CHROMATIC CHORDS IN THEORY AND PRACTICE

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ABSTRACT

'Chromatic harmony' is seen as a fundamental part of (extended) tonal music in the Western classical tradition (c.1700–1900). It routinely features in core curricula. Yet even in this globalised and data-driven age, 1) there are significant gaps between how different national 'schools' identify important chords and progressions, label them, and shape the corresponding curricula; 2) even many common terms lack robust definition; and 3) empirical evidence rarely features, even in discussions about 'typical', 'representative' practice. This paper addresses those three considerations by: 1) comparing English- and German-speaking traditions as an example of this divergence; 2) proposing a framework for defining common terms where that is lacking; and 3) surveying the actual usage of these chromatic chord categories using a *computational* corpus study of *human* harmonic analyses.

1. INTRODUCTION

Different traditions for teaching music theory come with divergent terminology. These gaps often correspond to national trends (or 'schools') and to the different languages used. As always with language, these gaps can take several forms. Some terms may be *shared* by the two languages, so no translation is needed. Other times, a term is present *in one language only*; this inclusion may indicate an importance for the term/concept on one side of this divide and not the other. More complex still, two languages may have some terms with *partially overlapping* meaning.

There are significant gaps between English- and German-speaking terminology for chromatic harmony, despite so much shared historical heritage. Even the distinction of 'chromatic' from 'diatonic' betrays an English-language stance. Section §1.1 introduces something of a frame for this comparison and §2 discusses three interesting case-studies of 'canonical' terms. The focus is on chords that are either *intrinsically* chromatic (Augmented Sixths, §2.2), or chromatic against their diatonic *context* (Neapolitan Sixths, §2.1; Modal Mixture, §2.3). We leave to one side what is sometimes called 'functional chromaticism' (the 'secondary'/'applied' chords involved in tonicisation/modulation – see [1, Part 5]) though the final section (§5) briefly considers some relevant chord *progressions*.

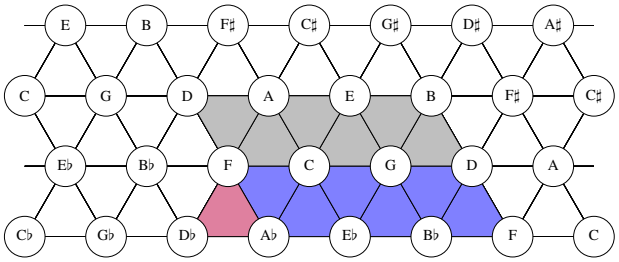

Figure 1. A 'Tonnetz' diagram of tonal space. Major and minor triads in the key of C *major* are grey; those in C (natural) *minor* are in blue, and the 'Neapolitan' is purple.

Moreover, a closer look reveals that even some of the apparently core concepts in chromatic harmony are only vaguely defined. For example, although 'modal mixture' is common (at least in US-English music theory), no source sets out comprehensive criteria for inclusion in this category. Section §3 addresses this, seeking to establish not so much a single, definitive answer, but a *framework* to deal with the various issues involved.

Finally, having established the (range) of terms that German- and English- speaking scholars elevate as important, and clarified the meaning of some, §4 provides an initial overview of the relative *usage* of these chords in the 'When in Rome' repository: a meta-corpus of all Roman numeral analyses that human annotators have encoded in computational formats [2]. In doing so, we gain insight into how common these chords are, at least in the repertoires covered and the view of those human analysts.

Clearly, sheer *usage* is not the only relevant consideration for the *significance* of a chordal category — many subjects are interesting partly because of their rarity. In any case, all such discussions, and any claims about 'general practice', need a basis in this kind of empirical evidence. The clarity that evidence brings may prompt a review of our existing practice (how we categorise these chords, and/or how much time we devote to them in our curricula and wider musical practice). It may also clarify the extent to which that attention is based on the frequency of occurrence as opposed to some other factor, like how *explainable* the concept is in terms of a particular theory.

1.1 Textbooks, Terminology, and Tradition

We begin with that slippery notion of a 'tradition'. While it is hard to pin down exactly what this means in practice, [1] the contents of widely circulated textbooks provide

[1] For more on the question of 'representativeness', see [3].

one kind of insight into what is 'typically taught and commonly known' in a given context. Among the issues here is the privileging of contexts in which textbooks are common (broadly speaking, the US), and lack of sensitivity to more flexibly amassed materials, particularly in a changing world with ever more materials shared ever more accessibly online. [2] Then again, many of these online materials and apps continue to reflect what is described here in terms of textbooks. And I implicate myself in this: see, for example, the chapter listings and content of the 'Open Music Theory' (OMT) textbook [5] which (incidentally) serves throughout this paper as a go-to resource for further reading, with links to relevant chapters provided.

