages (Alexiadou et al. 2012, Iatridou et al. 2003, Bertrand et al. 2022). The ongoing debate concerning whether the Perfect aligns more with aspect or tense remains unresolved. Consequently, the present study refrains from examining the Perfect as we explain in Section 3.

The research of heritage languages and their speakers is a relatively recent field within the broader discipline of bilingualism. Heritage speakers are typically characterized as individuals who speak both a minority language, typically used within their family, and a majority language spoken by the wider society (Polinsky 2018, Rothman 2009). Unlike L2 learners, heritage speakers are claimed to belong in the nativeness continuum according to Wiese et al. (2022) and Rothman et al. (2023), and their competence usually varies alongside the dominance in the two languages that changes across their lifespan (Kim & Puigdelliura 2020, Papastefanou et al. 2019). Heritage languages are usually acquired at home, using the informal spoken form known as vernacular. As a result, speakers are

[1]The information of imperfective can also be neutral to the expression of certain meanings, i. e. the imperfective paradox.

more accustomed to the spoken varieties of the language, while the written variety requires formal instruction. Research exploring register variation in heritage speakers suggests that when heritage languages are learned within the family context, without receiving any formal instruction in the heritage language, heritage speakers' repertoire exhibits a conversational and informal style, which is often limited to everyday topics, resulting in a register narrowing (Dressler 1991, Chevalier 2004).

The paper's objective is to examine the expression of grammatical aspect in languages with distinct typologies: Greek, Russian, and Turkish. By maintaining a parallel analytical framework across the three languages, we explore how both monolingual speakers[2] and heritage speakers of the respective languages in the US and Germany utilize perfective and imperfective aspect. The study is motivated by the typological differences on verbal aspect of languages in contact, such as Greek, Russian, and Turkish in contact with English and German, and the way aspect is marked. We ask whether and to which extent the use of aspect is affected under language contact situations in heritage Greek, Russian, and Turkish. Additionally, we investigate how extra-linguistic factors such as formality and mode influence their language production. What makes this study stand out is its focus on cross-linguistically comparable and ecologically valid data from monolingual and heritage varieties of Greek, Russian, and Turkish in storytelling tasks. Another core grammatical factor, tense, is also taken into account since participants had to narrate what has taken place in a stimulus video as it is explained in Section 6. Participants usually narrated the sequence of events in past tense, and thus the factor of tense has been accounted for an important variable. A unified statistical modeling allows us to assess whether factors like formality and mode impact the speakers' preference in the use of aspect. The paper highlights the great benefits and challenging pitfalls that such research brings and demonstrates ways to build insightful results and conclusions based on careful linguistic, analytic, and statistical decisions.

This paper is structured as follows. In Section 2, we give an overview of aspectual marking in Greek, Russian, and Turkish. Section 3 presents verbal aspect in English and German while Section 4 reviews previous studies on aspect in bilinguals. In Section 5, we introduce our hypotheses and research questions, and Section 6 exhibits a detailed analysis of the methodology including the experimental design (Section 6.1), the participants pool (Section 6.2), the corpus

[2]For the purpose of this paper, we will refer to such speaker groups as monolinguals, although we are aware that most speakers are not truly monolinguals, they are rather monolingually-raised mainly using their first language which is the majority language of the surrounding society, see Section 6.2.

compilation (Section 6.3) and finally the statistical analysis (Section 6.4). Section 7 presents the results on grammatical aspect in the different groups of heritage and monolingual speakers; in Section 7.1, the results are presented descriptively, while Subsection 7.2 provides a joint overview of the results reported by the models. Finally, Section 8 discusses our findings and limitations of the study.

2 Aspect in Greek, Russian and Turkish

The expression of verbal aspect in Greek, Russian, and Turkish differs in its morphological realization. All three languages distinguish between perfective and imperfective aspect although in typologically different ways. In the following section, we address aspect realization in each of the languages in turn.

2.1 Aspect in Greek

The grammatical aspect in Greek can be either perfective or imperfective. The perfective aspect in Greek denotes either completion or instantaneity of events, as shown in (1). The imperfective aspect as presented in (2) is ambiguous between two interpretations. It can correspond to either continuous[3] or habitual[4] interpretation depending on the lexical aspect and linguistic contexts. By using lexical cues like adverbs, the relevant interpretation is clarified (Moser 1994).

(1) Epek-s-e me ti bala tou.
play-PFV-PST.3SG with the ball his
'He played with his ball.' (RUEG corpus, DEbi65MG_isG)[5]

[3]The imperfective verbal form combined with the appropriate adverbial phrase gives a different interpretation to the imperfective aspect.

(i) I Maria pez-i edo ke tris ores.
The Mary play.IPFV-PRES.3SG here and three hours.
'Mary plays for three hours.'

[4]The same imperfective verbal form as in i in the following example expresses habituallity.

(i) I Maria pez-i tis Kiriakes.
The Mary play.IPFV-PRES.3SG on Sundays.
'Mary plays on Sundays.'

[5]In examples taken from the RUEG corpus (henceforth indicated via the participant's code), the

(2) Enas andras epez-e me mia bala.
a man play.IPFV-PST.3SG with a ball
'A man was playing with a ball.' (DEbi03FG_iwG)

Greek has a concatenated morphology, meaning that each verb is marked for tense, aspect, voice and agreement. All verbs are categorized under two main Conjugation Classes (CC).[6] The 1st CC contains verbs which stress falls on the root of all IPFV [-PAST] forms like *gràf-o* 'write' while the 2nd CC contains verbs that exhibit non-root stress like *pid-ò* 'jump'. The imperfective aspect is unmarked, while in order to mark the perfective an exponent /s/ is added in regular (strong) and some irregular (weak) verbs of the 1st and 2nd CC as demonstrated in (3) and (6). In some irregular verbs of the 1st CC morpho-phonological rules are applied while adding the exponent /s/. The consonant /x/ turns into /k/ due to voice and manner assimilation, while the coronal /n/ disappears as it is licensed by morpho-phonological rules (4). Another pattern, besides the exponent /s/, that these irregular verbs of the 1st CC exhibit, is the systematic alternation of the root vowel (5) according to Revithiadou et al. (2019). Furthermore, in all verbs of the 2nd CC there is a vocalic extension that functions as a verbalizer *v*, which either remains empty or it is materialized with a vocalic element. The verbalizer /i/ in (6) denotes the perfective aspect. This vocalic element that carries the perfective value is characteristic for the verbs of 2nd CC, unlike verbs of 1st CC for which the alternation of the vowel, when necessary is part of the root. All examples presented below show the morphological distinction between imperfective and perfective and are in present tense. The imperfective form is always in the indicative mood while the perfective form in the present tense is always in the subjunctive mood.

(3) a. idri-o
establish.IPFV-PRS.1SG
'establish'

b. (na) idri-s-o
SBJV establish-PFV-PRS.1SG
'to establish'

original spelling of the participants is preserved. More information about participants' coding can be found in https://osf.io/qhupg/

[6]There is a 3rd CC according to Holton et al. (1997) and Spyropoulos et al. (2015) consisting of a few verbs like *léo* 'say', *kéo* 'burn'. These verbs possess a null morpheme meaning that they do not have an overt verbalizing suffix, e. g. *akú- Ø-o* 'I hear'.

(4) a. sproxn-o
push.IPFV-PRS.1SG
'push'

b. (na) sprok-s-o
SBJV push-PFV-PRS.1SG
'to push'

(5) a. sern-o
drag.IPFV-PRS.1SG
'drag'

b. (na) sir-o
SBJV drag.PFV-PRS.1SG
'to drag'

(6) a. agap-∅-o
love.IPFV-vocalic.element-PRS.1SG
'love'

b. (na) agap-i-s-o
SBJV love-vocalic.element-PFV-PRS.1SG
'to love'

Some verbs of the 1st CC which are quite frequent in Greek undergo strong suppletion to mark the perfective aspect as shown below in (7):

(7) a. tro-o
eat.IPFV-PRS.1SG
'eat'

b. (na) fa-o
SBJV eat.PFV-PRS.1SG
'to eat'

In sum the morphologically marked form is the perfective form because it requires suffixation or complete stem change, while the imperfective aspect is the morphologically unmarked one.

