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The "phonetic prehistory" of Grassmann's law in Greek

Abstract: Grassmann's Law (=GL) is generally regarded as a quintessential example of regular sound change, though dissimilation processes are generally said to be quite rare and sporadic. In the present paper, evidence is presented aiming to show "the phonetic prehistory" of Grassmann's Law in Greek, namely a diachronic stage during which GL acts in all but regular fashion. In particular, especially in some dialectal areas, some forms retain the original diaspirate stem up until Classical epoque (V–IV c. BC). Moreover, the presence of an opposite process, that is the assimilation (generally regressive) between aspirated segments, is also documented. Both of these aspects seem to show a lexically constrained spread of such a change. Its relatively late regularity can be explained as a process implemented by phonological constraints, which intervene at some point in the linguistic change.

Keywords: Grassmann's law, dissimilation, minor sound changes, aspiration

1 Grassmann's law and non-local dissimilation: On resolving an apparent paradox

Grassmann's law represents one of the most famous examples of non-local dissimilation in Indo-European languages. According this law, one of two non-adjacent aspirated stops (generally the first one) undergoes dissimilation and deaspirates. As Grassmann himself stated:

> Wenn in zwei konsonantengruppen eines wortes, welche durch einen vokal getrennt sind, aspiraten vorkommen, die derselben wurzel angehören, so wird eine derselben, in der regel die erste, ihrer hauchung beraubt […] (Grassmann 1863: 111).[1]

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[1] "Given two consonant-groups in a word, separated by a vowel and themselves aspirated, and provided that they are within the same root, then one (and normally the first) is deprived of its breath feature" (Collinge 1985: 47). On the original formulation and on the subsequent interpretations of the law, see now Pozza (2019).

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The law applies regularly in Greek and Sanskrit, following independent changes, but some hints are traceable at least in Latin (Weiss 2018) and in Tocharian (Winter 1962). As for Greek, the process affects both voiceless aspirated stops and /h/ (<*s), which, like the aspirates, is characterized by a reduced glottal resistance after release of the closure (Demolin 2007: 77–78; Ohala and Ohala 1972). Moreover, in Greek GL is generally blocked by the presence of a morphemic boundary between two aspirated segments (Belardi 1973: 215; Blümel 1982: 135; Collinge 1985: 52; Dressler 1975; Jatteau 2016), in compounds (see e.g. Hom. ἐχέθυμος /ek^{h}e+t^{h}y:m/-, lit. 'a master of one's passions, under self-control', ἐχέφρων 'sensible, prudent' etc.), as well as in derived stems, see e.g. forms with a flexional suffix such as the passive aorist.

Non-local dissimilation is generally invoked as a prime example of minor sound changes, namely characteristically irregular changes. Dissimilation itself is generally said to be quite rare and sporadic (Bybee 2015: 69–71; Campbell [1998] 2004: 30–32; Garrett 2015; Garrett and Johnson 2012: 77; Hock 1991: 111–113; Lehmann 1992: 203; McMahon 1994: 16–17; Salmons 2010: 100–101). In spite of these assumptions, Grassmann's Law has always been regarded as the quintessential example of regular sound laws. Hock (1991: 111), for example, considers it as "one of the most shining examples of regularity", and even formulates two additional "rules", seeking to establish specific conditions under which this process can apply in regular fashion.

This paper focuses on such an apparent contradiction. Epigraphic evidence concerning GL reveals at least two different aspects: (1) its late stabilisation: some forms, especially in some dialectal areas, retain the original diaspirate stem up until Classical epoque (V–IV c. BC); (2) the presence of an opposite process, that is the assimilation (generally regressive) between aspirated segments. Both of these aspects seem to show a lexically constrained spread of such a change. Its relatively late regularity can be explained as a process implemented by phonological constraints, which intervene at some point in the linguistic change. Before they came into play, GL behaved as other attested "minor sound changes" do (Hoenigswald 1964).

The paper is organized as follows: in Section 2 the two main approaches currently assumed to explain the phonetic preconditions which lead to long-distance dissimilation are displayed; Section 3 provides the available epigraphic evidence concerning Greek aspirated forms; Section 4 is devoted to analyse the phonetic status of GL prior to its phonologization; Section 5 displays a possible conspiratory process leading to the phonologization of GL; in Section 6 some final remarks are made.

2 The phonetic basis of dissimilation

Explanations about the phonetic preconditions which lead to dissimilation are mainly two (see Garrett and Johnson 2012 for a broad survey). The first one is the well-known model of Ohala. According to Ohala (1981, 1989, 1993, 2003, *passim*), dissimilation processes, especially those involving non-adjacent segments, represent the result of the listener's misapplication of corrective processes. Acoustic-perceptual cues of some "secondary" features (such as glottalization, pharyngalization, retroflexion, nasalization, aspiration and so on) spread beyond the immediate realm of the segment in which they are distinctive. Therefore, the listener may misinterpret the original presence of one of these features in the segment in which it is distinctive and intended as the outcome of an erroneous production by the speaker, triggered by coarticulatory effects; consequently, the hearer undoes such features through a mechanism of hypercorrection. For example, the outcome of an original diaspirate root $*p^h e\underset{\smile}{u}t^h$- may be misperceived by the listener as the erroneous result of the speech production, stemming from the widening of the [+spread glottis] feature on the first segment $*p$-.

The second motivation for non-local dissimilation accounts for the change as due to motor planning, producing speech errors, in a similar fashion to what happens in tongue-twisters: "in this process, speech errors may occur as planning elements (syllables, segments, gestures, etc.) influence each other through priming or coactivation, or through the inhibition of one segment by the activation of another" (Garrett and Johnson 2012: 59–60). The typology of dissimilation and of motor-planning speech errors is actually quite similar. The involvement in this process of "weak" features (such as the aspiration), as well as the finding that dissimilation targets segments in "weak" positions (such as onsets rather than codas) would support the motor-planning approach: a process of so-called *inhibition* "[...] eliminates repetition by preserving the more salient (anticipated or positionally 'stronger') segment" (Garrett and Johnson 2012: 78). In the present paper, I will leave the question open, because data supporting one or the other of the two explanations remain controversial.