1.1.1 English-language (hereafter 'Anglophone')

On the Anglophone side we benefit from two surveys of the 'core curriculum' in American music theory teaching, including information about the textbooks typically used [6, 7]. The more recent of these surveys finds that 91.89% (238/259) respondents include 'Chromatic harmony' in their core curriculum (see Table IV-1), with 1 or 2 semesters being the 'most commonly reported lengths of time for teaching' this content (p.202, Table IV-9), and that 79.92% use textbooks/anthologies (Table IV-10).

These surveys also appear to indicate that the preference for *which* textbook to use changes quickly, [3] but that *what* those textbooks cover remains largely the same: they consistently cover the same canonical collection including at least the so-called 'Neapolitan sixths', 'Augmented sixths', and 'Modal Mixture'. [4]

Click on those terms above for OMT chapters about them, and click here for a summary of these chords in a musical score that you can view, play and more online (no login required). That rendering is relatively typical of the simple, purportedly 'prototypical' ways these chords are set out in textbooks. (Naturally, we will discuss here just how prototypical they really are.)

1.1.2 German-language (hereafter 'DACH')

As no equivalent survey existed for the DACH side, [5] we conducted one anew in mid-2022. [6] Specifically, we asked anyone teaching chromatic harmony at a German-speaking tertiary education institution to answer basic questions about the textbooks and terminology they know and use. Please refer to that study for a thorough report on the method and results of the survey. This paper refers to only the most salient results as relevant for present purposes, as discussed in the following sections.

[2] On the growing adoption of technological alternatives see the 'What Do Musicologists Do All Day' (WDMDAD) surveys (2014-15, [4] and 2021-22, forthcoming) which investigate 'the use of technology in the work of music researchers in the widest sense' (including teaching).

[3] I.e., there is little overlap between the 2000 and 2017 results.

[4] Increasingly, many also refer to the common-tone diminished sevenths, (for which see §5) though they often package this more deeply e.g., within the 'Rise of Symmetrical Harmony in Tonal Music' [1].

[5] 'DACH' is an abbreviation/acronym for Germany, Austria and Switzerland. These are the main areas of German-speaking today and where all the institutions approached for the survey are situated.

[6] The written report is forthcoming (Feilen, Schnauss and Gotham).

2. THREE CANONICAL CATEGORIES

2.1 Similar usage: the 'Neapolitan sixth'

The 'Neapolitan sixth' appears routinely in both languages. It is interesting to note the status of this chord in relation to the *Funktions-* and *Stufentheorie* approaches to harmony which capture much of the core divide between DACH and Anglophone approaches (respectively).

The Neapolitan can be seen as a simple, one-semi-tone modification to the minor subdominant. [7] In *Funktionstheorie*, such small transformations typically indicate close harmonic relations, leading to maps of tonal space like the *Tonnetz* of figure 1 which shows how the Neapolitan sits alongside diatonic chords, especially in minor. [8] (We will return to the minor-specific aspect *in practice* in §4). *Stufentheorie*, by contrast, typically describes the Neapolitan in terms of a modification of the second degree ($\flat$II^6). This is clearly relegated to a subsidiary position, a 'chromatic' chord outside the main, 'diatonic' set. [9]

Notwithstanding the different theoretical frames, the Neapolitan presents relative close Anglophone-DACH agreement: not only is there agreement on which pitches are involved, but both typically relate this chord to the 'subdominant' (both), or more loosely to 'predominant' function (Anglophone). Despite the Anglophone notion of $\flat$II^6, the close relation to 'iv' ('s') is often emphasised, and likewise it is common in DACH to eschew the possible *Funktions*-only explanation in favour of the symbol s^n that further emphasises the proximity to the subdominant.

Anglophone and DACH traditions also share most of the definitional incompleteness, notably terms of whether to admit: other *inversions* (e.g., 53) and other *tones* (e.g., seventh chords such as 653). DACH theory often *does* admit the 53 configuration of this chord, and reserves a special name for it: the *verselbständigter*. It is noteworthy that, despite being rather sparing in its use of special terms for individual chords, DACH considers the Neapolitan worthy not only of one term, but two. [10] Both Anglophone and DACH theories lack an explicit consensus on whether the Neapolitan may have a seventh.