From the acquisitional perspective, perfective aspect is considered to be the default. This means that it is acquired first even though it requires additional morphological marking (Christofidou & Stephany 2003). Stephany (1997) reports that the perfective aspect is acquired early on in L1 children and specifically at

the age of 1;1 and according to different scholars perfective aspect is acquired earlier than imperfective (Kaltsa 2012, Konstantzou et al. 2013). Finally, the imperfective aspect and the semantic mapping between the habitual and the continuous interpretation is acquired at the age of approximately 5-6;5 (Delidaki 2006, Panitsa 2010).

2.2 Aspect in Russian

The Russian verbal system is rooted in distinctions of aspect. Almost every verb form, both non-finite and finite, is classified as either perfective or imperfective. The perfective aspect, which is considered to be semantically marked, signifies an event in its entirety and establishes its boundaries. Interpretations of imperfective aspect are still debated (Xrakovskij 2015, 2018); the most central are continuous and non-continuous. The latter denotes an event in its entirety. The syntactic context and lexical aspect determine the exact interpretation.

Regarding the morphological markedness, the perfective aspect is considered the marked form, while the imperfective in the morphologically unmarked one (Comrie 1976: 113).[7] The distinction between perfective and imperfective aspects is primarily given by the morphology. The perfective aspectual forms are distinguished from the imperfective verbal stems by means of prefixation (8), suffixation (9), stress placement (10), thematic suffix (11), or suppletion (12) (Gagarina 2008a, Kistanova & Sekerina 2019, Čertkova 1996, Bondarko 1983, Zaliznjak & Šmelev 2000):

(8) a. delat'
do/make.IPFV
'to do/make'

b. s-delat'
PFV-do/make
'to do/make'

(9) a. max-at'
wave-IPFV
'to wave'

[7] One has to add that Russian also allows for additional suffixation of perfective verbs, cf. (17), making these derivations morphologically more marked. However, this strategy is restricted and may only apply to a subgroup of perfective, almost exclusively prefixed verbs. The vast majority of simplex verbs are imperfective in Russian.

b. max-nut'
wave-PFV
'to wave (once)'

(10) a. vysypAt'
pour-out.IPFV
'to pour out'
b. vYsypat'
pour-out.PFV
'to pour out'

(11) a. reš-at'
solve-IPFV
'to solve'
b. reš-it'
solve-PFV
'to solve'

(12) a. brat'
take.IPFV
'to take'
b. vzjat'
take.PFV
'to take'

The majority of verbs in Russian tend to form aspectual pairs (Čertkova 1996, Bondarko 1983, Zaliznjak & Šmelev 2000):

(13) a. uwidila kak Sobaka bischit na Matsch
saw how dog run.IPFV.PRS.3SG to ball
'(I) saw how the dog was running to the ball' (DEbi76MR_fwR)
b. sobaka vy-bežala na ulicu
dog PFV-run.PST.3SG to street
'the dog ran into the street' (DEbi01MR_fsR)

However, there are verbs that do not form aspectual pairs, such as *perfectiva tantum*, as shown in (14), as well as *imperfectiva tantum*, shown in (15):

(14) a. kašlanut'
cough-once.PFV
'to cough once'

b. očutit'sja
find-oneself-somewhere-suddenly.PFV
'to find oneself somewhere suddenly'

(15) nenavidet'
hate.IPFV
'to hate'

Also, Russian features several thousand biaspectual verbs, which, according to the context, can be interpreted as perfective or imperfective.

(16) ispol'z-ovat'
use/utilize-IPFV, use/utilize-PFV
'to use/utilize'

In the example above, the biaspectual verb *ispol'zovat'* 'to use/utilize' may be used both in contexts which require either a verb in the perfective or the imperfective, without changing its form.

Interestingly, Russian allows for the morphological derivation of imperfective verbs from perfective ones (secondary imperfectivization). Imperfective aspect is formed by adding the suffix *-(y)va-* or *-a-* to the stem of mostly derived/non-simplex and some simplex perfective verbs:

(17) a. pisat'
write.IPFV
'to write'

b. pere-pisat'
PFV-write
'to rewrite'

c. pere-pis-yvat'
PFV-write-IPFV
'to rewrite'

Additionally, various *Aktionsarten* are regarded as lexical aspects.[8]

[8] In Russian, Aktionsart and aspect are strongly linked since the aspectual category of a verbal form is also determined by its semantic meaning, as discussed in Isachenko (1968), Lehmann (1978), Seljakin (1983), Hamburger (1984), Seljakin (2001).

In L1 acquisition of Russian, children acquire aspectual meanings very early and produce target-like forms already in their first utterances (Gagarina 2000, 2007, Cejtlin 2000, Kiebzak-Mandera 2000, Gvozdev 1981, Bar-Shalom 2002). However, researchers also report that even monolingual children sometimes produce innovations, i. e. non-target marked aspectual forms, which can be found in child speech until the age of 6 (Cejtlin 2000).

2.3 Aspect in Turkish

Similar to Greek and Russian, Turkish encodes aspect grammatically. In a narrow sense, Turkish expresses aspect with overt verbal suffixes that sometimes also express tense (Göksel & Kerslake 2004). The copula in past tense *-(y)DI*, the marker *-DI*, and the multifunctional evidential marker *-mIş* are mainly applied to mark the perfective aspect. For imperfective, there are several verbal suffixes to express different subtypes. In this sense, the perfective is the morphologically unmarked aspectual form as it is not marked by additional suffixes. The marker *-mIş* denotes the tense as well, and it is not used solely for aspectual marking. Therefore, we consider the perfective form the unmarked one because multifunctional markers are used to denote perfectivity. In contrast, the imperfective is the morphologically marked form as it is expressed using overt suffixes. This opposes Greek and Russian, where the imperfective is the morphologically unmarked form.

In children's acquisition of Turkish, the first and main aspect/tense markers that are acquired and dominate the speech are the perfective-past marker *-(y)DI* and the progressive-imperfective marker *-(I)yor* (Aksu-Koç 1988). These two are also the most frequent markers in our corpus, and thus, we focus on these in the analysis. The two aspectual markers present an ideal case study for the dichotomy between perfective and imperfective aspect. While Aksu-Koç (1988) points out that in a child below the age of 2, these two markers never co-occurred, we know from adult Turkish that they co-occur in utterances where an ongoing event is marked in the past tense, such as in (18). In the Turkish MacArthur-Bates Communicative Development Inventory (MB-CDI) data, more than half of the children older than 3 years old are reported to produce these structures according to their caregivers (Acarlar et al. 2008). This structure is specific to Turkish and cannot occur in Greek or Russian. In our data, these utterances commonly occur in the heritage and monolingual Turkish groups (N=1,186). This significantly distinguishes our adolescent and adult heritage speakers from young children's more limited use of aspect markers and categories.

(18) gid-iyor-du-m
go-PROG-PST-1SG
'I was going.'

For a better understanding of how tense-aspect-mood morphemes (henceforth TAM-morphemes) interact in Turkish, let us have a look at Erguvanlı-Taylan's (2001:101) scheme of the order of verbal morphemes in Turkish applied to the use of aspect in our corpus (Wiese et al. 2020):

(19) V + (voice) + (neg.) + (mod.) + TAM-I + (TAM-II) + agreement +
yerleş + -tir + (neg.) + (mod.) + -iyor + du + m +
(-DIr)
(-DIr)
'I was placing (something).' (DEbi41FT_isT)

The structure of the morphemes in (19) is a valid template for most verbs in Turkish. Optional morphemes are placed in brackets, and obligatory ones are not. In (19), the morpheme *-(I)yor* represents the imperfective progressive aspect. In this example, the TAM-morpheme *-DI* marks tense and occupies the TAM-II position. To turn the given example into a perfective, dropping the *-(I)yor* morpheme and moving the *-DI* morpheme into the TAM-I position would suffice. The *-DI* suffix would then express aspect as well as tense, as shown here:

(20) yerleş-tir-di-m
place-CAUS-PST.PFV-1SG
'I placed (something).'