Both in Ohala's framework and in motor planning model, the scientific debate has been focused on the phonetic preconditions on which a sound change is based. Neither of these frameworks seems to provide a viable explanation for the actuation of the change, that is, its sporadicity and irregularity over time.

As we have already observed, dissimilation involves only some features which have important perceptual cues. Biases in speech production or in perceptual parsing which produce dissimilation are triggered by the spreading of

a feature beyond the bounds of a single segment. Therefore, the smallest linguistic item included in such typology of sound change is the whole syllable CVC.[2] Such a linear prosodic dimension leads to a main consequence: when overcorrection (in the perceptual model) or inhibition (in the motor planning model) applies, its operation would not be able to detect a specific feature at segmental level. Broadly speaking, if the prosodic domain of "weak" features such as aspiration overrides the segment, dissimilation is forced to operate with non-discrete units, by acting on a phonic *continuum*. Therefore, when it applies, it would not be so accurate as to remove a single feature at segmental level, nor would it be able to give rise to binary oppositions, such as those involving the feature [±spread glottis].[3] The first pieces of evidence supporting this scenario have recently been found in a number of languages, for example, in the Halh Mongolian dialect (Jatteau and Hejná 2018; Svantesson and Karlsson 2012), Georgian (Beguš 2016) and Aberystwyth English (Jatteau and Hejná 2016). In all of these varieties, dissimilation affecting an aspirated segment in a /C^hVC^h/ sequence does not lead to the complete elimination of one of the two aspiration features, rather to its partial reduction. For example, in Halh Mongolian, the first aspirate in a /C^hV^hC/ sequence (where -^hC is a preaspirate) has a shorter VOT than in a /C^hVC/ sequence, where dissimilation does not operate at all (Svantesson and Karlsson 2012). In Aberystwyth English, in a string /C^hV^hC/, preaspiration or breathiness associated with C^2 are less frequent and shorter when C^1 is a fortis aspirated plosive or /h/. In my view, gradient dissimilation originates from the misapplication of the delete operation on the part of the speaker or the listener: in a phonic *continuum* where the [+spread glottis] feature is stretched-out, a partially unsuccessful delete operation can produce a decrease of VOT in one of the two segments, rather than its entire removal.

The same difficulty of cutting off the phonic *continuum* at the segmental level might be behind some aspects relating to the spread of GL in Greek. The law acts in a regular fashion at least from the Classical epoque – that is, it affects much of the lexicon and is consistent in directionality (it is generally anticipatory). Such regularity promoted the restructuring of the underlying diaspirate form

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2 Such features with important perceptual cues overriding the single segment also appear in some modern Indo-Aryan languages like Western Hindustani or Hāṛautī, where aspiration entails the breathiness of the vowel (Allen 1957). Indo-Aryan aspiration actually affects the whole prosodic unit in which such features surface, in a way only partially reflected in the spelling, where it is marked only on the consonant that has such a feature (Allen 1970).

3 These assumptions differ from Ohala's hypothesis, according to which dissimilation is categorical.

(Miller 1977: 149–151): in Attic, by about the end of the fifth century BC, GL was firstly replaced by a synchronic sub-rule of aspiration throwback (already formulated by Grassmann himself),[4] which explains the alternating pattern such as ἔχω/'ekʰoː/ versus ἕξω/'heksoː/ (Miller 1977).

However, a thorough analysis of the epigraphic evidence reveals that the path which led to the phonologization of the dissimilatory process – with the emergence of a template provided with a sole aspirate – showed clear signs of notable exceptions, particularly in certain dialects. I consider this set of variants as evidence of what I would like to call "the phonetic prehistory" of GL. In the next sections, evidence relating to such a "phonetic prehistory" will be presented.

3 Diaspirate forms

According to many authors, GL surfaces as a regular sound change in Greek only relatively late. First, the change is generally considered not to have happened in Mycenaean (see now De Decker 2015: 148–150 and the bibliography therein; Jatteau 2016: 548–551). Due to the fact that the Mycenaean spelling did not have specific signs for the aspirated stops (except the signs a_2, with the value of /ha/, see Pierini 2014, and pu_2 with the value /pʰu/), the amount of uncertainty in assessing the operativity of GL is considerable. A more reliable datum turns out to be the non-involvement of /h/ in GL at this chronological level. Intervocalic /h/ was not yet completely gone when the Mycenaean tablets were inscribed (Colvin 2006). Therefore, historical forms such as θεός 'God' suggest the reconstruction of Myc. *te-o* as *tʰeʰós < *thesós (Ruijgh 1967: 45), in which -/h/- could not trigger GL by changing /tʰ/ into /t/. As for the initial position, many forms prove that /h/- as undergoer of the process was still not affected by GL in Mycenaean. In particular, in some ἔχω 'to have'-compounds, the presence of a *hiatus* in the morphemic boundary entails the presence of initial *h*-, which evidently has not been deleted by the dissimilatory process triggered by the following aspirated stop (de Lamberterie 2012; Plath 2002), see e.g. *ko-to-no-o-ko* (*κτοινο-hόχος) 'owner of a κτοίνη', attested *passim* at Pylos; *a-pi-e-ke* PY Un 2.2 (*ἀμφί + hέχει > ἀμπέχω 'wrap, cover,

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4 "Wenn eine wurzel mit einer aspirate auslautet und mit einem der aspiration fähigen konsonanten beginnt, und der auslaut derselben durch einwirkung irgend eines anders lautgesetzes seine hauchung verliert, so tritt diese auf den anlaut über […]" (Grassmann 1863: 110–111) ["Given a root with a final aspirate and an initial consonant capable of aspiration, and given also that the final element loses aspiration (by some separate sound law), than that feature is retracted to the initial element" (Collinge 1985: 47)].

clothe'); *po-ro-e-ke* PY Ta 713.2 and 715.2 (*πωρο-hεχής 'having a marble/stone support') and so on. These examples are potentially useful as an indication that the initial stage of development of aspirate dissimilation involved only aspirated stops, not /h/ (see also Section 3).