2.2 Divergent terms: Augmented-sixth chords

The Anglophone convention for teaching Augmented-sixth chords identifies (at least) three forms that have been given spurious national labels: the 'Italian sixth' (63), the 'French' (643), and the 'German' (653). Those labels seem

[7] This can be viewed as the *Mollsubdominantgegenklang* (sG), though see the following text on s^n. The *-gegenklang* transformation is the same as the *-gegenparallel* and better known in Anglophone contexts as the *leittonwechsel* or 'leading-tone exchange'.

[8] Although this common visual analogy for tonal 'space' is familiar to Anglophone music theory, is much more closely related to the *Funktions* mentality. The earliest, recognisable form seems to be from Euler [8] (yes, the mathematician) but the best known exposition of this idea and 'space' is that of Riemann [9] (no, not the mathematician).

[9] DACH can also express this chromatic alteration (*hoch-* and *tiefalterierte*), but usually does so a last resort where other theory fails.

[10] One of the earliest recorded Anglophone uses of this term treads a middle line in which the chord is explicitly built on the subdominant scale degree ('Fa', i.e., $\hat{4}$) and 'is never inverted', apparently meaning that, unusually, this 63 form is not to be considered 'inverted' [10].

to have originally been proposed (c.1800) based on their usage in the repertoire. For example, [11] explicitly links these chords to the music of those nations. [11]

Leaving until §4 the question of whether these national labels have anything to do with repertoire usage, there is an Anglophone/DACH division in the terms themselves which may perhaps be telling. DACH emphasises a single category for which the recognised term is *übermäßiger Quintsextakkord*. This explicitly refers to the 653 form — the one that Anglophone theory calls the 'German' sixth.

This also indicates opposing ways of handling augmented sixth chord categories: Anglophone traditions not only use 3 categories, but tend to start with the 'Italian' (63) as the prototype (at least in the pedagogical sense) and then *add* tones to build the French (6*4*3) and German (6*5*3); DACH, by contrast, starts with the 653 and would need to *remove or modify* from there. [12]

These differences aside, there is broad Anglophone-DACH agreement on the composition of the chords. The eponymous augmented sixth interval is needed (and spelt as such), and there is a strong focus on both the *inversion* that sees the lower note of that interval in the bass and the *voice-leading* whereby this interval expands 'out' to a perfect octave on the dominant ($\hat{5}$).

2.3 Anglophone only: 'Modal Mixture'

Most Anglophone textbooks offer a short definition of 'modal mixture' (a.k.a. 'borrowing') as the use of a chord that is not diatonic in the key specified, but would be in the parallel (German: *variant*) major / minor and can therefore be thought of as a 'mixture' of major and minor modes, or a 'borrowing' from the one to the other. Some coverage of this topic is present in all the Anglophone textbooks surveyed, usually with a dedicated chapter.

No DACH equivalent appears in German textbooks. Equivalents do sporadically appear in DACH analysis scholarship with terms such as *Dur-moll-Austauschbarkeit*, (or simply *Austauschbarkeit*, literally 'exchange'), but this term cannot be assumed knowledge in the classroom or beyond. [13]

Despite the ubiquity of the term 'mixture' in Anglophone textbooks, it is particularly under-defined and never fully unpacked to account for all in-/exclusions. This is perhaps understandable in a pedagogical context where the increased clarity must be weighted against the corresponding complexity, but as a field, we clearly need a framework for robust definition. The following, dedicated section §3 provides such a framework.

[11] Callcott appears to have inherited the term 'Italian', noting that it 'has been termed' the Italian. There's no direct reference, though nearby mention of Rousseau suggests that may be at least one of his sources. Callcott seems to introduce the other two 'nationalities'.

[12] Click here for a modern, online example of this DACH pattern, and see also Biamonte's account of this chord, including DACH sources dating back to Marpurg 1755 [12].

[13] Incidentally, it is not self-evident that this 'mixture' is indeed a mixture of distinct parts, as opposed to a unified entity. For instance, another school of thought (historically of German-origin, now more common in Russian music theory) sees the major mode with $\flat\hat{6}$ as a single 'harmonic major' scale. See [13] for the progress of this idea from Hauptmann, via Iogansen, Liadov, and Rimsky-Korsakov to modern Russian theory.

3. DEFINING MODAL MIXTURE

In a major context, the subdominant is also major ('IV' or 'S'). Probably the most common chord identified in terms of modal mixture is the minor variant of this subdominant ('iv' or 's'). So in C major, for example, we would have <F-A♭-C> in place of <F-A-C>.