An inquiry of the most influential linguistic grammars of Turkish shows that there are no uniform definitions of aspectual categories in Turkish (Göksel & Kerslake 2004, van Schaaik 2020, Kornfilt 2013, Lewis 1970). Therefore, we propose the following working definitions firstly for perfective and then for imperfective aspect based on the existing literature: The perfective aspect indicates that an event is bound in time. In other words, it is not continued or repeated with reference to time. Perfectively marked events are completed. This is one of the most frequent aspectual categories in Turkish and is overtly represented by the past suffix *-DI*, as shown in (21).[9]

[9]The multifunctional morpheme *-mIş* is beyond the scope of this paper due to its main role as an evidential marker and its contribution for aspectual and temporal interpretations heavily depends on contexts. It was also not considered in the data analysis of this paper.

(21) Ondan sonra polisi ara-dı-lar.
this later police call-PST.PFV-3PL
'Then, they called the police.' (DEbi04MT_isT)

In Turkish, imperfective aspect is not always overtly marked by an aspectual morpheme (Jendraschek 2011). Rather, imperfective aspect is found when no tense or aspect morpheme is present, as in (22). Marked cases of the imperfective are seen with the suffix *-(y)AcAk* but only when it is not followed by another TAM-marker. Otherwise, the imperfective category would be similar to other aspectual categories, e. g. the prospective.

(22) Sonra bir tane köpek var.
later one piece dog exist.IPFV.3SG
'Later, there is a dog.' (DEbi69FT_isT)

However, there are several other aspectual categories that broadly fall under the umbrella of the imperfective in Turkish. These are all marked with overt suffixes. In the scope of this study, we focus on the progressive marker as a general imperfective marker. Other subcategories, such as habitual, prospective, and rapid-sudden-action are beyond the scope of the general perfective-imperfective contrast in this paper.

The progressive aspect is the most frequent aspectual category within the broader area of the imperfective in Turkish. It is clearly marked by the suffixes *-(I)yor* and *-mAktA*. The latter is specific to formal settings and much less frequent than *-(I)yor*. The progressive aspect expresses that an event is continuous with respect to the referenced time. As we see in (23), the morpheme that expresses the progressive aspect can also express tense if it is the only apparent TAM-morpheme. When *-(I)yor* is followed by a tense morpheme (e. g. the past tense *-(y)DI*), it solely expresses aspect.

(23) Sonra arkadan iki araba gel-iyor.
later from-behind two cars come-PRS.PROG.3SG
'Later, two cars are coming from behind.' (DEbi53MT_isT)

3 Aspect in English and German

The presence of aspect-marking in English has been attributed to the contrast between the Simple Past and the Past Progressive where the former represents

the perfective and the latter the imperfective, which further encodes either continuity or progressivity (Smith 1991). An assumption established by Giorgi & Pianesi (1997) states that eventive predicates in English carry a perfective feature by default. This is evidenced by the fact that English, unlike many other European languages, does not license using the simple present to refer to the ongoing action, but rather is used to mark a general statement, as illustrated in the different meanings in (24) and (25). English requires marking on the verb using the progressive imperfective *-ing* suffix as in (25) while the tense is marked on the auxiliary verb *be*. Thus, regarding the morphological markedness, the progressive (imperfective) aspect with the suffix *-ing* is considered the marked one.[10]

(24) The girl eat-s a watermelon.
the girl eat-PRS.3SG a watermelon

(25) The girl is eat-ing a watermelon.
the girl be.PRS.3SG eat-IPFV a watermelon

However, in past tense, particularly in Simple Past, the flexion *-ed* added in the regular verbs, as in (26), can denote perfectivity and even habituality. Habituality can also be expressed periphrastically with the expressions *used to* and *would* as in (27) (Smith 1991).

(26) The girl plant-ed a watermelon.
the girl plant-PST.PFV a watermelon

(27) The girl use-d to plant a watermelon.
the girl use-PST to plant a watermelon

In contrast, recent studies investigating aspect processing across different languages found that English speakers only interpret the progressive as having an aspectual interpretation but not the past tense marker as having a perfective interpretation (Minor et al. 2023, 2022). Specifically, the participants were shown images of completed versus ongoing events in a Visual Word Paradigm eye-tracking experiment. English speakers looked more often at pictures showing an ongoing event when the verb was progressive-marked. However, participants did not show a preference for the ongoing event or the completed event when they heard a verb in the simple past. In this case, participants' looks were at chance level. Additionally, the progressive imperfective is commonly used as a mean to present the context of a situation in narratives such as in (28) (Smith 1991).

[10]The Perfect is considered marked as well because it carries extra morphological material, namely the suffix *-en* (Comrie 1976: 114).

(28) The sun was sett-ing when they got home.
the sun be.PST set-IPFV when they get.PST.PFV home

It is important to mention that German does not mark grammatical aspect on the verb. Thus, one cannot determine morphological markedness as in the other languages. Aspectual distinctions are made by employing lexical cues (Sioupi 2014). Following Löbner (2002), a broad characterization of three aspectual categories, the perfective, the imperfective, and the perfect, is possible.

Habituality and continuity can be marked in German with periphrastic forms. The former can be expressed in present and past tenses with expressions such as *pflegen zu* 'used to' and *die Gewohnheit haben zu* 'have the habit to' followed by infinitives as in (29). For past tenses, the habituality can be also expressed with the preterite.[11] The latter, continuity, is expressed either with the temporal adverb *gerade* 'now' or again with two different kinds of periphrases like *am/beim* 'on/at' followed by an infinitival form and *dabei sein zu* 'be about to/in the process of' followed by an infinitive.

(29) Er hat die Gewohnheit zu lesen.
he had the habit to read
'He has the habit to read.'

It is a matter of debate whether the German present perfect (Perfekt, *haben* + past participle) corresponds to the English present perfect (Alexiadou et al. 2012, Klein 2000).

4 Previous research on aspect in bilinguals

Heritage varieties of Greek, Russian, and Turkish are claimed to show interesting dynamics regarding aspectual formation and use. Several studies investigating verbal aspect show that this feature is vulnerable in Greek heritage groups. The first scholar who mentioned inconsistencies in the category of aspect is Seaman (1972), who observed an overall simplification of the verb forms and the use of periphrastic constructions in Greek heritage speakers in the US. An exploratory study in adult Greek heritage speakers in Argentina by Zombolou (2011) pointed to the overgeneralization of the perfective over the imperfective aspect, among other phenomena in production tasks. Another study by Rizou (2021) revealed

[11] However, most German speakers make no semantic distinction between the preterite and the present perfect. In some regions, the present perfect is the only form in use, and the preterite is no longer present in the spoken language (Löbner 2002).

that heritage speakers in Germany and the US are more accurate in perfective aspect in an elicited production task without time constraints. Finally, Paspali et al. (2022) checked the accuracy of Greek heritage speakers residing in the US and Germany via a speeded grammaticality judgment task. The German group performed monolingual-like, while the group in the US scored significantly better in the imperfective conditions than in the perfective conditions, indicating that these speakers prefer the morphologically default type, which is the imperfective and, specifically, the habitual one. In their study, Alexiadou & Rizou (2023) show heritage speakers' preference for periphrastic constructions with light verbs, which do not morphologically differentiate the perfective from the imperfective aspect, instead of lexical verbs with prefixes and stem alternations. Results from studies on bilingual children[12] reported in Dosi (2016) for majority Greek in Greek-Albanian children and heritage Greek in Greek-German children (age range 8;0 – 12;0) contradict the results in Paspali et al. (2022) as the imperfective habitual aspect seems to be the most inconsistent one. Similar results are found by Dosi et al. (2017) for (non-)heritage Greek-English bilingual children (age range 8;0 – 12;0). Further research on different groups of bilingual children has shown that the imperfective aspect is in general intact and bilingual Greek-German (age range 8;0 – 11;9) and Greek-English children (age range 8;7 – 12;0) perform monolingual-like (cf. Andreou & Tsimpli (2017) and the same holds for Greek-Italian (age range 8;0 – 8;7) and Greek-English bilingual children (age range 8;0 – 8;8) in the study of Andreou et al. (2021). The common finding in all acquisition studies for children is that the most pervasive aspect is the perfective in line with the Aspect Hypothesis[13] proposed by Andersen & Shirai (1994).