As for the epigraphic evidence, some dialects attest a late stabilisation of GL. In Attic, the application of GL appears more systematic by the end of the fifth century BC: after this age, cases of GL-failure, or even aspirate assimilation (see Section 3.1), are generally not attested (Miller 1977: 144). Threatte (1980: 455) provides examples dating up to the 5th c. BC; in the 4th c., GL becomes less frequent, and by the 3rd c. is extremely rare.

Although outnumbered by dissimilated outcomes, a certain number of forms coming from different dialectal areas display a diaspirate template. More specifically, Ionian, Boeotian and Arcadian seem to have preserved diaspirate forms for a long time, even if the precise dating of the sound change remains controversial. Miller (1977: 143) considers GL as "[…] a fairly recent innovation that was not yet completed by the time of the earliest inscriptions". Warren Cowgill (quoted in Miller 1977: 144) concluded that GL applied in West Greek before 500 BC (with some cases of GL-failure in Cretan, see also Bile 1988). Dubois (1988: 51–52) supposes a later dating of GL in Attic and Arcadian. Sánchez Garrido (1988: 165) even claims that a "fijación definitiva" ('a definitive stabilisation') of GL took place only in the Hellenistic age. De Decker (2015: 165) states, conversely, "[…] that GL operated in the period when the Homeric poems were being composed".

In what follows, I present evidence from inscriptions from various dialects, with data from Miller (1977) and Jatteau (2016: 552–564), as well as new data now available in the PHI-Greek inscriptions corpus (https://inscriptions.packhum.org).[5]

With regard to **Ionian**, see the frequently quoted form θυφλός 'blind', instead of τυφλός (< *$d^heu̯b^h$- EDG), in a funerary inscription from Cuma (IG XIV 865; IGASMG III 16, 675–650 BC); the athematic aorist ἔχιχε for ἔκιχε, from κιχάνω 'reach, overtake' (Eretria, IG XII, 9 286, 6th c. BC; cf. Att. χινχά[νεν for κιγχάνειν in a stele from Marathon, IG I³ 2, about 500 BC, with the meaning 'prosecute', see Vanderpool 1942: 332–333); the participial form θυθέντος (θύω 'sacrifice'), from Delos (IG XI, 2 287, l. 24); the Euboean anthroponym Ἐπιθρέ<φ>εος (gen., Styra, IG XII 9, 56 104; LGPN I, 5th c. BC, cf. ἐπιτρέφω 'grow, support, maintain' < *d^hreb^h- LIV).

As for **Aeolic**, see the reduplicating form φεφύλαχσο, attested in a hexametric epigram devoted to Apollo, that displays a mixing between Boeotian and epic

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features (sanctuary of Apollo Ptoios at Akraifnion, about 550–525 BC, SEG 29: 449, Ringe 1984: 172–174.).

As far as the **Arcadian** evidence is concerned, Dubois (1988: 299; 515) quotes the form θαφαῖος (from Oresthasion, about 500 BC), cf. Hom. ταφήϊος adj. 'funeral', presumably tracing back to a diaspirate stem (EDG s.v. θάπτω).[6] The ethnonym θελφοίσιος from Olympia (Dubois 1988: 227–228, about 500–475 BC; SEG 11, 1254a) supposes a reconstructed form *Θέλφοισα (Heine Nielsen 2004: 533). This toponym is also attested in the diaspirate form Θέλφουσα in the Arcadian *koiné* since the fourth century BC, and in the form Θέλπουσα in the literary texts and on coins of Achaean age (Dubois 1988: 227). Neumann (quoted in Dubois 1988: 228) considered this form an ancient thematic participle from the root $d^h elb^h$- 'dig' (LIV), also documented in Germanic and Slavic hydronyms. Evidence confirming the late spreading of GL in this area can be found in the Arc. adverb μεσακόθεν 'in the midst', from Orchomenus (IPArk 14, 1l.7–8, about 369–361 BC), coming from *μεσαχόθεν (with a suffix -αχω-), where the lack of analogical restoration of -χ- is noteworthy, if compared with Attic forms such as πανταχόθεν, πανταχόθι, analogical to πανταχῶς, πανταχῇ, πανταχοῦ (Lejeune 1972: 58). It is probable that in this Arcadian form the morphological reaction to the dissimilatory effect of GL had not yet intervened (Dubois 1988: 52), exactly because of the late activation of the sound change.

More difficult to assess is the **Attic** dossier. Due to the possibility of having unetymological diaspirate forms (see Section 3), Miller (1977: 145) regards as etymological – among the evidence of ἔχω-forms with an initial *h-* – only those attested in inscriptions otherwise devoid of unetymological aspirated segments. See the form hέχει (2X)[7], from the Acropolis, which occurs in an elegiac distich within an offering (IG I³ 766, about 500–480 BC); two instances of hέχον from Parthenon's inventories (IG I³ 21, 450–449 BC; see also IG I³ 351, 422–21 BC; IG I² 287.181, 413–412 BC); the form hέχοντ', from Athens, on a block of Pentelic marble (not later than 530 BC, IG I³ 1234), from an inscription where the spelling of the aspiration is consistent; the form καθ[έ]χει (IG I³ 1215, ca. 500 BC) on the grave of Stesias, where cases of unetymological diaspirate forms are not otherwise documented. Based on this evidence, Miller (1977: 147) claims that GL first involved aspirated voiceless stops, affecting /h/- only later.

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6 One can compare from the same root the diaspirate form ἐνθάφιον in a graffito on a local cup (Sicily, Gela, ca. 530 BC, IGASMG II² 11). As far as the form ἐνθαφέντων is concerned, see further in the text.

7 I use \<h\> to represent the letter \<H\>, which was utilised in the Attic epichoric alphabet until 403–402 BC (Eucleidean reform) instead of the rough breathing.