But what if this mixture chord had a seventh, so not simply <F-A♭-C>, but <F-A♭-C-E♭>, or <F-A♭-C-E>? The first case, <F-A♭-C-E♭> seems like a very good candidate: the additional borrowing from the minor of E♭ further strengthens the case for mixture. The same can't be said for <F-A♭-C-E> as E belongs to C major exclusively and arguably counts *against* the notion of mixture. [14] So **should cases of clear *non-mixture* be excluded**?

If we admit the <F-A♭-C-E> as a case of modal mixture, then what do we have to say about the case of <F-A-C-E♭>? Is that equivalent? Now the E♭ is borrowed, but the A is arguably not depending on the type of minor mode. **What minor form are we talking about when we speak of mixture?** Some accounts seem to hint at the natural minor, but then every raised leading-tone chord (V, V7, viio, ...) would count as cases of mixture in minor.

Should the case of <F-A-C-E♭> depend on whether it is cast as IV♭7 or as V/♭VII? That is, **should secondary/applied chords be handled differently** as a case of 'functional' chromaticism or (put another way) as diatonic elements in a new key area? Does this depend on whether that secondary tonality is realised by a subsequent **tonicisation or modulation**? This question opens a second set of possible criteria: in addition to questions about the chord's *content*, we now must also consider its *context*.

Speaking of context, **does the so-called 'Picardy Third' count?** [15] And arguably related to both content and context, (and certainly relevant to applied chords) is the question: **does pitch spelling matter?** Were our <F-A-C-E♭> chord spelt as <F-A-C-D♯>, apart from potentially leading analysts to describe it differently, should that spelling itself have a bearing on the status of mixture? Is the minor third mixed only when spelt as such, or is it to be handled as a pitch class, and thus admitting the enharmonic equivalent of a raised second degree ($\sharp\hat{2}$)?

Altogether, these musical questions capture something of the ambiguity in defining modal mixture, and the need for greater clarity in what 'counts'. They also suggest the need to create a *framework* for category membership, rather than clear-cut rules applicable in all contexts.

Realising this, functionality at 'When in Rome' enables user-defined answers to any of the questions raised above, while also providing default settings and proposing a system for grading the *relative* strength of mixture, both in terms of the chord *content* and of the surrounding chord *context*.

[14] Note we are talking specifically about how relatively *mixed* these chords are, not how *chromatic*.

[15] This term stands for the practice of ending a minor key passage with a major tonic as the final chord. (Click here for the modal mixture chapter of OMT, including an example of the 'Picardy Third'.) It is extremely common, at least in some repertoire contexts.

3.1 Which pitches, which minor?

In working towards a relative gradation of mixture (which may be paired with strict requirements/exclusions), we begin with an account of how *each pitch* can add to or detract from the mixture status. This necessarily also involves the question of 'which minor', a conundrum which often complicates matters of definition in tonal music.

Many definitions of modal mixture restrict themselves to natural minor specifically (minor $\hat{6}$ and $\hat{7}$), yet they do not describe V in minor as a mixture, despite the raised $\hat{7}$ clearly belonging to major and not the chosen minor form. Tones' mixture status can be organised in a few categories: *clearly* indicative of one mode and not the other; *possible* indication of mixture; and *neutral/shared*. The following categorisation is logically guided, but only one (set of) opinion(s). Users of this framework are free to re-allocate the status of these pitches (within reason).

3.1.1 Clear (non-)mixture: m3, M3, m6

Tones strongly indicate (non-)mixture when they clearly belong in either the host mode or the parallel mode but not both. The clearest example is scale degree $\hat{3}$. The minor third (m3) is a clear case of mixture when it appears in major (hereafter min→maj mixture) and non-mixture when in minor. Likewise, vice versa, for the major M3: this is a clear case of mixture in minor (hereafter maj→min) and non-mixture in major. (Again, these comments are separate from the *context* caveats discussed elsewhere, e.g., concerning the 'Picardy Third'.)

The minor sixth (m6) in major is almost as clear: it is not in the major scale and does belong to both natural and harmonic minors, as well as the descending melodic minor form. Only the ascending melodic minor misses this pitch. When in Rome defaults suggest the inclusion of m6 as a case of *clear* mixture, in the definition framework, while enabling theorists to categorise it instead as a case of *possible* mixture if they prefer for a specific repertoire/task.

3.1.2 Possible mixture: M6, m7, M7

Some tones offer a lower level of *possible* mixture due to their considerably more ambiguous status. When in Rome proposes the major sixth degree (M6) for this category as it is more strongly associated with major, though it can be reached in one melodic minor form (ascending). M6 may therefore indicate *possible* maj→min mixture.

Likewise, the minor seventh degree (m7) may indicate min→maj mixture: it does not feature in major, but it is also not as strongly indicative of minor mode as m6 is, appearing only in natural and descending melodic forms.