Recent studies on heritage Russian have provided evidence of systematic changes in the usage of perfective and imperfective aspect alongside morphological discrepancies while acquiring this phenomenon (Antonova-Ünlü & Wei 2016, Gagarina 2011, Gagarina et al. 2020, Kistanova & Sekerina 2019, Laleko 2008, Pereltsvaig 2004, Mikhaylova 2018, Pereltsvaig 2008, Isurin & Ivanova-Sullivan 2008). These changes have been observed in periphrastic contexts, some of which are also characteristic of the baseline usage of aspect in child monolingual Russian. An increased use of periphrasis and a decrease of morphologically complex

[12] As bilingual acquisition differs from L1 acquisition, it's worth mentioning how bilingual children perform with respect to aspect in Greek.

[13] The Aspect Hypothesis claims that the inherent semantics of the verbs are the basis on which L2 speakers rely to acquire tense and aspect. Past perfective is used with telic predicates, while imperfective of non-past tenses is used with atelic predicates. It is also known as Aspect First Hypothesis (Delidaki & Varlokosta 2003). Stephany (1981) and Christofidou & Stephany (2003) report that the Aspect Hypothesis also applies to L1 Greek children as they observed in longitudinal studies.

synthetic aspectual forms has been observed for Russian and Turkish bilinguals (Gagarina et al. 2020, Pfaff 2000). Mikhaylova (2018) found out that Russian heritage speakers face difficulties with aspectual morphology, which is decisive in comprehending the aspectual distinctions.

While, to our knowledge, there are no studies that investigate grammatical aspect in (heritage) Turkish bilinguals as an isolated phenomenon, some studies have focused on phenomena that interact with comprehension and production of aspect. In two pioneering online processing studies, Arslan et al. (2015), Arslan et al. (2017) showed that heritage Turkish speakers are slower in responding to evidentiality violations and also that these speakers process evidentiality cues in an eye-tracking task less accurately. Evidential morphology in Turkish is partly syncretic with aspect-marking morphology, which would indicate that heritage speakers of Turkish might also have difficulties when processing grammatical aspect. Another study by Coşkun Kunduz (2018) reports an investigation of production data of English-Turkish bilinguals who acquired Turkish as a second language. She focused on inflectional morphology in the nominal and verbal domain in Turkish in general. In the verbal domain, she finds that substitution errors exceeded omission errors, meaning that speakers tended to replace the target TAM morphemes with inappropriate ones in their productions. Such a finding could also be relevant here, where the use of aspectual morphemes in production data is also relevant.

Although the focus of the paper is on Greek, Russian, and Turkish heritage speakers with English or German as their majority languages, the studies on adolescents and adults in these language combinations are scarce. Nonetheless, findings for grammatical aspect in different heritage languages in contact with English and German report divergent results. Diaubalick et al. (2020) found that Spanish heritage speakers in Germany have successfully acquired the Spanish aspectual morphology on the verbs unlike Montrul & Perpiñán (2011), Cuza et al. (2013) and van Buren (2012) who report low accuracy in terms of aspect and an avoidance strategy of the morphologically complex verbal forms for Spanish heritage speakers in the US and Chile. A study on heritage Icelandic showed that the progressive is used more frequently compared to the homeland variety, pointing to an overstandardization of this morphologically simpler form (Jóhannsdóttir 2023).

In sum, previous studies explored the performance on aspect in different groups of heritage speakers of different ages reporting their accuracy in various tasks. The picture is mixed concerning the cross-linguistic influence of the majority language. In some of the aforementioned studies, it is shown that the way the grammatical aspect is encoded in the majority language facilitates the use of the

equivalent aspect in the heritage language, cf. Dosi (2016) for Albanian-Greek and Andreou et al. (2021) for Greek-Italian, while the exact opposite pattern is shown for different language combinations such as Greek-English in Andreou et al. (2021). This study aims to provide a cross-linguistic exploration of the aspectual use in comparable groups of heritage speakers on typologically distinct languages with a shared methodology. In the next section, we present our research questions for all language groups.

Literature has shown that depending on the different communication settings, phenomena can be affected and realized in different ways. Formality and mode variation fall under the notion of *register* as defined by Pescuma et al. (2023), which is the 'recurring variation in language use depending on the function of language and on the social situation'. Different studies revealed contradicting results regarding discourse and syntactic phenomena in different languages. In the study by Özsoy et al. (2022), coordination is used mainly in informal spoken communication settings while subordination in formal written settings from both heritage and monolingually-raised speakers. Studies on clause combining by Schleppegrell & Colombi (1997), Tsehaye et al. (2021) and Pashkova et al. (2022) show that bilingual/ heritage speakers are aware of formality and mode variation and thus perform monolingual like. The same is revealed in the study by Wiese et al. (2022) for a variety of phenomena. Another example is the cross-linguistic exploration regarding pro-drop, which remains intact in Greek in different communication settings, while formality and mode affect the realization of subjects in Russian and Turkish as shown in Özsoy et al. (In press). Besides the aforementioned studies, there is evidence that heritage speakers overgeneralize the same patterns across communication settings, such as in the case of Greek heritage speakers a specific indefinite article in Alexiadou et al. (2022) and in the case of German heritage speakers light-weight constituents in Tsehaye (2023). This is corroborated by the lack of formal instruction in the heritage language, making some linguistic features and domains inaccessible to heritage speakers as naturalistic language acquisition does not necessarily imply high proficiency in the acquired language (Rothman 2009, Rothman & Treffers-Daller 2014). Due to the lack of formal education in the heritage language, heritage speakers usually have limited or no command at all of the written language (Montrul 2015).

5 Research Questions

To fill the gap in the literature and to test the existing assumptions on the use of aspectual forms in narratives of monolingually-raised and heritage speakers

of Greek, Russian, and Turkish, we formulated the following research questions and hypotheses:

- RQ1: Do heritage and monolingually-raised speakers of Greek, Russian, and Turkish align in their use of aspect?
  - H1.1: The morphological markedness of grammatical aspect might play a significant role in the aspectual preference of our speakers in the different language groups (Polinsky 2018). As we introduced in Section 2, perfective is marked in Greek and Russian, while imperfective is marked in Turkish (Comrie 1976). By hypothesizing that the notion of markedness might affect speakers' aspectual realizations, we expect heritage speakers to opt for the unmarked forms more, namely the imperfective in Greek and Russian and the perfective in Turkish, respectively. These forms are morphologically less complex, and thus, their use might be easier for heritage speakers.
  - H1.2: In addition to H1.1, we also expect to find differences between heritage speaker groups, namely heritage speakers in the US vs. heritage speakers in Germany in the different language groups. Cross-linguistic effects of the majority languages, English and German, might influence the aspectual choices of our speakers while narrating the events. As German has only lexical aspect, heritage speaker groups recruited in Germany will opt for the unmarked forms more frequently. Heritage speaker groups in the US will opt for the marked ones more frequently because English marks aspect grammatically in a similar way heritage languages mark grammatical aspect, namely with prefixes, affixes, and in general with overt markers regardless which aspect is the marked or unmarked in each language.
- RQ2: How do the extra-linguistic factors, such as mode and formality, impact aspect marking across heritage and monolingual speaker groups?
  - H2: Based on the particular methodology used to elicit data, the authors are able to formulate such a research question and explore the speakers' performance in the different communication settings. According to studies on different phenomena and typologically different languages formality and mode variation seem to affect participants' performance on them. In the study by Özsoy et al. (2022), both monolingually-raised and heritage Turkish speakers use more coordination in informal spoken and more subordination in formal

written communication settings. However, there are instances where we would expect register leveling from heritage speakers, but their productions align with the respective monolingually-raised speakers as shown in Wiese et al. (2022) for different language groups. On the other hand, heritage speakers seem to generally pattern with monolingually-raised speakers regarding their knowledge of different communicative settings in many studies on clause types as reported by Schleppegrell & Colombi (1997), Tsehaye et al. (2021) and Pashkova et al. (2022). However, the effects are not universal, and it does not affect the same phenomena across typologically different languages. One such example is the cross-linguistic study by Özsoy et al. (In press) where pro-drop remains intact in Greek, while effects of both formality and mode variation are observed for Turkish and Russian. Furthermore, considering that heritage languages are usually restricted to informal conversations, sometimes the speakers' repertoire lack features transmitted via formal instruction (Dressler 1991, Chevalier 2004, Rothman 2009, Polinsky 2018). Therefore, in cases such as in Alexiadou et al. (2022) Greek heritage speakers overgeneralize an informal determiner across communication settings, unlike monolingually-raised speakers, and this might be related to their proficiency in the heritage language.