As far as aspirated stops are concerned, a form θρεφθές, instead of τρεφθείς (IG II² 8523, early 4th c. BC), is attested in an inscription where assimilatory processes producing novel aspirates are not otherwise documented, as shown by regular forms such as ἔσχεν (not *hεσχεν), Πυθοκλῆς (not *Φυθοκλῆς) etc. The same diaspirate form is also attested in other areas, see e.g. θρεφθείς at Kos (SEG 15: 510, 2nd c. BC) and θρεφθέντα at Thermos, in Aetholia (IG IX,1² 1:196, 4th c. BC).

In spite of the fact that the (-)τιθε- forms are more numerous – recurring in Attic documentation from 450 BC onwards (Threatte 1980: 458) – the infinitive κα[τ]α-θιθέναι is nevertheless attested in a decree (IG I³ 8, l. 17, about 455–454 BC) where cases of assimilation between aspirates are not otherwise documented (see forms such as καθάπερ, καταθδσιν, καταθέναι, but in these two latter forms a possible assimilation could have been prevented by the morphemic boundary between prefix and verb). Among the reduplicated verbal forms, see χεχ[αρίσθο (IG I³ 788, after 480–479 BC or, following another interpretation, χεχ[αρισμένον, SEG 15.37, from χαρίζομαι). See furthermore the form θρόφος instead of τρόφος on the François vase (ca. 570 BC, Threatte 1980: 460).

3.1 Aspirate assimilation

Other forms do display two aspirates, one of which (generally the leftmost) is unetymological (Threatte 1980: 455–464), resulting from an apparent process of long-distance regressive assimilation. As regards proper nouns, Φαρτέν-forms (Φαρθένε, IG I³ 728, ca. 500–480 BC; Φαρθένε, IG I³ 745, ca. 500–480 BC. etc.; see also Arc. φαρθένδ, IG V,2 262, 5th c. BC, from Mantineia, see Dubois 1988: 51), instead of Παρτέν-, illustrate this typology of process, if the etymology proposed by Klingenschmitt (1974) is correct (<*pr̥-steno- lit. 'having protruding breasts').

From vase inscriptions Threatte (1980: 460) quotes, among other forms: θεθίς for τηθίς 'aunt', on a pinax of about 500 BC (see also two instances of the same form in a tomb painting of the 6th c. BC, preceded by the form θέθε, instead of τήθη 'grandmother', SEG 16: 35). Furthermore: Θυφειθίδες, instead of Τυφειθίδες, on a red-figure vase (ABV: 178; LGPN II: 230, 6th c. BC);[8] Χόλχος (ABV: 110, n. 37; LGPN II: 479, about 535 BC) for Κόλχος; Καχρυλίον, a potter's name – presumably linked to κάχρυς 'parched barley' (see Bechtel 1917 s.v., possibly in turn connected to κάγκανος 'dry' EDG) – is frequently attested with two aspirates in the form Χαχρυλίον (more than 15 occurrences, see LGPN II: 257; cf. also Χαχρυλίων, about

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8 According to Beazley (1932: 194), the spelling would represent Θουπειθίδης, linked to θεοπειθής 'obedient to God'. If the hypothesis is valid, Τυφειθ- could be an example of aspiration metathesis (on which see Section 3.2).

500 BC, maybe from Athens, LGPN II: 478, and Χαχρυλίο[ν], about 500 BC, from Thasos, SEG 38.38); Ταλθύβιος (originally name of Agamemnon's herald, see Bechtel 1917 *s.v.*) is attested in the form Θαλθύβιος on three red-figure vases (ARV[2]: 458, n. 109) etc. The personal name of the potter Παμφαῖος is also attested in the form Φανφαῖος in a vase (late 6th century BC; SEG 34: 55; Threatte 1980: 460; ARV[2]: 53–54).

Long-distance regressive assimilation of aspirates probably involves the name of Persephone, attested as περσόφαττα in Attic vase inscriptions starting from the 5th c. BC (Wachter 2007–2008), but as Φερρέφαττα in Attic inscriptions on stone (the form is cited as Attic by Moeris *s.v.* Φερρέφαττα, see Threatte 1980: 451). The first member, *perso-*, is comparable with the Vedic hapax legomenon *parṣá-* 'sheaf of corn', whereas the second has been reconstructed as $*-g^wn\text{-}t\text{-}ih_2-$ (< $*g^{wh}en-$ 'hit, strike'); the entire probable meaning is therefore '(female) thresher of corn' (EDG). In the same vein, one can justify the Attic form Φερσεφόνη on 4th c. sepulcral monuments and on the *defixiones* of the 5th and 4th centuries, while the regular form Περσεφόνη is normal in Roman times. A similar assimilatory process beyond the morpheme is represented by the form Ἀνθίλοχος /ant^{h}i+lok^h/, instead of Ἀντίλοχος, on a vase (Threatte 1980: 463; ABV p. 136, n. 54).

Other forms would seem to show a progressive assimilation. The form Θεμιστοκλῆς surfaces very frequently as Θεμισθοκλῆς (/t^{h}emist^h/-) on *ostraka* coming from the Acropolis and Agora since 480 BC, later replaced by the regular form Θεμιστοκλῆς (Threatte 1980: 464). The isolated form hιφοχράτος (ostrakon from Athenian Agora, ca. 480 BC, Vanderpool 1949: 403), instead of the expected ἱπποκράτος (cfr. ἵππος 'horse'), would presuppose a double progressive spreading of the aspirate beyond the morphemic boundaries, triggered by initial /h/-.

Outside Attica, see the Boeotian form Θριφόνδας in an epitaph (Thebes, LGPN III.B; SEG 2, 192 6th c. BC), which probably derives from θρίψ, θριπός 'wood-worm' + -ώνδας, with -/ph/- (<φ>) instead of -/p/- (<π>) (Masson 1986: 256).