Finally, as discussed, the major seventh degree (M7) arguably indicates maj→min mixture, though raised leading-tones are too common in tonal music to support this as a chromatic category.

3.1.3 Neutral (1, 2, 4, 5) and 'chromatic' (♯1, ♯4)

Neutral tones belong to both major and minor forms equally. This group includes scale degrees 1, 2, 4, and 5 along with any tones excluded from the above categories.

That leaves tones which may be called 'chromatic' in the sense that they do not belong to either mode. We can confidently populate this category with degrees $\sharp\hat{1}$ and $\sharp\hat{4}$. If the user asserts that spelling matters, then the chromatic category also hosts enharmonics (like $\sharp\hat{2}$, discussed above).

3.2 Metrics and/or Categories

If we accept the notion some chords are more strongly indicative of mixture than others, largely because of the relative status of the tones, then we may wish to explicitly weight that relative strength, note by note. For example, *clearly* mixed tones might attract twice the weight (2) of *possible* mixture (1), with *neutral* values at 0. *Chromatic* tones are perhaps the most ambiguous. When in Rome defaults to a value of -1, because their clearly chromatic status often detracts from their candidacy for mixture.

For instance, to return to the above example cases of min→maj mixture: the strength of mixtures like ♭VI, ♭VI7, and iv7 derives from that fact that they all feature the m6 and m3, and all avoid any detractions. The weighting values above would grade each of these at 4, twice the strength of chords like iv with only the m6 (no m3, but also no detractions) at 2. The pros and cons of an ambiguous chords combining m6 and M3 would effectively balance out.

One asset of this weighting-by-tone metric is its flexibility: it enables any chord to be assessed, including modifications like added/altered tones, and it can handle the enharmonic question separately. Context can be handled either categorically (e.g., excluding all secondaries) and/or with further weightings. For instance, the status of mixture may be enhanced when it is bookended by clearly *non-mixed* chords as in I-iv-I (T-s-T). Again, see 'When in Rome' for a demonstration.

4. IN PRACTICE (CORPUS STUDY)

All of the above discussion – 'national' category variants, graded definitions, and more – would benefit from comparison with the actual usage in practice. For instance, if a chord is *not* commonly used in a particular style but *is* commonly taught in courses purporting to represent that style, then we need to be clear on the reasons why.

Part of the difficulty of establishing robust definitions of the chords above comes from the fact that a robust definition of the 'chord' itself is challenging. Western classical notation includes information about which *pitches* to play, and when, but has no explicit statements on how they connect as *chords*.[16] It differs in this (and other) respects from leadsheets, for example, where it *is* typical to include chord symbols.[17] While many explicit algorithms for automatic harmonic analysis have been proposed, none really approaches the quality of a human expert. And arguably the best automatic analysis systems to have emerged in recent years are those based on machine learning, which derive, in turn, learns from the *computer* encodings of *human* expert analyses discussed here [14].

[16] Baroque figured bass is arguably a partial exception: given the bass note and figuring, you have something like a chordal analysis.

[17] Though they are not key-relative like Roman numerals.

The assessment of chordal usage 'in practice' here is based on that data, and specifically the 'When in Rome' repository, which provides a synthesis of all those *computer* encodings of *human* analyses for Western classical music using Roman numerals.

As with all analysis, this is inherently subjective; while the score source material may have editorial ambiguities that evade the notion of 'ground truth', this is all the more so in analytical commentary on that source. Then again, the harmonic analyses are our subject of interest, and so this subjectivity is not only inevitable, but also desirable.

Once the analyses have been encoded in a suitable format (legible to human and machine alike), although there are still operational decisions to make, the process of extracting them is readily implemented and interpreted. The operational decisions include filters for more or less detailed versions of the chords used as best befits the research question at hand. For example, it is sometimes necessary to *retain* inversion information, while at other times it is best to report on aggregated data *excluding* inversion.

Every such option is fully, openly implemented in extensively documented and tested code at 'When in Rome' to allow maximum re-use and adaptation for future research. Moreover, that repository presents the percentage usage per basic chord type in dedicated files, separated both by sub-corpus and for major-*versus*-minor contexts.

From this alone, we can assess the relative usage of our 'canonical' chords. Any such survey highlights the extreme predominance of basic tonic and dominant function chords (c.75% of the total). Chromatic chords are certainly marginal in relation to this, but we are more concerned here with how common the chromatic chords are *relative to each other*. Figure 2 provides an example of the summative data and visualisations provided on 'When in Rome', in this case for the example of Augmented Sixth chords in the lieder sub-corpus, divided (as discussed) into separate data for major-*versus*-minor tonal contexts.

