Cadences

Some Goals

- Discuss how looking at cadences can help us with other questions, such as statistical learning, pattern detection, and the analysis of form.
- Discuss how we might define cadences, and how they represent varying degrees of perceived closure and tension.
- Discuss how cadences are historically, culturally, and stylistically situated.

What is a cadence?

- From the Latin *cadere*, meaning “to fall” (or *cadentia,* “a falling”).

- Cadences are more than simply a movement of one chord to another, which makes them a little tricky to find sometimes.

- So how might we define a musical cadence?

Cadence Fact #1

- A cadence generates expectations:
  - From Sears (2015):
    - “[…] a cadence, or more precisely, the progression preceding cadential arrival, elicits very definite expectations concerning the melodic scale-degree, the harmony, and the metric position of the goal event.” (p.254)
    - See also the collection this essay comes from (*What is a Cadence*, edited by Neuwirth and Bergé).

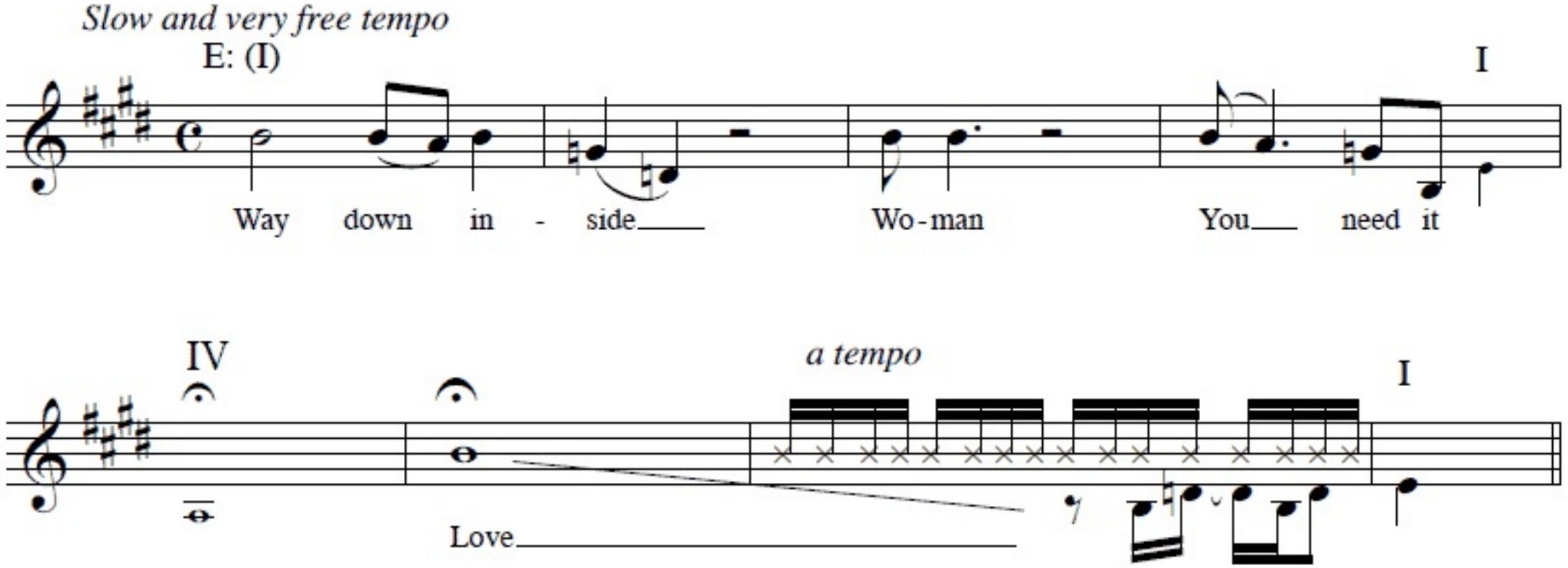
Cadence Fact #2

- A cadence is a confluence of many musical parameters, such as harmony, melody, rhythm, and meter:
    - From Hentschel, Neuwirth, and Rohrmeier (2021):
        - “Cadences are seen to emerge from coordinated activities of harmony, voice-leading, rhythm, and meter that are difficult to disentangle and have therefore been accounted for from a schema-theoretical perspective (e.g., Temperley, 2004; Gjerdingen, 2007).”

Cadence Fact #3

- Broadly defined, cadences are present in many types of music (if not all).
  - Jairazbhoy (1971) writes that, in North Indian classical music, phrases and sections often end with patterns that function in a cadential way.
  - Temperley (2011) points out that the V-I cadence is quite common as an end of sections in pieces in jazz standards.
    - Discusses the IV chord as a place of arrival, a cadential goal-point.