In other cases, diaspirated forms arise from etymological diaspirate roots. Nevertheless, due to their late date, they probably do surface with two aspirates following a sub-rule of aspirate assimilation, as in the above-mentioned forms. See the personal name Διοφείθου (Athens, sanctuary of Asklepios, 274–273 BC, IG II³,1 898, cfr. πείθω 'persuade'); the verbal form ἐνθαφέντων (part. aor. gen. pl., Caria, Aphrodisias, from θάπτω 'honour with funeral rites', see fn. 6); the compound ἱ]ππποθ<ρ>όφων (Attic, IG II² 2317, Panathenaic victor list, 162–161 BC, cfr. τρέφω 'feed'); the reduplicated verbal form ἐκτεθρο[φότα (IG XII,4 2:981, Cos, honorific inscription,150–100 BC).

Outside Attica, see **Boeotian** personal names such as Φίθōν (many attestations, see see for example Tanagra, IG VII, 665; LGPN III.B, 5th c. BC; Thebes, IG VII 3682; Thespies [or maybe Leuttra], IG VII 1951; LGPN III.B, 6–5th c. BC),

Φιθάδας (= Πειθάδης, a painter's name, LGPN III.B, 6th c. BC), Φίθε̄ (probably a shortened form of the latter, LGPN III.B, SEG 42: 438, Thebes, about 550 BC), all variants of the onomastic stem Πειθ- (linked to πείθω 'persuade' < *$b^hei̯d^h$-, see Bechtel 1917 s.v.); Χιχίδας (IG I3 584; LGPN III.B, 7th c. BC, maybe related to κιχάνω 'reach, hit, meet with').

As far as **Cretan** is concerned, the late date of some forms (starting from the 5th c. BC, Bile 1988: 139) compels us to consider them as evidence for aspirate assimilation, despite some of them displaying an original diaspirate stem: μήπιθιθέτω (=μὴ ἐπιτιθέτω, Cnossos, IC I viii 5, 3rd c. BC); the dative form θύχαι (Gortyna, IC IV 186; Chaniotis, Verträge 43, ca. 168 BC); the proper names Θύχασις (SEG 35:989, 2nd–1st c. BC), a phonetic variant of Τύχασις (=Τύχασιος), and the genitive Εὐθυχίωνος (Lebena, IC I xvii 9, 2nd c. BC). It is more difficult to assess if the following forms show a retention of the original diaspirate stem, or – as Bile (1988: 139) believes – if they are instances of the same phenomenon of aspirate assimilation: the present subjunctive θιθῆι (Gortyna, IC IV 43, beginning of 5th c. BC); θιθεμένōι (middle present participle, singular dative, Gortyna, IC IV 43, beginning of 5th c. BC); καταθίθεθθαι (IC IV 72, Gortyna, ca. 480–450 BC).

However, even if the comparison with other dialectal areas showing comparable forms with two aspirates suggests that the Cretan occurrences are showing two actual aspirated stops, nevertheless the peculiarities of the Cretan writing system – which distinguishes only /t/ from /t^h/ (but not /p/ from /p^h/ or /k/ from /k^h/) – has led some scholars to interpret the sign for /t^h/ as evidence of a process of incipient spirantisation (Bile 1988: 140–142; Brixhe 1976), which is why all these forms would be excluded by our collection of examples.

Slightly different are the following forms, in which an unetymological *h*- replaces a word-initial Ø, and in some cases the aspiration extends beyond adjacent syllables (Threatte 1980: 462–463). See for example the frequently attested form hαρ[ιθμὸν (IG I3 343, 434–33 BC; IG I3 346,59, 431–430 BC; IG I3 357–362, 412–411 BC and so on); participial forms of ψηφίζω with an initial unetymological *h*-, such as hεφσεφι[σμένον] (IG I3 46,26, ca. 445 BC), hεφσεφισμένα (e.g. hεφσε]φισ[μέ]να IG I3 9, ll. 16–17, about 458 BC; hεφσε[φισμένα IG I3 58, ll. 18–19, about 430 BC; hεφσεφισμένα IG I3 78,a,23, from Eleusis, about 422 BC etc.). The original form was *ψηφισμ-, with a prosthetic *e*-, analogical to the perfect, where this vowel was prefixed to stems beginning with a consonant cluster (Chantraine 1961: 187–188). Lastly, an unetymological *h*- was added to the novel form *ἐψηφισμ-. Moreover, a form hαφροδίτε for Ἀφροδίτε on the François vase should be mentioned (about 570 BC, SEG 34: 50, n. 121).

Some of the above-mentioned forms may be the result of misspelling (especially in the case of vase inscriptions, where the spelling is frequently found to be careless). Moreover, they constitute a very modest percentage if compared with the

overwhelming majority of diaspirate forms which undergo GL in a regular fashion. Nevertheless, they represent a good number to suppose that, at least in Attic, such a phenomenon was actually attested. Miller (1977: 147) interprets the assimilation between aspirates as a process leading to the formation of over-corrected diaspirate forms, therefore, as a counter-process pointing to an actual, coeval spreading of GL. However, Jatteau (2016: 560) points out these forms are too frequent to interpret them as evidence for hypercorrection.

3.2 Aspiration floating

In this section, forms showing a notable instability regarding the positioning of the [+spread glottis] feature are presented. Although these cases are different from GL, they can also testify to the ambiguous location of the aspiration feature within a word. Such an ambiguity could lead to different outcomes: aspiration can "float" between one and the other segment, positioning itself on only one of the two; in this case, it can give rise to so-called aspirate metathesis, in which aspiration surfaces in a segment different from the one where it generally surfaces. Alternatively, aspiration can surface in both segments or, finally, it cannot appear at all. Since some of the forms affected by "aspiration floating" are loanwords or have an unknown etymology, one could recognize such an instability as a difficulty on the part of Greek speakers to identify the original shape of the word. However, this difficulty could only have enhanced a phenomenon which already existed, dependent on the articulatory and acoustic basis of this typology of features.