In addition to the source repo, anyone interested can interact with this data on OMT's chromatic harmony anthology (click here) where instances of these chromatic chord types can be browsed in sortable tables, in their full score context, and in few-bar excerpts.

4.1 Results for the Three Chromatic Categories

For each of the three 'canonical' chromatic categories discussed above, this section provides some high-level observations from the evidence of the corpus, and it considers the implications these observations might have for reviewing our attitudes to those chords.

The **Neapolitan sixth** is used relatively little. The main use cases in the lieder sub-corpus are '♭II6' and '♭II65' in minor (c.0.5%). Another c.0.4% accounts for the other Neapolitan candidates in minor, and there is very little use in major contexts at all. Other corpora broadly bear out this trend, and with even less usage of the seventh chords. Even here in the lieder, many of the '♭II65' sevenths cases occur in progressions against an inverted pedal, potentially suggesting a possible sub-category for this specific device.

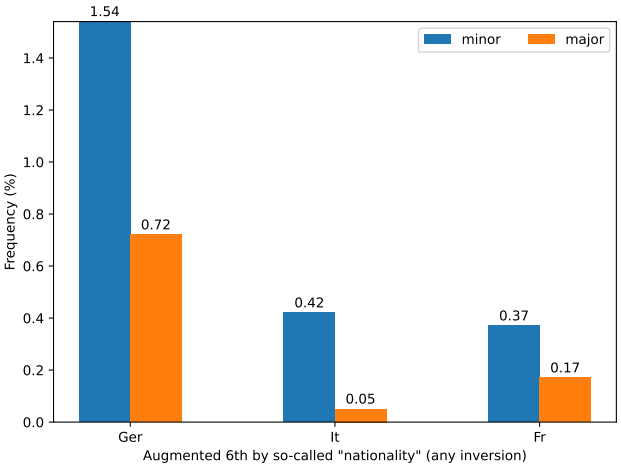

Figure 2. Augmented sixths chords in the Lieder corpus.

The fact that Neapolitans are so commonly taught is somewhat is contrary to the evidence of usage, perhaps prompting a review of the importance attributed to them, especially in the 'category light' DACH tradition.

Augmented sixth chords are much more common. For instance, in the lieder the 'German' (653) in minor alone accounts for over 1.5%, and thus more than all the possible Neapolitans in both modes. Within the augmented sixth category, it is notable that the 'German' (653) is so much more common than the other forms, and that all forms are much more common in the minor mode context. The DACH practice of concentrating teaching and terminology of *augmented sixths* on the 653 form arguably receives support from this usage-in-practice evidence.

Modal mixture is much more common still, but very unevenly so. The kinds of strong candidates for mixture described above occur relatively infrequently, for instance, with only '♭VI' making a short-list of top-10 cases (c.0.1%). Much (c.10x) more common are moderate mixtures like i (c.1.2%) and iv (c.1.0%). This extremely varied extent of usage reinforces the need for a distinction between types or grades of *relative* mixture strength.

It is perhaps also notable that the 'other' chromatic chord categories discussed (Augmented and Neapolitan sixths) feature among the most common cases of possible 'mixture'. They all pose a strong case for mixture, (especially the 'German' which features both of the main mixed tones), but they also have the detraction of chromatic notes (at least $\sharp\hat{4}$ for the Augmented Sixths; $\flat\hat{2}$ for Neapolitans). This may prompt a review or clarification of categories which, in turn, speaks to wider issues such as the 'French' sixth's status in relation to tritone substitution (again, see [12]), the 'bebop' dominant seventh with diminished fifth, and even some secondary dominants.

5. PROGRESSING TO CHORD PROGRESSIONS

This brief paper has set out some of the musical, computational, and even national/institutional issues at stake in defining chromatic chords and commenting on their use in practice, focussing on three individual chromatic chords.

Clearly this is only an initial step towards developing recommendations for how to define chords and describe 'general' practice in a given repertoire.

There is plenty of opportunity for future work, not least in growing the datasets (their sheer scale, repertoire coverage, and range of analytical perspectives), and in widening the range of both chordal categories and the languages/'schools' considered. Another clear next step is to expand the remit from individual *chords* to chord *progressions*. This is not so clear-cut a distinction as it may seem.

We close with some examples. Once again, all of the logic discussed here is implemented in the When in Rome repository, and examples are presented in both the 'Anthology' section of that repo, and in the more browsing-friendly format of the OMT harmony anthology.