The Cadential IV in Rock (Temperley, 2011)



Led Zeppelin, ”Whole Lotta Love” (4:05)

Cadence Fact #4

- The cadences we will be talking about for the most part today are very stylistically, culturally, and historically situated:

  - Cadences in Western classical music function in a very specific way, and this is very different in jazz, pop, rock, or literally any other style that doesn’t fit within this very specific geographic and historical context.

So…why, then?

- Although a very specific musical task, asking questions about classical cadences can allow us to better understand aspects of:

  - Pattern Recognition
  - Statistical Learning
  - Broader Musical Structures

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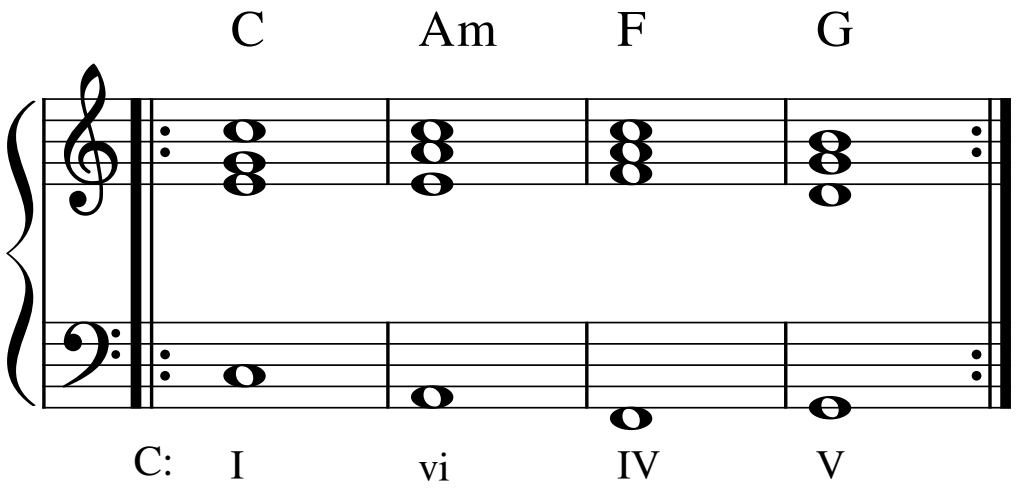
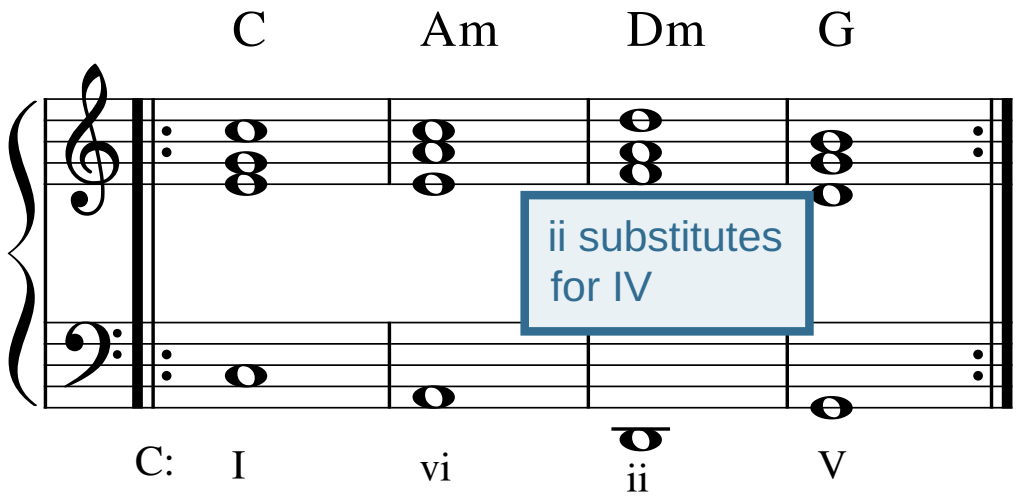
Pattern Discovery

- Cadences are about pattern discovery.
  - They are temporal patterns that functions as endings.
  - We have patterns that begin things, patterns that end things.
  - For example the Doo-Wop Cadence that Johanna Talked about:

The Doo Wop



OR



(Open Music Theory)

Pattern Discovery

- This cadence is part of a larger stylistic pattern that can be used for other research questions, such as genre classification.

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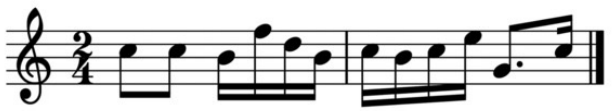
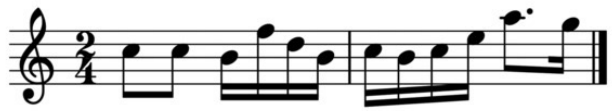
Pearce (2018)

- In C (bars 23–24), we see how the IDyOM model predicts a melodic cadence.
- By understanding when and how cadences occur, we can model long-term and short-term expectations, as well as more general aspects of statistical learning.