Turning our attention first to Attic, Threatte (1980: 464) states that examples of this phenomenon are infrequent after 300 BC, even though there are several instances still in the Roman period. Among forms which undergo this process, some examples are connected to the word for 'copper', χαλκός (Threatte 1980: 465–466). A form καλκοῦν lit. 'bronzy' is attested on two fourth-century inventories (IG II² 1472, 34, 36, after 319–318 BC). Beside the form κάλχας (IG I³ 474, 90, 409–408 BC), lit. 'murex, purple limpet', forms such as χάλκας (IG I³ 293), χάλκον (IG I³ 476.259–60, 353) are attested, as well as the diaspirate form χάλχας (IG I³ 476, l. 54, 408–407 BC), with the sense of 'rosettes applied to columns'.[9]

The Semitic loanword for 'tunic' (Levin 1969, DELG, EDG) is attested both in Homeric Greek and in Attic (since the 5th c. BC) as χιτών. Three Attic inventories of 4th c. BC attest the form κιθων-, which is the form also documented in the Ionian

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9 Threatte (1980: 465) follows Frisk (GEW) by considering these forms eymologically related to χαλκ- 'bronze'. However, both Chantraine (DELG) and Beekes (EDG) believe these forms to be loanwords of unknown origin.

prose (see e.g. Her., 5,87,3): κιθώνιον (some instances in IG II², 1527, ca. 325 BC); κιθώνια (IG II² 1464, l. 13, ca. 330 BC); κιθωνίσκον (IG II² 1523, l. 18, before 334–333 BC). Doric attests the non-aspirated form κιτών (see Sophron, fr. 34 K.-A.).

A form χύτρα 'earthen pot, pipkin', related with χέω 'pour', is frequent in Attic, but Κύθρους appears in a late ephebic catalogue (IG II² 2130.69, 192–193 AD). In Doric, a form κύτρη, with no aspirates, surfaces (Bettarini 2017: 91).

Beside the Homeric form φάτνη 'manger, crib' (an Atticism, according to Wackernagel 1916: 23), a variant πάθνη is attested in the Hellenistic epoque (φάτνη Ἀττικοί, πάθνη Ἕλληνες, Moeris 391P.), but also in Herodotus. This latter form could be the most ancient (GEW, DELG), preserved in the rural lexicon until its re-emergence in the *koiné*. The diminutive πιθάκνη 'cask, jar' (see πίθος), maybe of Pre-Greek origin (see EDG s.v. πίθος), surfaces in Attic as φιδάκνη (see also φιδάκνιον), maybe influenced by φείδομαι. Beside the above-mentioned Attic form χύτρα, an Ionian form κύθρη can be mentioned (but see in Herodotus the form χυτρίδων, 5,88,15 and the toponym Χύτρους 7,176,15). Hipponax shows κύθρος (fr. 118Dg.), which Fotius considers an Ionian form (Bettarini 2017: 89–93). A form θεῦτιν (Hipp., fr. 162 Dg.) is glossed by Hesychius as †σκαράδιν†, Ἱππῶναξ (θ 434 Latte), which could represent a metathetic form (with barytonesis) of τευθίς 'squid' (Bettarini 2017: 89), of unknown etymology. Eustathius mentions as Ionian the form βάθρακος 'frog', instead of βάτραχος (but see in Herodotus 4,131 the form βάτραχον), and ἀκάνθια 'thorn, prickle' for ἀχάντια.

With regard to Cretan, see the form θροπάν, corresponding to Attic τροφή 'nourishment, food', maybe from the area of Lyttos-Aphrati (SEG 27: 361, about 6th c. BC); θυκάγαθᾶι (dative, Gortyna, IC IV 64, beginning of 5th c. BC); κεϳίθεκνα (adj., IC IV 75, col. B, ll. 4–5, about 480–450 BC); θύκοι (optative, Gortyna, IC IV 82 col. B,1, ca. 480–450 BC); καυχῶι (dative, Gortyna, IC IV 162, about 250–200 BC); Ἀχάντω (gen. of Ἄκανθος, Gortyna, IC IV 387; SEG 23.594, 2nd c. BC).

4 GL as a phonetic process

In this section, I try to explain the irregularities of GL cited in the previous paragraphs. The first group of these exceptions include original diaspirate stems, such as Ion. θυφλός 'blind' < *$d^heu̯b^h$- (EDG), see Section 3. The presence of these forms in different dialects would suggest that the evidence reflects genuine usage, rather than being the result of random errors. The easiest way to explain these occurrences is regarding them as frozen forms that escaped the wave of regular dissimilation, especially in some conservative areas. An alternative solution could be related to the phonetic preconditions affecting aspirated segments: the effort on the part of the speaker or the listener to trace a prosodic feature within the

segmental level can be considerable. In this case, the original diaspirate form continues to be generated by the grammar until phonological constraints select only monoaspirate candidates.

A second trend against the regularity of this sound change concerns the reverse process of GL, that is, the *aspirate assimilation* (Gallagher 2010), mentioned above. Such an output can be explained within the Ohala framework. Due to the long spread glottis gesture across a /CVC/ prosodic unit, speakers in speech production could extend the aspiration all along the phonic sequence. If the listener fails to implement the corrective rules which should bring back the form to its original shape, then diaspirate (non etymological forms) arise, coexisting side by side with monoaspirated forms. Such a failure could be related to the difficulty on the part of the listener to restore the original place of the [+spread glottis] feature at the proper segmental level.

A last outcome does not concern GL, but rather what we called 'apiration floating', namely the unstable placement of the [+spread glottis] feature within the same word: forms generally of unknown etymology or loanwords can surface as /CʰVC/, /CVCʰ/, or even with no aspirates at all. Consider, for example, alternations such as Att. χιτών, κιθων-, Dor. κιτών (see Section 3.2). This sort of aspiration shift seems triggered by the same phonetic preconditions underlying GL-failure, and from this perspective one can justify its presence here. Since neither the speaker nor the listener can detect the exact spot at which the [+spread glottis] feature is placed at the segmental level, a pool of variants arises as a consequence of this state of uncertainty. How long irregular outcomes can be generated in the grammar depends solely on when phonological constraints intervene. When phonology incorporates phonetic outputs, it can implement some of them by promoting one or the other, and by discarding the others.