5.1 Chord or progression? The Case of the 'Cto7'

Some chromatic cases sit ambiguously between 'chord' and 'progression'. As discussed, mixture is arguably an example: we certainly have to take account of the modal context (iv is diatonic in minor but mixture in major) and we may also chose to have additional contextual requirements such as the elimination of secondary dominants that resolve, and/or of the 'Picardy Third' endings.

The common-tone diminished seventh chord ('Cto7') presents an example that nudges further into the realm of progressions. Once again, we describe a single chord, though certainly need a wider contextual view. Here the chord's construction as a fully diminished seventh is required, but only a small part of the definition which otherwise relies on the context of at least the following chord. Almost certainly required is a common-tone with the *following* chord ... which is not a suspension. [18] Not usually required, (though potentially strengthening the case) is use of a common-tone with the *preceding* chord. And the case is arguably stronger still if the preceding and following chords are the same, indicating more of a *prolongation*.

5.2 Anglophone/DACH Progressions

The comparison of Anglophone and DACH traditions can, of course, continue to chord progressions. The 'Cto7' does not feature in DACH traditions, though a related form known in Anglophone circles as the 'Omnibus' does have a relative in the DACH concept of the *Teufelsmühle* [15].

Not yet at the textbook level, Lewandowki [16] recently proposed a category pair for *fallender Quintanstieg* (hereafter, fQ) and *aufsteigender Quintfall* (hereafter, aQ) both of which see pairs of fifth in the same direction, separated by a step in the opposite direction. For example, D-A-C-G would be an instance of the fQ, while G-C-A-D would be a case of the aQ.

Instances of these progressions can be extracted by any corpus, functional or otherwise. [19] Filtering When in Rome for the minimal, 4-chord instances of each shows that the aQ is much (c.20x) more common than the fQ across all corpora (RHS of fig.3). The better known pattern of rising/falling cycles of fifths are related in that they also feature pairs of fifths a step apart. Filtering for 4-grams of these progressions reveals a similar, and even more extreme (c.50x) preference for one direction (falling) over the other (rising). So once again, while we may seem to have a class of equal schema *in theory*, the usage *in practice* highlights an imbalance that arguably needs including at the outset of teaching these materials.

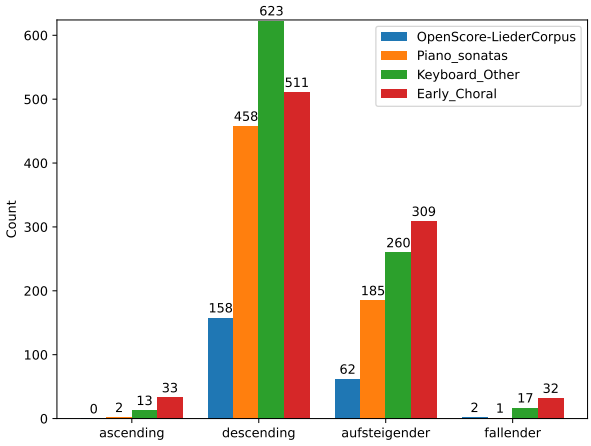

Figure 3. Fifth progressions by category and corpus.

5.3 Beyond the Anglophone-DACH Comparison

We close with an example progression originating in another language, and with the additional constraint of having an expected *position* for its usage, thus further expanding the *context* we need to assess.

'Partimenti' treatises originating in 18th-century Italy have enjoyed a renewed interest from music theorists in recent years [17]. This method centres on prototypical, schematic patterns that can serve as the basis of composition (including improvisation). The schema are typically defined by their bass and melodic lines, their harmony, and their position both in relation to the metre and the large-scale form. [20] Harmonic analysis data captures all of this except the melodic line. For example, most aspects of the *Quiescenza* are captured by progressions like I-V7/IV-IV-V-I, [21] and by the expected position at the *end* (coda) of a work. These textbooks provide repertoire examples, and there are certainly cases in the meta-corpus (which includes a sub-corpus of Corelli Trio Sonatas) that fit.

However, counter-examples are also easy to find and an initial survey of overall usage finds no tendency towards end-section emphasis in any sub-corpus, including the Corelli. [22] Once again, the data suggests that it is time for a thorough re-evaluation of schematic associations passed pedagogically from one generation to the next.

[18] The progression of viio7/V to the cadential 64 is common, but a weak candidate for the Cto. It is excluded by most definitions (e.g., on OMT), though it may be significant as an historical origin for this progression.

[19] As the labels are not dependent on key-context or RN labelling, it is reasonable to include pop examples here (as Lewandowki does). For example, the fQ (D-A-C-G) is the chord progression of TLC's *Waterfalls*.