A (bars 1–2)



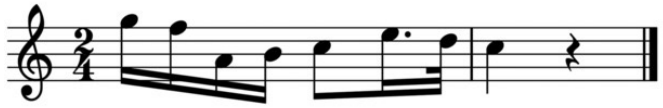
B (bars 21–22)



Pitch	Penultimate note		Final note	
(Number)	Probability	IC	Probability	IC
G_4 (67)	**0.015**	**6.02**	0.289	1.79
A_4 (69)	0.002	8.93	0.060	4.06
B_4 (71)	0.003	8.58	0.059	4.08
C_5 (72)	0.106	3.24	**0.134**	**2.90**
D_5 (74)	0.344	1.54	0.067	3.89
E_5 (76)	0.189	2.40	0.285	1.81
F_5 (77)	0.128	2.96	0.028	5.15
G_5 (79)	0.186	2.43	0.016	5.97
A_5 (81)	0.013	6.29	0.000	13.81
Entropy		2.49		2.81

	Penultimate note		Final note	
	Probability	IC	Probability	IC
	0.015	6.02	0.001	10.24
	0.002	8.93	0.000	11.41
	0.003	8.58	0.003	8.24
	0.106	3.24	0.003	8.18
	0.344	1.54	0.028	5.16
	0.189	2.40	0.034	4.86
	0.128	2.96	0.048	4.38
	0.186	2.43	**0.535**	**0.90**
	0.013	**6.29**	0.170	2.56
		2.49		2.15

C (bars 23–24)



Position	1	2	3	4	5	6	7	8
Pitch	G_5	F_5	A_4	B_4	C_5	E_5	D_5	C_5
Probability	0.509	0.234	0.003	0.053	0.691	0.234	0.314	0.360
IC	0.98	2.10	8.34	4.25	0.53	2.09	1.67	1.47

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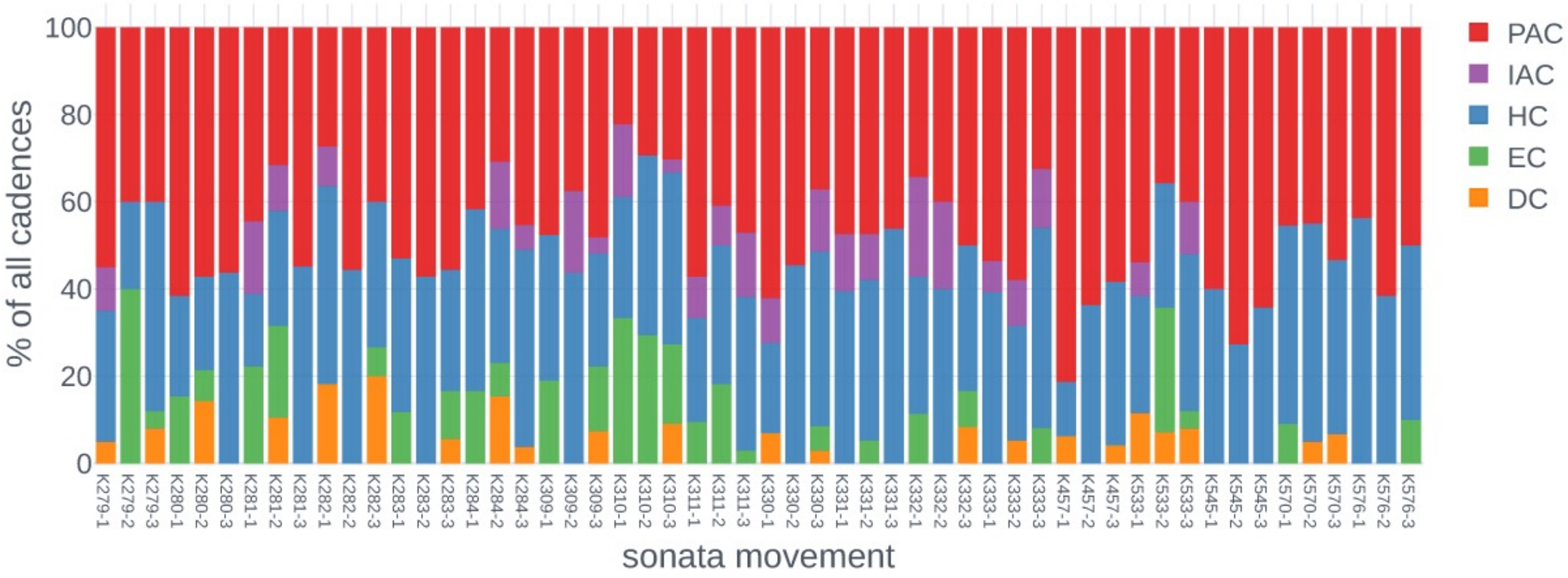
Distribution of Cadences by piece (from Hentschel, et al., 2021)