6 Methodology

In the following subsections, we provide an overview of the experimental set-up, the composition of the participants' sample, introduce relevant corpus annotation layers as well as the statistical approach we use in the present study.

6.1 Experimental design

The data used in this study stem from the RUEG corpus, an online open-access corpus specifically targeting language variation in heritage speakers (Wiese et al. 2020). The RUEG project aims to investigate heritage speakers' linguistic systems and resources across various language pairs, registers, and age groups. These language pairs include Greek, Russian, and Turkish as heritage languages in Germany and the US, German as a heritage language in the US, and monolingual controls for the majority languages German and English, along with their respective heritage languages, Greek, Russian, and Turkish. The approach utilized in this research is a modified version of the setup developed by Wiese (2020) referred

to as the "Language situations" communication setting, allowing researchers to elicit semi-spontaneous ecologically-valid data. This approach offers comparable naturalistic data in both spoken and written forms, encompassing both formal and informal contexts. By using this particular methodology, we do not explicitly target the elicitation of one specific phenomenon. Unlike controlled experiments, the narration tasks provide us with a variety of phenomena (Alexiadou et al. 2022, 2023). This method captures participants' explicit knowledge through written responses and their implicit knowledge through spoken narratives. During the data collection process, participants were presented with a brief video depicting a fictional minor car accident. Their objective was to describe what took place, imagining themselves as witnesses, either while narrating the incident to a close friend or providing an account to a police officer. To test how formality and mode affect narrations, we simulated the formal spoken, the formal written, the informal spoken, and the informal written settings. Elicitation orders were balanced to avoid bias. Heritage speakers took part in two sessions, one in their majority and one in their heritage language, while monolingually-raised participants took part only in one session, namely in the majority language of the respective country of elicitation. In that way, the participants took part in four different communication settings within one experimental session.The design of the formal and the informal communication setting is described in detail in the OSF repository.[14] The entire session was recorded for transparency purposes, and the data files were pseudo-anonymized.[15]

Following the transcription and completion of annotation layers, the data was published as the RUEG Corpus (Wiese et al. 2020). This corpus was created within the Research Unit Emerging Grammars in Language Contact Situations: a Comparative Approach (RUEG).[16]

6.2 Participants

Table 1 summarizes participant demographics by country, including token and verb counts and mean age of onset (M AoO) of majority language. Heritage speakers were recruited mainly in urban areas via various channels like mailing lists, social media, schools, universities, language courses, and public organizations.

[14]Detailed user guidelines and all experimental materials are available in an open access repository: https://osf.io/qhupg/.

[15]Pseudo-anonymization means that all personal information, including names, street names, and school names, were anonymized. However, since the participants' voices are accessible in the oral files in the corpus, the anonymization cannot be considered complete.

[16]https://korpling.german.hu-berlin.de/rueg-docs/v0.4/

In the United States, recruitment spanned from September 2018 to March 2019 across the greater Washington area, New Jersey, Chicago, and New York City. In Germany, it occurred from September 2018 to January 2021 in Berlin and Brandenburg. Participants regularly spoke the heritage language with immediate family and lived in their current country, with occasional allowances for temporary visits to their country of origin. Before the experiment, participants received information about their rights and procedures, and consented in either English or German. Minors' consent was obtained from a parent or guardian. All participants had normal hearing, vision, and speech.

Table 1: Participants information

Country	Group	Participants	Tokens	Verbs	M age	M AoO
Greece	monolinguals	64	27,931	4954	21.4	–
Russia	monolinguals	66	25,930	3965	21.0	–
Turkey	monolinguals	64	20,947	4609	22.2	–
Germany	heritage Greek	48	19,782	3494	22.6	1.8
	heritage Russian	61	32,882	4624	21.1	1.3
	heritage Turkish	64	23,722	4986	21.5	2.5
USA	heritage Greek	63	18,302	4371	23.0	1.3
	heritage Russian	60	29,214	4342	22.2	3.3
	heritage Turkish	58	18,502	4257	22.0	2.5

The adolescent group ranged from 14 to 18 years, while the adult group ranged from 22 to 35 years.[17] For adolescents, current school attendance was crucial to ensure regular peer contact during data collection. They needed to have attended monolingual high schools after bilingual primary schooling. Most had also received private heritage language classes. All participants were either born in the US or Germany or immigrated at a young age not exceeding the period of 48 months.[18] Thus, the sample included both simultaneous and sequential bilingual individuals.

Monolingual participants from Greece, Russia, and Turkey were recruited similarly to bilingual participants in Germany and the US. They were assumed to speak only the majority language in daily life and at home. Their age range

[17] In exceptional cases, participants slightly outside these ranges were included if they met all other criteria and were not marked as outliers.

[18] Participants with majority language acquisition up to the age of 8 years were considered if all other criteria were met as the age of onset did not significantly impact the study design.

matched that of the heritage speakers. Data collection for Greek monolinguals occurred in March 2019 in Athens, matched with the origin of heritage speakers' majority from central Greece. Russian monolinguals were recruited in St. Petersburg between November and December 2018. Turkish monolinguals were recruited from İzmir and Eskişehir in September-October 2018, both in western Turkey. Before the experiment, all participants signed consent forms in their country's majority language. Both bilingual and monolingual participants had no speech disorders and normal or corrected-to-normal hearing and vision.

6.3 Corpus and sample composition

To make the data samples as comparable as possible for typologically different languages like Greek, Russian and Turkish turned out to be challenging and the authors are aware of the fact that the data samples used in the present investigation are not fully parallel. To achieve the closest approximation, several carefully weighted decisions were made, and we will now address them in turn. First and foremost, the data were automatically annotated following the Universal Dependencies scheme (de Marneffe et al. 2021) and manually corrected afterwards by instructed native and/or near-native speakers of Greek, Russian and Turkish, since the parser was not accurate enough, especially for oral and heritage speakers' data. Irregular verbs in all languages needed closer attention and were carefully annotated for aspect from the authors. The same holds for copula and modal verbs, which exhibit limited morphology, although these are excluded from the present analysis. The annotation levels relevant for the present research include the following values:

- Aspect: imperfective (including progressive for Turkish) and perfective
- Tense: past and present
- Verb Form: finite

After the data were exported from the three RUEG sub-corpora for Greek, Russian and Turkish, a number of data points were excluded from further analysis. In total, 3990 verbs are excluded from the whole amount of the observations. Specifically, infinitives in Russian and Turkish (Greek does not possess infinitives), as well as other aspectual forms apart from perfective and imperfective were removed from the analysis. Additionally, verbs without morphological distinction in perfective and imperfective past tense were excluded from the Greek sample. This comprises full verbs like *ksero* 'know', copulas such as *eho* 'have' and *ime*

'be', modals such as *prepi* 'must', light verbs like *kano* 'do' and finally loan verbs ending in *-aro* such as *parkaro* 'park' (Veloudis 2009, Soukalopoulou 2020).

Finally, since in the present research we focus on the morphological form of grammatical aspect and given the large number of observations, verbal forms were not controlled for felicitousness in given contexts. In other words, our data might content non-target like use of aspectual forms.

6.4 Statistical Analysis

We apply methods from a Bayesian statistical framework in order to make more meaningful interpretations of our models (Gelman et al. 2013, Kruschke 2014, Kruschke & Vanpaemel 2015). For example, we can explicitly report and interpret any uncertainty involved in our inferences (Vasishth & Gelman 2021). In general, all posterior distributions can be interpreted, and the interpretation does not hinge on arbitrary p-values. This makes it possible to directly test our research hypotheses instead of following frequentist models with Null Hypothesis Significance Testing, which does not directly inform the reader about the research hypotheses (Vasishth 2023). The advantage of Bayesian statistics is that it allows us to incorporate previous information about the research question as priors in the model. Additionally, we include random effect as varying intercepts and slopes, which help the model to avoid individual participants skewing the estimate of an effect into a certain direction and also account for the nonindependence of data points (Baayen et al. 2008, Winter & Grice 2021).