[20] Click here for examples in the relevant section of OMT.

[21] Again, the code sets out how to catch all and only the relevant cases.

[22] The code includes functionality for plotting usage-by-position.

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7. REFERENCES

[1] S. G. Laitz, *The Complete Musician: An Integrated Approach to Theory, Analysis, and Listening*, 4th ed. New York: Oxford University Press, 2016.

[2] M. Gotham, G. Micchi, N. Nápoles-López, and M. Sailor, "When in Rome: a meta-corpus of functional harmony," *Transactions of the International Society for Music Information Retrieval*, expected 2023.

[3] J. London, "Building a Representative Corpus of Classical Music," *Music Perception: An Interdisciplinary Journal*, vol. 31, no. 1, pp. 68–90, 2013, publisher: University of California Press. [Online]. Available: http://www.jstor.org/stable/10.1525/mp.2013.31.1.68

[4] C. Inskip and F. Wiering, "In Their Own Words: Using Text Analysis to Identify Musicologists' Attitudes Towards Technology," in *Proceedings of the 16th International Society for Music Information Retrieval*, 2015.

[5] M. Gotham, K. Gullings, C. Hamm, B. Hughes, B. Jarvis, M. Lavengood, and J. Peterson, *Open Music Theory*, 2nd ed. VIVA Pressbooks, 2021. [Online]. Available: https://viva.pressbooks.pub/openmusictheory/

[6] R. B. Nelson, "The College Music Society Music Theory Undergraduate Core Curriculum Survey - 2000," *College Music Symposium*, vol. 42, pp. 60–75, 2002, publisher: College Music Society. [Online]. Available: https://www.jstor.org/stable/40374423

[7] B. Murphy and B. McConville, "Music Theory Undergraduate Core Curriculum Survey: a 2017 Update," *Journal of Music Theory Pedagogy*, vol. 31, no. 1, Jan. 2017. [Online]. Available: https://digitalcollections.lipscomb.edu/jmtp/vol31/iss1/9

[8] L. Euler, *Tentamen novae theoriae musicae ex certissismis harmoniae principiis dilucide expositae*. Saint Petersburg Academy, 1739.

[9] H. Riemann, *Vereinfachte Harmonielehre; oder, Die Lehre von den tonalen Funktionen der Akkorde [Harmony Simplified: Or, the Theory of the Tonal Functions of Chords]*. London: Augener, 1893.

[10] W. Crotch, *Elements of musical composition : comprehending the rules of thorough bass, and the theory of tuning*. London : Printed for Longman, Hurst, Rees, Orme, & Brown by Nathaniel Bliss, Oxford, 1812. [Online]. Available: http://archive.org/details/elementsofmusica00crot

[11] J. W. Callcott, *A musical grammar, in four parts: 1. Notation; 2. Melody; 3. Harmony; 4. Rhythm.* London: Printed by B. Macmillan for R. Birchall, 1806, open Library ID: OL14794362M.

[12] N. Biamonte, "Augmented-Sixth Chords vs. Tritone Substitutes," *Music Theory Online*, vol. 14, no. 2, Jun. 2008. [Online]. Available: https://mtosmt.org/issues/mto.08.14.2/mto.08.14.2.biamonte.html

[13] P. Ewell, "Harmonic Functionalism in Russian Music Theory: A Primer," *Theoria*, vol. 26, 2020.

[14] N. Nápoles López, M. Gotham, and I. Fujinaga, "AugmentedNet: A Roman Numeral Analysis Network with Synthetic Training Examples and Additional Tonal Tasks," in *Proceedings of the 22nd International Society for Music Information Retrieval Conference*. Online: ISMIR, Nov. 2021, pp. 404–411. [Online]. Available: https://doi.org/10.5281/zenodo.5624533

[15] M.-A. Dittrich, "›Teufelsmühle‹ und ›Omnibus‹," *Zeitschrift der Gesellschaft für Musiktheorie [Journal of the German-speaking Society of Music Theory]*, vol. 4, no. 1–2, pp. 107–121, 2007, publisher: Gesellschaft für Musiktheorie. [Online]. Available: https://www.gmth.de/zeitschrift/artikel/247.aspx#abstract

[16] S. Lewandowski, "›Fallende Quintanstiege‹," *ZGMTH*, vol. 7, no. 1, pp. 85–97, 2010. [Online]. Available: https://www.gmth.de/zeitschrift/artikel/508.aspx

[17] R. O. Gjerdingen, *Music in the Galant Style*. Oxford ; New York: Oxford University Press, 2007.