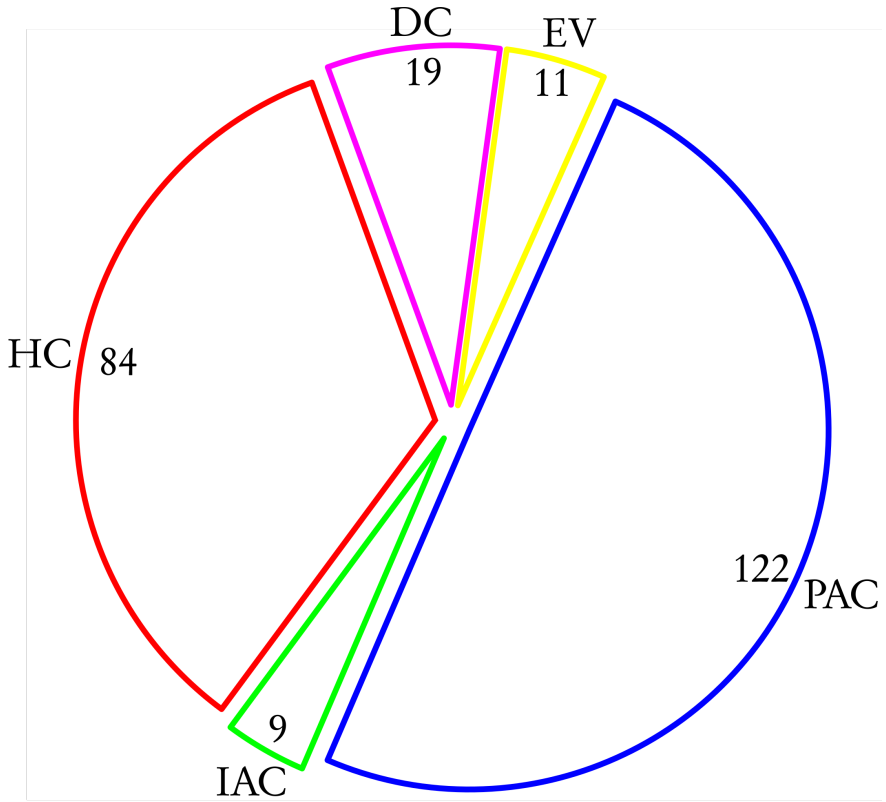
Distribution of Cadences (from Hentschel, et al., 2021)