The above-mentioned examples of GL-failure would fit well with the sporadicity of other dissimilation processes. However, as we have already noted, they are overwhelmed by the majority of occurrences in which GL acts with absolute regularity: in this regard, the evidence is too faint to represent actual counterevidence to the *Ausnahmslosigkeit* of this sound law.

The crucial fact is that all the irregularities quoted this far are attested until a certain epoque (even though the exact age remains difficult to determine, see Section 3). After this time, GL acts in a regular fashion and the exceptions significantly decrease. In my view, this point to the fact that cases of GL-failure represent a linguistic status prior to the definitive phonologization of the law. Both the forms not affected by GL and those with an aspirate assimilation testify to the huge phonetic variation which a dissimilatory sound change involving "secondary" features can produce, as long as it is not constrained by phonology. In this way, sporadicity can be seen as the indirect consequence of the dissonance that

speakers or listeners feel when they are faced with features containing long perceptual cues. Perceptual or motor planning errors responsible for non-local dissimilation produce a set of outputs reflecting the frequency of these same errors which have intervened to unscramble the speech act.

Against this view, one could emphasize that many cases of dissimilation represent good evidence of regular sound change. For example, gradient dissimilation both in Hahl Mongolian and in Aberystwyth English is lexically regular (Jatteau and Hejná 2018). Garrett and Johnson (2012: 75) quote the case of the so-called *Salish Grassmann's Law*, which involves dissimilatory deglottalization in a regular fashion. In a similar way, Katupha's Law in Makhuwa affects aspirated consonants through dissimilation in a systematic manner (Schadeberg 1999). However, these and other examples of regularity might represent a last stage in a diachronic path, resulting from the phonologization of the sound change, through which one of the possible outputs which originate from the disentanglement of the phonic space has been selected and regularized. For cases in which different diachronic stages of the process are available, the picture is not so homogenous. For example, Halh Mongolian dissimilation – which involves a reduction in duration of VOT in the first of the two consonants – seems to represent the diachronic ancestor of the Chahar Mongolian regressive dissimilation, where the aspiration feature is deleted (Jatteau and Hejná 2018). However, in some speakers of Halh, the rightmost consonant can be affected by the type of the first consonant, namely it shows a progressive gradient dissimilation (Jatteau and Hejná 2018: 49–50). This latter process could represent, albeit restricted to few Halh speakers, the precursor of progressive dissimilation displayed by another dialect, Monguor Mongolian, in which the second aspirated consonant loses its aspiration through dissimilation. Data from Hahl reveal a biredictional process in a same individual, a fact which can be related to the large number of variants generated by features with long perceptual cues. If dissimilation in Hahl Mongolian actually represents the common precursor both of regressive and progressive dissimilation of other Mongolian dialects, it provides evidence for a diachronic stage in which the process was not yet stabilised, at least with respect to its directionality.

5 The path towards phonologization

In the same vein, the case study of Grassmann's Law in Greek allows us to consider a diachronic phase in which dissimilatory outputs still displayed a large number of solutions, evidence of the phonetic stage of the process. The enhancement of a stable template with only one aspirated segment is implemented by some phonological constraints, which conspire by deleting diaspirate variants from the

grammar. Here I will provide evidence of two changes which lead to the same result, namely the deletion of one or the other aspirate in a stem, but the involvement of other conspiring changes cannot be ruled out.

5.1 The cluster assimilation constraint

Already in prehistoric times, aspirated voiceless stops began to lose the [+spread glottis] feature in some clusters. In the case of original diaspirate stems, this cluster assimilation produced outcomes with the [+spread glottis] feature affecting only one segment, generally the leftmost. In corradical forms where such clusters did not surface, the [+spread glottis] feature originally affected two segments, but GL intervened by deleting one of this (generally the leftmost, see Jatteau 2016). See, for example, forms in which C^2 is coded by /pʰ/ and /tʰ/ followed by an obstruent or /s/ : θρέψω /'tʰrepsoː/, ἐθρέφθην /e'tʰreptʰeːn/ versus τρέφω /'trepʰoː/; θρίξ /'tʰriks/ versus τριχός /tri'kʰos/ etc. Aspiration was also lost when an original /i̯/ followed; see, for example, ἅπτω /'hapto:/ (< */hapʰi̯oː/) versus ἀφάσσω /a'pʰassoː/; θάσσων /'tʰassoːn/ (< */tʰakʰi̯oːn/) versus ταχύς /ta'kʰys/ and, at least in some forms, after /m/, see e.g. θάμβος /'tʰambos/ versus τάφος /'tapʰos/, θρόμβος /'tʰrombos/ versus τρέφω /'trepho:/ etc. (Jatteau 2016: 515–521; Lejeune 1972: 58, 72, 79–80).

In this way, many diaspirate stems lost one of the two aspirates, by contributing to the restructuring of the underlying diaspirate form (Miller 1977: 149–151): GL was replaced by a synchronic sub-rule of aspiration throwback, which explains alternations such as ἔχω /'ekʰoː/ versus ἕξω /'heksoː/. As a result of these sound changes, only two different templates surfaced in Classical Greek: /CʰVC/ and /CVCʰ/, deleting diaspirate forms from the grammar.