Our modeled variables were all contrast-coded to gain insightful results about the effects (Brehm & Alday 2022). We applied sum-coding to all variables in the model, as all of them are factors. All our variables, but the Country variable, have two levels, so sum-coding just ensures that the variables are compared to each other in an equal manner. The Country variable has three levels in each language's respective model. As we do not assume a homeland baseline in the model, the sum-coding of this variable allows us to compare each level to the respective grand mean of all three levels. Conceptually, this puts all three levels, or in other terms, varieties of the language, as levels in their own right without a normative baseline. In an approach where we try to view heritage languages as varieties or dialects in their own right, this ensures that the homeland standard variety is not taken as the comparative baseline which is in line with current ideas in the field of heritage languages (Rothman & Treffers-Daller 2014, Wiese et al. 2022, Rothman et al. 2023).

Our model includes weakly informative priors, which are mainly used to regularize effect sizes for the parameters in the model (Etz et al. 2018). We do not opt

for priors that assume a certain effect direction as the previous evidence basis for aspect use in bilinguals is not sufficiently conclusive regarding the effect that were found. These priors allow the effect to be between null and relatively large effects of the independent variables under investigation (Nicenboim et al. 2024): The intercept is set as a normal distribution with a mean at 0 and a standard deviation at 1.5. The priors for all the effects are set as a normal distribution with a mean at 0 and a standard deviation at 0.1.

The data were exported from the corpus and subsequently processed and modelled in R using the *tidyverse* and *brms* packages (Wickham et al. 2019, R Core Team 2021). The aspect observations were coded as a binary dependent variable with the levels imperfective and perfective. This results in 26,788 data points (8,829 in Greek, 11,626 in Russian and 6,333 in Turkish). To understand which factors affect aspect realization, we compile a Bayesian regression model for each language, taking into account random slopes for participant to account for individual variation. The independent variables in these models are Country of elicitation (Germany, USA, and the homelands Greece, Russia, and Turkey), Formality (formal vs. informal), Mode (spoken vs. written) and Tense (past vs. present). The R code for this model syntax reads as: brm (Binary response ~ 1 + Country + Mode * Formality + Tense + (1 || Participant). Using the same model structure in all languages allows comparability when interpreting the results. The data and the code of the analysis are available in an open repository to guarantee reproducibility of the analysis: https://osf.io/23dnw/.

After reporting the general descriptive statistics, the inferential statistics (here the outcome of the Bayesian regression models) allow to quantify how certain variables affect the production of aspect. The effects are characterized as meaningful or not based on the median estimate as well as the 89 % credibility intervals (CI). If the CIs do not contain the value for zero, a negative or positive effect can be inferred and interpreted. This study reports meaningful effects for the dependent variables Country, Formality, Mode and Tense.

7 Results

The presentation of the results in this section is twofold. First, we begin by showing descriptive patterns that underlie the observed data. Here, we try to give an overview of the patterns and to characterize them. It is important to emphasize that the descriptive results do not allow inferences regarding the research questions and hypotheses. For this, we substantiate the findings with inferential analyses from our statistical models. This allows us to draw inferences about

the relationship between aspect use in the data and the driving factors behind this. The aim is to get a causal understanding of how these factors relate to the research questions.

7.1 Descriptive results

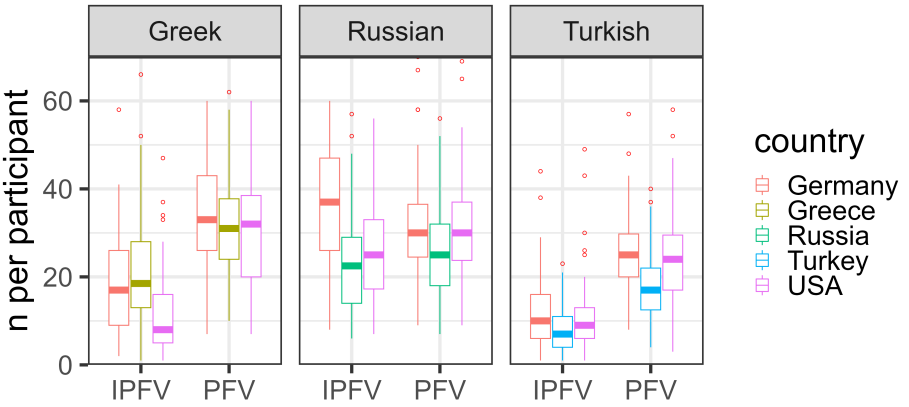

Figure 1: Use of aspectual categories in heritage and monolingual speakers grouped by Language and Country.

The descriptive results can be seen in Figure 1, which shows boxplots for the distribution of perfective and imperfective verbs per Country and Language group, including the participant variation. We see three subplots with the titles "Greek", "Russian", and "Turkish" indicating that the data within each subplot stem from that language. The y-axis on these subplots shows the normalized number of uses the respective aspectual category by participant. The normalization was done according to the number of finite verbs in each subcorpus and then turned into percentages. On the x-axis, we see the labels "IPFV" (for imperfective) and "PFV" (for perfective) representing the two aspectual categories that are contrasted in this study.

Starting with the left subplot, which presents the results from the Greek groups, we notice that Greek heritage speakers in Germany and the monolingual group perform alike, producing almost the same amount of verbs bearing both the perfective and the imperfective aspect. Regarding the perfective, all Greek groups do not differ from each other. However, the mean and standard deviation (SD) for the use of the imperfective shows that this category is much less common in the US-group: Germany-IPFV (M =19.3, SD = 12.3), Greece-IPFV (M = 22.6, SD = 14.5), USA-IPFV (M = 11.7, SD = 9.9). Notably, there is a high level of variation between

participants, which becomes evident in the high SD values. For the use of the perfective aspect, the groups seem to be more similar: Germany-PFV (M = 34.1, SD = 12.2), Greece-PFV (M = 34, SD = 15.7), US-PFV (M = 31.4, SD = 14.8).

Moving to the center subplot, we see the overall patterns in the Russian-speaking groups. From the descriptive results, one can see that in two groups (monolinguals and Russian heritage speakers in the US) the ratio between perfective and imperfective verbs is comparable with perfective verbs slightly outnumbering the imperfective ones. Heritage speakers in Germany behave differently from the two other groups in producing numerically in producing a higher number of imperfectives. This is the only group that produces numerically more verbs in imperfective aspect and patterned differently from the other groups. In detail, the means and SDs for the use of the imperfective highlight this pattern: Germany-IPFV (M = 38.5, SD = 18.1), Russia-IPFV (M = 24.5, SD = 13.5), USA-IPFV (M = 26.9, SD = 14.3). Again, the results for the perfective aspect point towards smaller differences between the groups in terms of descriptive patterns: Germany-PFV (M = 32.6, SD = 13.7), Russia-PFV (M = 26.1, SD = 10.4), USA-PFV (M = 31.4, SD = 12.1).

Finally, the Turkish language groups are presented in the rightmost plot. The three Turkish groups produce more verbs bearing the perfective aspect, while the production of verbs in imperfective aspect is lower in frequency. In terms of means and SDs in the Turkish data, we observe the following in the imperfective: Germany-IPFV (M = 11.5, SD = 8.3), Turkey-IPFV (M = 7.8, SD = 5.1), USA-IPFV (M = 11.1, SD = 8.9), and these numbers in the perfective category: Germany-PFV (M = 25.3, SD = 9), Turkey-PFV (M = 18.5, SD = 8.2), USA-PFV (M = 24.5, SD = 11.2).

What seems to be common across all language groups is that perfective verbs are more common and frequent than verbs with imperfective marking. The only exception to this pattern is the group of Russian heritage speakers in Germany who seem to produce more verbs in imperfective aspect. Regarding the perfective across groups, we indeed notice that all groups pattern similarly, while in the imperfective aspect, the distribution of the verbs between and within the language groups varies.