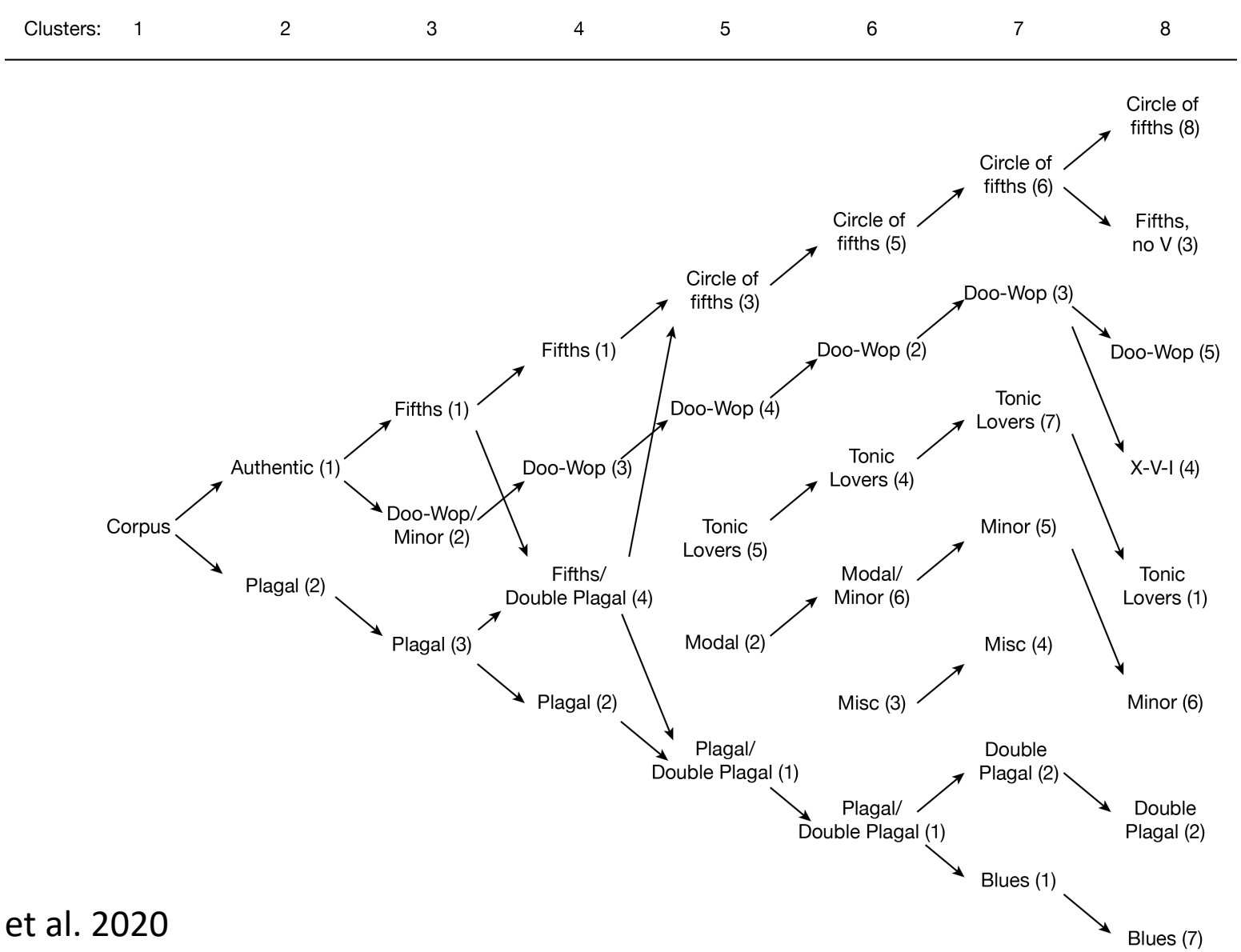
type	Mozart	%	Haydn	%
PAC	517 (528)	46.9	122	49.8
HC	398	36.1	84	34.3
EC	81	7.3	11	4.5
IAC	69	6.3	9	3.7
DC	38	3.4	19	7.8
sum	1103		245	

Details about the Haydn String Quartet Corpus. Here's a link to the data set:
https://www.tandfonline.com/doi/suppl/10.1080/09298215.2017.1367010?scroll=top

Cadence Collection

- 50 exposition sections derived from sonata-form movements of Haydn's string quartets (1771-1803).
- Annotated the cadences whose cadential progression and cadential idea appear in the cello and first violin parts, respectively.





From Schaffer, et al. 2020

Defining a Cadence

- Some features we need to look for (in common practice Western Art Music):
  - Harmonic progressions (V→ I for authentic cadences; I → V for half cadences)
  - Duration (a sense of finality)
  - Melody (movement to a specific scale degree)

Five types of cadences:

- Annotate five types of cadences:
  - Perfect Authentic
  - Imperfect Authentic
  - Half Cadence
  - Deceptive
  - Evaded

Cadence Types

- From Sears, 2015; p. 264

Cadence Categories	Characteristics	Subtypes
Perfect Authentic	- V and I in root position - Soprano $\hat{1}$	Main Theme Subordinate Theme (ECP)[a]
Imperfect Authentic	- V and I in root position - Soprano $\hat{3}$	Melodic Dissonance at CA[b] No Melodic Dissonance at CA
Half	- V in root position - No 7th	Main Theme Transition
Deceptive	- Ends grouping structure - Typically on vi	Failed PAC at CA Failed IAC at CA
Evaded	- Melody leaps up - Provides no resolution	Tonic Harmony at CA Non-Tonic Harmony at CA

Details for the five cadence types.

Cadences	**Characteristics**
Perfect Authentic (PAC)	1 V – I
Imperfect Authentic (IAC)	3 or 5 V – I
Half (HC)	5, 7, or 2 ? – V
Deceptive (DC)	Ends grouping structure V – ?, Typically on VI
Evaded (EV)	Melody leaps up, Typically to 5 V – ?