5.2 The reduplicated syllable in verbal forms

The second change which helped to the elimination of diaspirate forms from the grammar has been triggered by morphological constraints (De Angelis 2018; Keydana 2006). Compared to the general instability of the effects of GL, the reduplicating syllable – that is the CV morpheme prefixed to many verbal formations – stands out for a mandatory constraint on the presence of [+spread glottis] features: neither /h/ nor an aspirated stop of the stem can surface in the reduplicant. See for example perfect forms such as τέθνηκα, πέφευγα etc.; athematic presents such as τίθημι, κίχημι etc (Giannakis 1997: 88, 92); reduplicated -*sko*-presents, see πιφαύσκω (Giannakis 1997: 249); reduplicated presents coming from original intensive forms, e.g. παιφάσσω, παμφαίνω, πορφύρω (Di Giovine 2010;

Giannakis 1997: 269, 270, 274); onomatopoeic presents such as καγχαλάω, παφλάζω (Giannakis 1997: 281, 284); aoristic relic forms with zero-grade, such as Hom. πεφιδέσθαι (φείδομαι) (Chantraine 1948: 396 [§ 189]); reduplicated aorists with an expressive value, such as ἤκαχε 'anguish', ἤπαφε 'deceive' etc.

Differently from the forms subject to GL – which entail an underlying dia-spirate template – in the reduplicant the (eventually aspirated) segment is not prespecified in the underlying form, partially or totally copying the respective aspirated stop or *h-* in the stem. In doing so, it undergoes some specific morpho-prosodic constraints. Among these, one of the most striking oddities deals with the emergence of unmarked features – if compared both with the stem and with the specific phonotactic rules of a language (Halle 2008; Kager 1999: 196–198; Kiparsky 2007; McCarthy and Prince 1994; Milizia in press; Steriade 1988; Zukoff 2017) – that is cross-linguistically more frequent than the respective marked counterparts (Haspelmath 2006: 34–35).

As far as Greek verbal forms are concerned, the following can be identified as unmarked features in the reduplicant:

(a) Partial reduplication displays a strict unmarked CV syllable, in spite of the possible presence of a CVC root syllable (see perfect forms such as δέ-δορ-κα, πε-πέμπ-ται, with a CVC stem reduced to CV in the reduplicant).

(b) The reduplicating syllable allows for a simple Onset: stop + sonorant consonant clusters are simplified in favour of the first consonant (e.g. κέ-κρι-μαι, τέ-τρο-φα, πέ-πνυ-μαι etc.).[10]

(c) Both in the present and perfect reduplicated forms, the vowel in the reduplicant generally surfaces as *-e-* in the perfect, and *-i-* in the present, regardless of the vowel in the stem. This oddity constitutes a process of phonological reduction aimed at the emergence of an unmarked segment in the reduplicant (McCarthy and Prince 1994), according to the so-called "non-copying model" (Alderete et al. 1999).

In the same vein, one can justify the occurrence of unaspirated segments versus their aspirated counterparts – as well as the presence of Ø versus /h/ in the reduplicant – as the result of unmarked constraints: indeed, unaspirated stops are

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10 An apparent exception concerns forms with the so-called "Attic reduplication", such as ἀλή-λιμμαι from ἀλείφω, ὀρώρυγμαι from ὀρύσσω etc., which are generally reconstructed with an initial cluster HC (H = laryngeal + C = consonant) (Kümmel 2014; Zukoff 2017). However, this reconstruction has been recently criticized by Milizia (in press): indeed, the shape of the redu-plicant in the formation of such "Attic" forms follows a typologically widespread pattern, which differs from the canonical one exactly when the stem starts with a vowel. On the other hand, the process which leads to the rise of these verbal forms is driven by the same rules which form the canonical perfect.

less marked than the respective aspirated ones, as is shown by data relating to the frequencies with which both of them are attested in the languages of the world. Maddieson (1984: 27) records 91 languages (28.7%) provided with aspirated voiceless stops against 291 (91.8%) languages provided with unaspirated voiceless stops. The markedness of the feature [+spread glottis] could justify its exclusion from the reduplicated syllable, without the need to postulate any application of GL as a synchronic rule in this prosodic context.

If GL has been replaced by the aspiration-throwback rule (see Section 2), its apparent operation in reduplicated forms is difficult to explain. Moreover, it remains hard to explain why labials (and velars) show the effects of GL only in reduplicated forms (e.g. πέφευγα, if from an underlying $*/\text{'p}^\text{h}\text{e+p}^\text{h}\text{e}\underset{\smile}{\text{u}}\text{ga/}$), but in the other forms meanwhile /p/ and /t/ were generalized as the result of levelling, see for example παχύς /pa'k$^\text{h}$ys/ versus πάσσων /'passoːn/ (comparative of παχύς 'thick', instead of †/'p$^\text{h}$assoːn/); πεύθω /'pe$\underset{\smile}{\text{u}}t^\text{h}$o/ versus πήσομαι /'peːsomai/ (< $*/\text{p}^\text{h}\text{e}\underset{\smile}{\text{i}}\text{t}^\text{h}\text{somai/}$), instead of †/p$^\text{h}$eːsomai/ etc. (Sihler 1995: 143).

Therefore, the alternative hypothesis of considering the constraint against aspirates responsible for their absence in the reduplicant seems more persuasive than postulating a dissimilatory sound change, that is GL, which stopped acting as a synchronic rule at least since the Classical epoque.

6 Final remarks

The account sketched above has attempted to solve the "dissimilation-paradox": GL acts – both in Greek and Sanskrit – in a regular way, differently from other long-distance dissimilatory processes. However, before its definitive stabilisation in Greek, a certain number of forms reveal less homogeneous outcomes regarding the regularity of the process. The typology in which "irregular" variants surface agrees with the sporadicity of other "minor sound changes". The enhancement and the rise of the monoaspirated variant could depend on a set of different changes (phonetic as well as morphological) which conspired to produce an exclusive pattern with a sole aspirate, by removing other variants from the system.

The diachronic evidence examined in this paper allows us to classify GL in the ranks of the sound laws, in spite of the exceptions to its regularity which we have referred to. Such a set of occurrences instantiate the phonetic side of the law, namely what I proposed to call "the phonetic prehistory" of GL. In its prephonological life, the Greek law of dissimilation resembles other dissimilation changes known for their sporadicity. Further research is needed to show if other "minor sound changes" keep this status only as long as they are captured by the phonology, or if they preserve their irregular nature over time.

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