7.2 Bayesian statistics and modeling

In this subsection, the Bayesian statistical analysis is presented, demonstrating different effects for the different language groups regarding the production of verbal aspect. Crucially, to understand the results and effects, we need to remember that imperfective was coded as -1 and perfective was coded as +1. So

any negative estimates indicate more use of the imperfective and any positive estimates indicate more use of the perfective aspect.

We report 89 % credibility intervals (CIs) of the estimates and chose 89 % instead of 95 % as both conventions are common in the Bayesian statistical framework (Kruschke 2014, McElreath 2020). Additionally, setting the CI to 89 % helps to avoid that they are confused with 95 % confidence intervals in Frequentist statistics. The CIs are calculated using the Highest Density Intervals of the posterior distributions which is one of the most common methods to obtain a CI in Bayesian statistics. The CIs are highlighted in light blue in Figure 2. If a CI does not include the value 0, it is interpreted as a meaningful effect in the model which corresponds to the Frequentist notion of significance. The directionality of the effect is determined by whether the CI median is a positive or a negative number. In the case of our study, positive values indicate a higher probability to produce the Perfective, and negative values indicate a higher probability to produce the Imperfective as is indicate by the x-axis labels. Furthermore, the range of the CI values for the effect as well as the the shape of the curve in Figure 2 allows us to quantify the uncertainty of where the effect lies. A narrower range or curve indicates more certainty that the effect is at the given value. By custom, CIs are recorded in square brackets. For example, a CI stating [0.5, 1] indicates that the true estimate lies between 0.5 and 1. In the case of this study, it would indicate an effect that predicts a higher use of the perfective aspect.

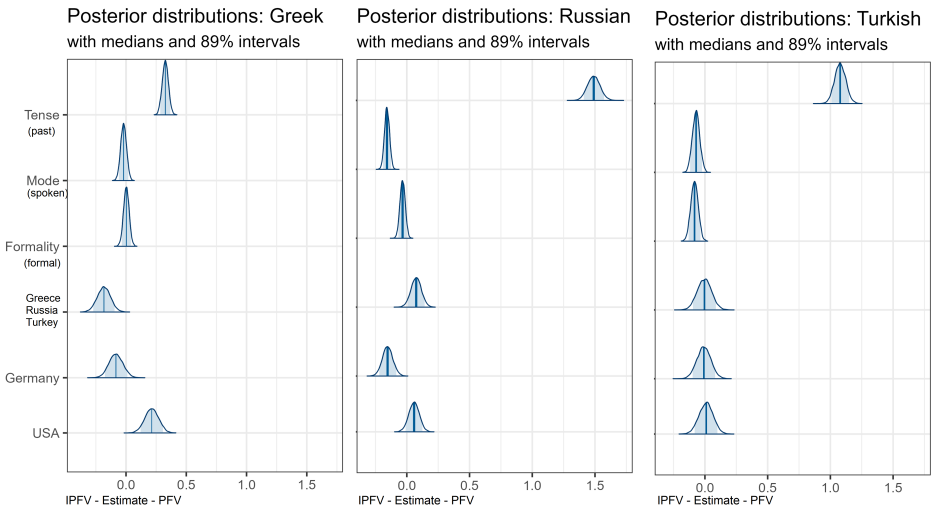

Figure 2: Effects of population-level predictors on log-scale.

Figure 2 shows three subplots, one per language group - from Greek to the left, Russian in the center to Turkish to the right. For the Greek group, the model predicts that in the past tense, more verbs bearing the perfective aspect will be produced [0.28, 0.37]. At the level of mode [-0.06, 0.02] and formality [-0.03, 0.02], we cannot observe any meaningful effect. For the Country variable, we report the CI for each level separately and follow the order that is seen in Figure 2. Greek speakers in Greece tend to use more imperfective compared to the grand mean of all groups [-0.27, -0.10]. For Greek heritage speakers in Germany, we do not observe a meaningful effect [-0.17, 0.01]. Greek heritage speakers in the US tend to produce more perfective compared to the grand mean [0.13, 0.31].

For Russian, the model predicts that in the past tense, more verbs bearing the perfective aspect will be produced [1.41, 1.57]. For mode, Russian speakers tend to produce more imperfective in the spoken compared to the written mode [-0.19, -0.13]. At the level of formality [-0.07, 0.00], we cannot observe any meaningful effect for the Russian language groups. For the Country variable, we report the CI for each level separately. Russian speakers in Russia tend to use slightly more perfective compared to the grand mean of all groups [0.01, 0.14]. In contrast, for the Russian heritage speaker group in Germany, the model predicts that speakers are more likely to produce the imperfective [-0.22, -0.09]. Lastly, Russian heritage speakers in the US do not show any meaningful effects [-0.01, 0.12].

Finally, for Turkish, the model predicts that in the past tense, a lot more verbs bearing the perfective aspect will be produced [1.01, 1.15]. For mode, Turkish speakers tend to produce more imperfective in the spoken compared to the written mode [-0.12, -0.02]. At the level of formality, we find a small effect indicating that speakers produce more imperfective in the formal compared to the informal condition [-0.13, -0.04]. For the Country variable, we do not observe meaningful differences as the CI always contains the value 0: Turkish in Turkey [-0.10, 0.08], heritage Turkish in Germany [-0.10, 0.08], heritage Turkish in the US [-0.08, 0.10].

8 Discussion

In this paper, we aimed to get an insight into the use of grammatical aspect in heritage Greek, Russian, and Turkish in Germany and the US, as well as in their monolingual varieties in Greece, Russia, and Turkey, respectively. In particular, this cross-linguistic study compares the use of perfective and imperfective aspectual forms in monolingual and heritage speakers and examines how formality and mode affect the production of the aspect forms. In the context of heritage languages, grammatical aspect shows common characteristics – its dynamicity and

tendency to systematic changes. As we have shown earlier, no previous studies used a comparative approach to aspect realization in heritage speakers of typologically distinct languages. In the present study, we seek to fill this gap by applying shared methodology on large-scale data in Greek, Russian, and Turkish. To achieve this goal, we conducted a corpus study and analyzed the observations using Bayesian regression. In this section, we discuss the results reported by the model and link them to our RQs and hypotheses formulated in Section 5.

Our first RQ asks whether monolingually-raised speakers and heritage speakers align in their production of aspectual forms. As there might be a combination of several factors involved in determining the speakers' preferences for aspectual forms, we formulated two hypotheses, both dealing with markedness and language contact (Comrie 1976, Polinsky 2018). On the one hand, we contrast heritage and monolingual varieties (H1.1); on the other hand, H1.2 teases apart the influence from the majority languages, German and English, in the different heritage varieties. According to H1.1, we expected heritage speakers to opt for the unmarked and morphologically simpler verb forms, namely the imperfective in Greek and Russian and the perfective in Turkish, as discussed in Section 2. As shown in Figures 1 (the orange box plots in the center subplot) and 2 at the level of Germany in the center subplot, this is indeed the case for the Russian heritage speakers in Germany, who are the only group producing more unmarked verb forms in the imperfective compared to the other two Russian-speaking groups namely, monolingually-raised speakers in Russia and heritage Russian speakers in the US. This finding goes in line with previous research on heritage Russian in Germany (Gagarina 2011, Gagarina et al. 2020). However, this effect cannot be observed in other heritage speaker groups or groups of monolingually-raised speakers of Greek and Turkish. Altogether, our results speak partially in favor of H1.1, with the Russian heritage speaker group in Germany being the only tribute of the prediction. The reason for this is not clear at this point. If one assumed that the perfective in Russian is not as clearly the morphologically marked member of the aspectual category as in Greek (see Section 2.1 and 2.2) one would expect the heritage speakers in the US to behave similarly in showing an increase of the use of the imperfective aspect, which is not what we found. A task effect is also unlikely since all Russian speaker groups had the same task.