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Examples

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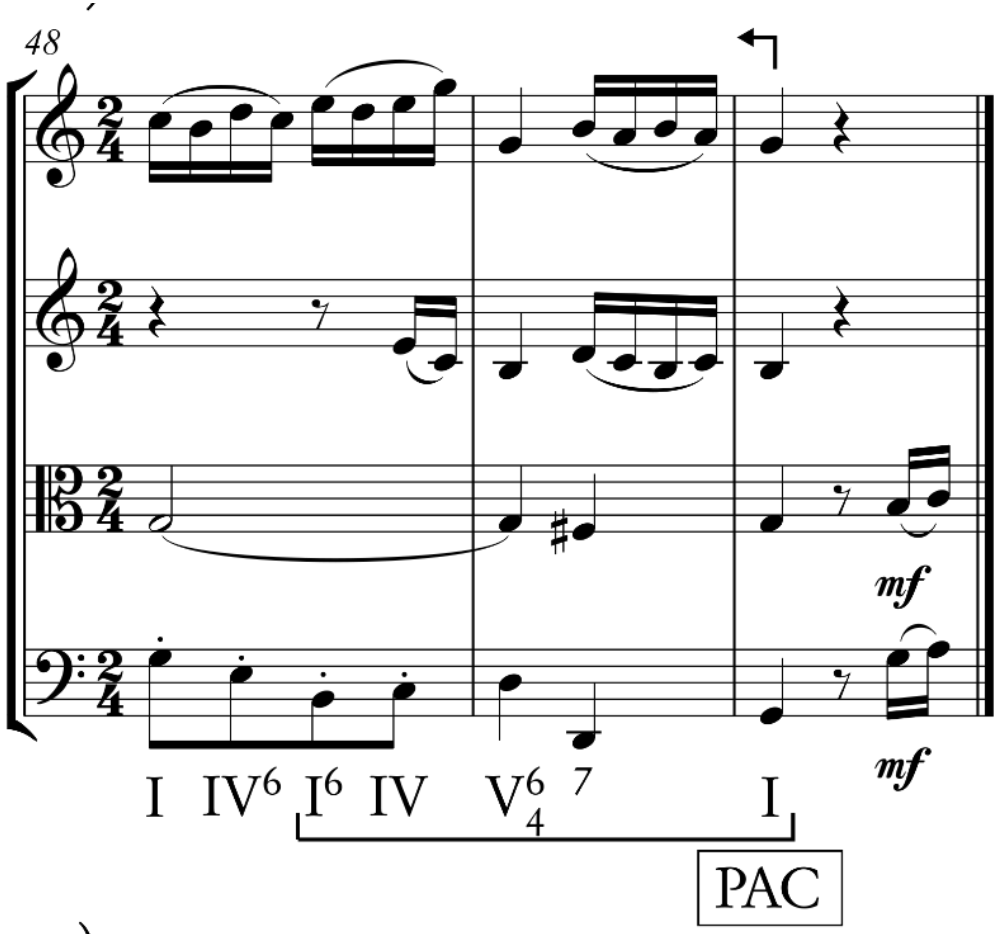
(Examples courtesy of David Sears)

Haydn, Op. 50/2, iv, mm. 48–50.



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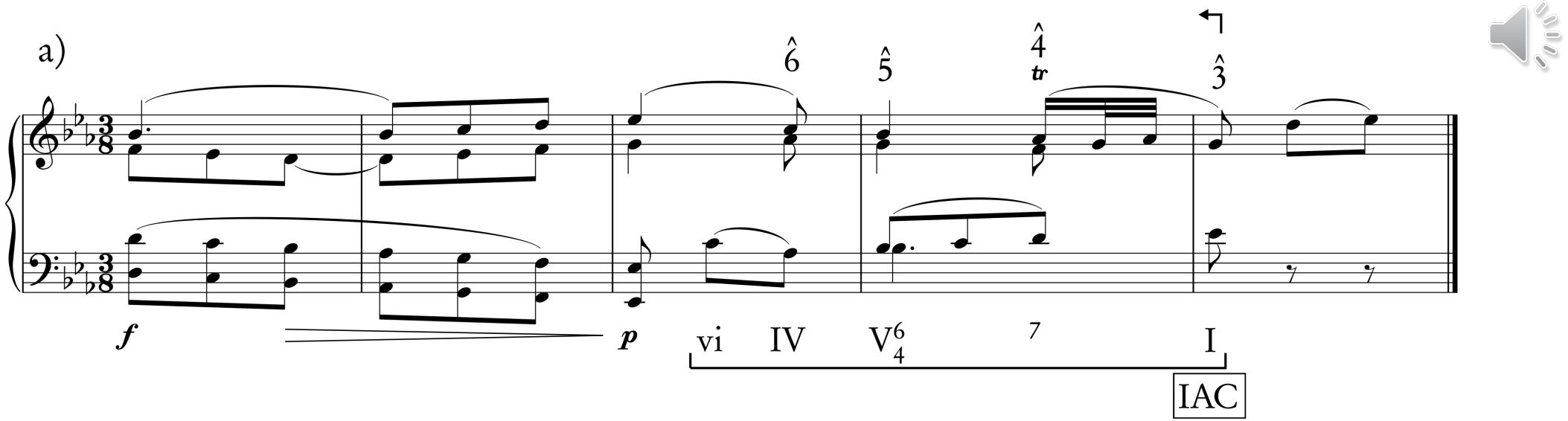
(Examples courtesy of David Sears)

Mozart, K. 281, ii, mm. 4–8.



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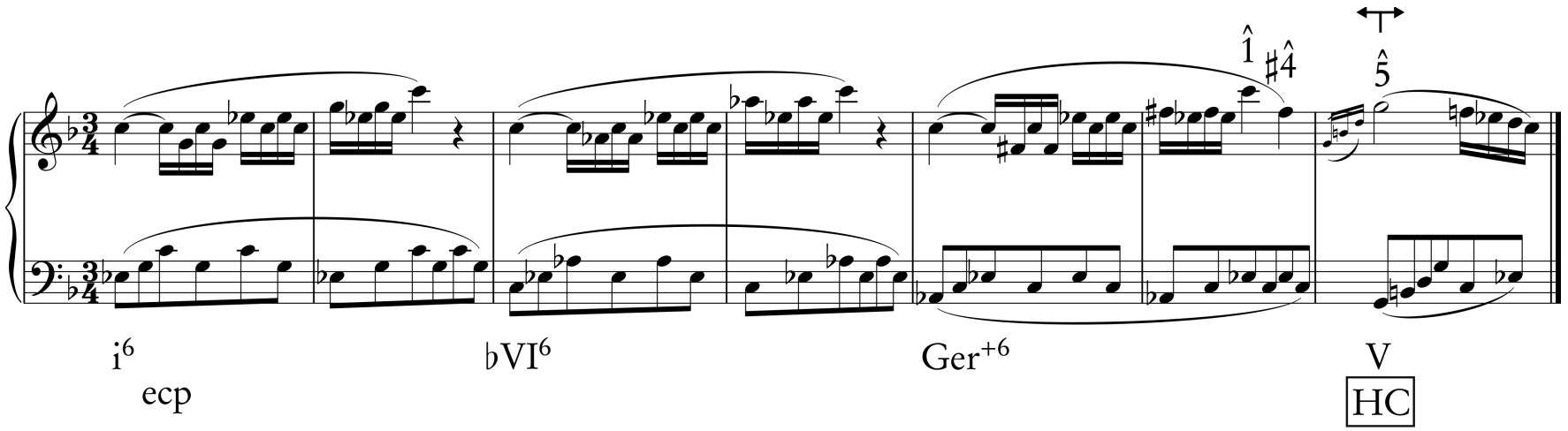
(Examples courtesy of David Sears)

Mozart, K. 332, i, mm. 31–37.



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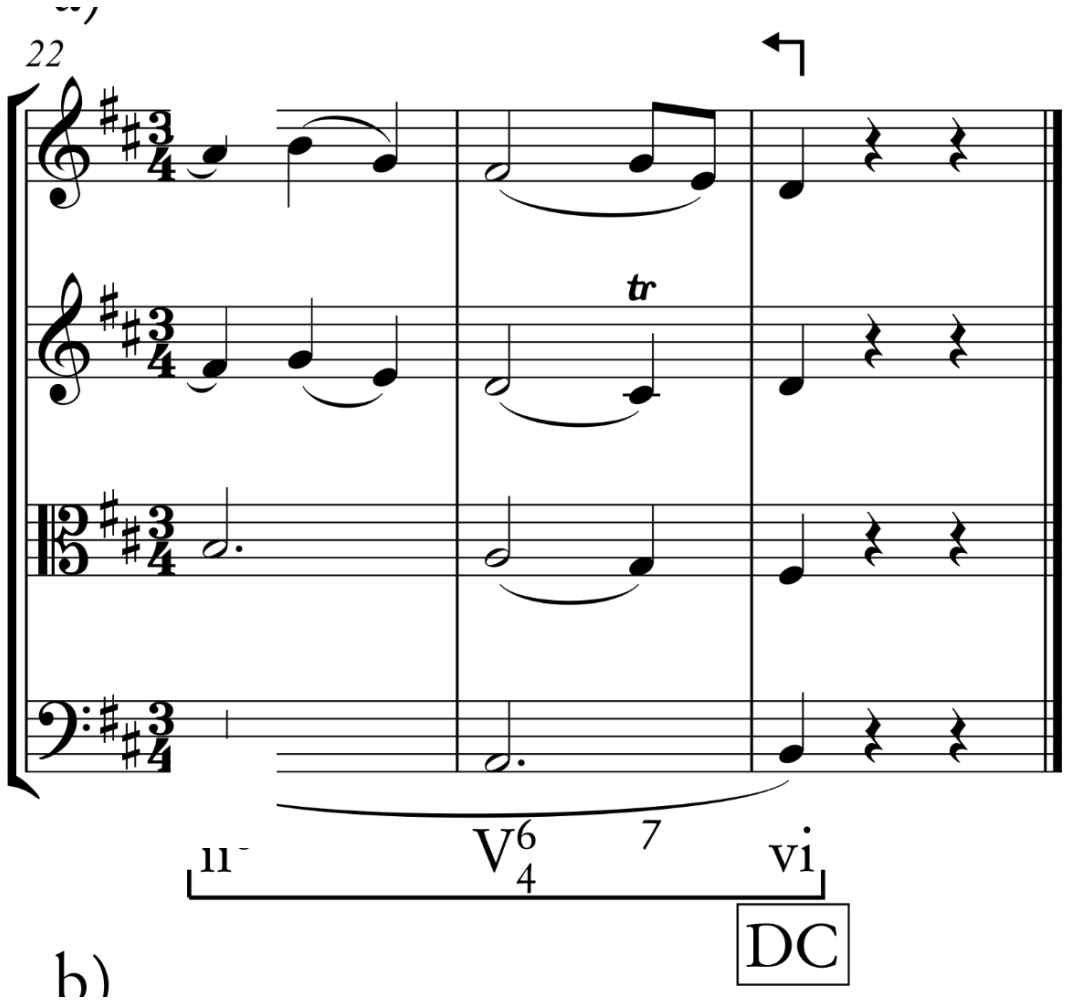