Concerning the influence of the majority languages (H1.2), we expected the heritage speaker groups in Germany to opt for the unmarked forms as German exhibits no grammatical aspect (Sioupi 2014). As for the heritage speaker groups in the US, we expected them to opt for more marked forms as English encodes grammatical aspect, namely both perfective and imperfective (Comrie 1976). Note that the marked member in English and Turkish is the imperfective, but in Greek

and Russian is the perfective. Heritage speakers of Greek in Germany and the US indeed behave as expected according to H1.2. In particular, heritage speakers of Greek in the US, with English as the majority language, produce more marked verb forms encoding the perfective aspect compared to the Greek heritage speaker group in Germany, see Figure 2 at the levels of Germany and USA in the left subplot. This can be interpreted by assuming the fact that English has an aspectual distinction with a marked form and facilitates the use of the marked form by Greek heritage speakers in the US, irrespective of the fact that in English, the imperfective/progressive is marked, and in Greek is the perfective. Finally, the same effect can be observed in Russian speakers concerning the markedness prediction as well. Specifically, Russian heritage speakers in Germany opt for the unmarked forms, namely the imperfective aspect, whereas Russian heritage speakers in the US behave like monolingual speakers of Russian. In contrast, no effect is observed for Turkish heritage speakers. This might be related to the Turkish aspectual system and the salient markers for both perfective and imperfective, unlike the imperfective verbal stem of Greek and Russian and the morpho-phonological changes required for the perfective aspect. In sum, the results indicate that a combination of different factors, namely cross-linguistic influence of the languages in contact on the one hand and markedness in terms of the morphological realization of grammatical aspect on the other hand, impact Greek, Russian, and Turkish heritage speakers' choice of aspectual forms in a different way.

Moreover, while analyzing the data, we noticed that Greek monolingual participants, who are expected to have more stylistic resources for Greek at their disposal, use quite a large proportion of verbs in imperfective aspect and present tense. By doing so, they employ the *historical present*, a stylistic device with which one can narrate past events in a more vivid way (Giannakis et al. 2013).

Given the "Language Situations" methodology, used in the RUEG corpus, we formulated our 2nd RQ, which focuses on the impact of mode and formality variation on the production of aspect forms. Combining different formality levels with mode levels triggers different outcomes in different languages, as has been shown in (Pescuma et al. 2023), which discusses register variation in various languages, including different linguistic domains such as phonology, syntax, semantics, and the lexicon. The authors highlight register as a ubiquitous phenomenon, robust in both monolingual and bilingual speakers and pervasive in diachronic data (Pescuma et al. 2023). Since there are no studies correlating the different formality levels and modes with the phenomenon of grammatical aspect, we approached mode and formality variation in an exploratory way as stated in Section

5 in H2. Interestingly enough, as reported in Section 7.2, formality and mode effects are found in the Russian and Turkish language groups but not in the Greek groups. This is in line with a previous cross-linguistic study by Özsoy et al. (In press) on pro-drop where similar effects for heritage Russian and Turkish were found while no effects for Greek were observed. Concerning the present study, strong mode effects are observed for Russian and Turkish, indicating that in spoken mode, more verbs in the imperfective are produced. In addition to the mode effects, formality effects for the Turkish groups are observed: in the formal communication setting, more verbs in the imperfective are produced. These findings for Turkish and Russian indicate that the distribution of aspectual forms in the respective languages is sensitive to situational-functional parameters. In the sense of Pescuma et al. (2023) and Lüdeling et al. (2022), aspectual forms may be used to constitute registers, among other linguistic means. Following these researchers, we consider register to be the intra-individual variation, which consists of conventionalized patterns depending on the different situational-functional contexts. In line with previous studies, researchers found that the different clause types are used in distinct communication settings from both heritage and monolingually-raised speakers of different language combinations like aspect (Schleppegrell & Colombi 1997, Tsehaye et al. 2021, Pashkova et al. 2022, Özsoy et al. 2022). This fact shows that for these phenomena, heritage speakers have awareness of the different register variation, unlike discourse phenomena such as an indefinite determiner, which is a marker of vague language in Greek and light-weight constituents in German (Alexiadou et al. 2022, Tsehaye 2023). However, the results in our comparative study revealed no effects of mode and formality for the Greek group, which does not allow us to make any far-reaching cross-linguistic generalizations. Aspect in Greek appears to be a grammatical phenomenon that is not affected by neither mode nor formality.

Moreover, an extra factor included in our study, which is a core grammatical feature, is tense. As shown in Figure 2 the past tense is preferred by all speaker groups as the participants were prompted by the question "What happened?" in the stimulus video. As we describe in Section 6 both monolingually-raised and heritage speakers had to retell the events presented in the short film. The past tense is the most prevalent tense in the narrations of all speaker groups in the three languages investigated in this study, namely, Greek, Russian, and Turkish. Evidence of the pervasiveness of perfective aspect in narrations are found in several studies (see Gagarina 2000, 2008b, Andreou & Tsimpli 2017, Andreou et al. 2021 and references therein).

The aspectual preference of our speakers is not shaped solely by one single factor, but it's rather a multifactorial interplay of internal and external linguis-

tic parameters. In fact, the results show that, under language contact, internal grammatical properties, like typological affiliation based on different aspectual markedness hierarchies and, in the case of heritage languages, also contact with languages belonging to particular aspectual types, might indeed shape bilingual speakers' choice of aspectual forms. In fact, heritage speakers of Russian in Germany opted for more imperfective forms as compared to heritage speakers in the US and monolingual speakers in Russia, whereas heritage speakers of Greek in the US produced fewer imperfective forms as compared to monolingually-raised speakers and heritage speakers of Greek in Germany. In other words, heritage speakers tended to avoid marked forms in favor of unmarked ones in a contact situation with German, a language that does not feature grammatical aspect on verb form. Contrary heritage speakers favor marked forms in contact with languages that mark aspect like English, such as in the case of Greek heritage speakers in the US, supporting the notion of morphological markedness.

Furthermore, external factors, such as mode and formality, seem to impact the speakers' preference for aspectual forms in different languages. However, as shown by the data in our sample, the influence of these factors is not distributed equally across different languages. Specifically, no impact of mode and formality was found in Greek, whereas Russian was found to be sensitive to mode and Turkish to mode and formality. This strongly indicates that the impact of particular situational-functional parameters varies across linguistic communities.

At this point, a limitation of the study needs to be addressed. Since we observed that the perfective aspect is the most pervasive aspect form in the narrations across all speaker groups, we cannot exclude the fact that this might be triggered by the task effect. Narrative tasks are the most appropriate for exploring speakers' productions and studying their repertoire, unlike controlled experiments. Narrations are one of the most functional tools of data elicitation among different groups of speakers (Bardovi-Harlig 2000, 1995). However, several studies on aspect in heritage speakers have shown that, in general, perfective forms dominate over imperfective ones, as we reported above (Gagarina 2000, 2008b, Andreou et al. 2021).

This study highlights a strong need for a multifactorial approach to explain phenomena belonging to the core grammatical system, such as grammatical aspect. The design and analyses presented here call for new studies to thoroughly investigate grammatical aspect in different languages and speaker groups in different situational-functional settings. With experiments controlling for the factors listed above, researchers can test whether these variables influence the production of grammatical aspect.

Abbreviations

TAM	tense, aspect and mood morphemes	SG	singular
		PL	plural
CC	conjugation classes	SBJV	subjunctive
CAUS	causative	RUEG	Research Unit Emerging Grammars
IPFV	imperfective		
PFV	perfective	AoO	age of onset
PROG	progressive	M	mean
PRS	present	SD	standard deviation
PST	past	CI	credibility interval

Ethics and consent

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the Deutsche Gesellschaft für Sprachwissenschaft (German Linguistics Association). Protocol Code: 2017-06-171120. Date of approval: 20.11.2017.

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Competing interests

All authors have read and agreed to the published version of the manuscript and have no competing interests to declare.

Authors' contributions

Conceptualization, V. R., O. Ö., M. M.; methodology, A. A., L. S., N. G., V. R., O. Ö., M. M.; software, V. R., O. Ö., M. M.; formal analysis, V. R., O. Ö., M. M.; investigation, A. A., L. S., N. G., V. R., O. Ö., M. M.; data curation, A. A., L. S., N. G., V. R., O. Ö., M. M.; writing – original draft preparation, V. R., O. Ö., M. M.; writing – review and editing, A. A., L. S., N. G., V. R., O. Ö., M. M.; visualization, V. R., O. Ö., M. M.; supervision, A. A., L. S., N. G.; project administration, A. A., L. S., N. G., V. R., O. Ö., M. M.; funding acquisition, A. A., L. S., N. G.

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