The Perceived Emotions of Harmonic Cadences (Smit, et al. 2020)

- The half cadence is more arousing than the authentic cadence (strong evidence)
- The deceptive cadence is more arousing than the authentic cadence (moderate evidence)
- Cadences in minor are less arousing than cadences in major (strong evidence).

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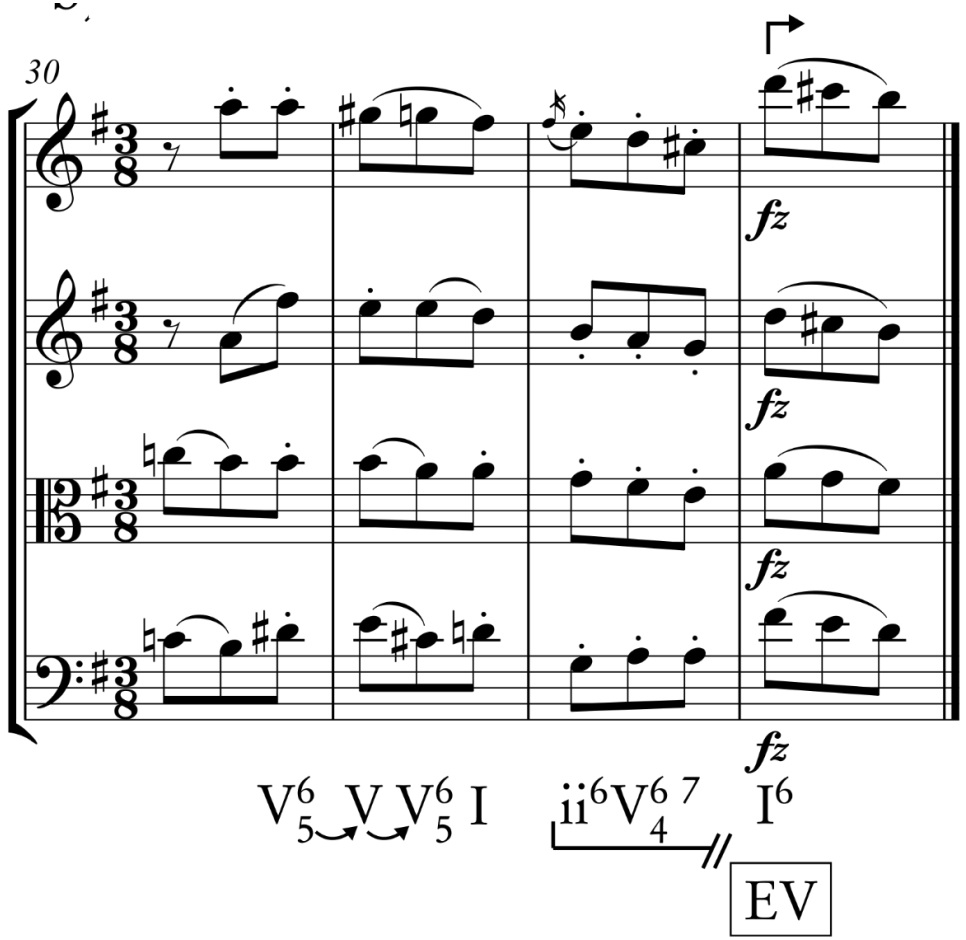
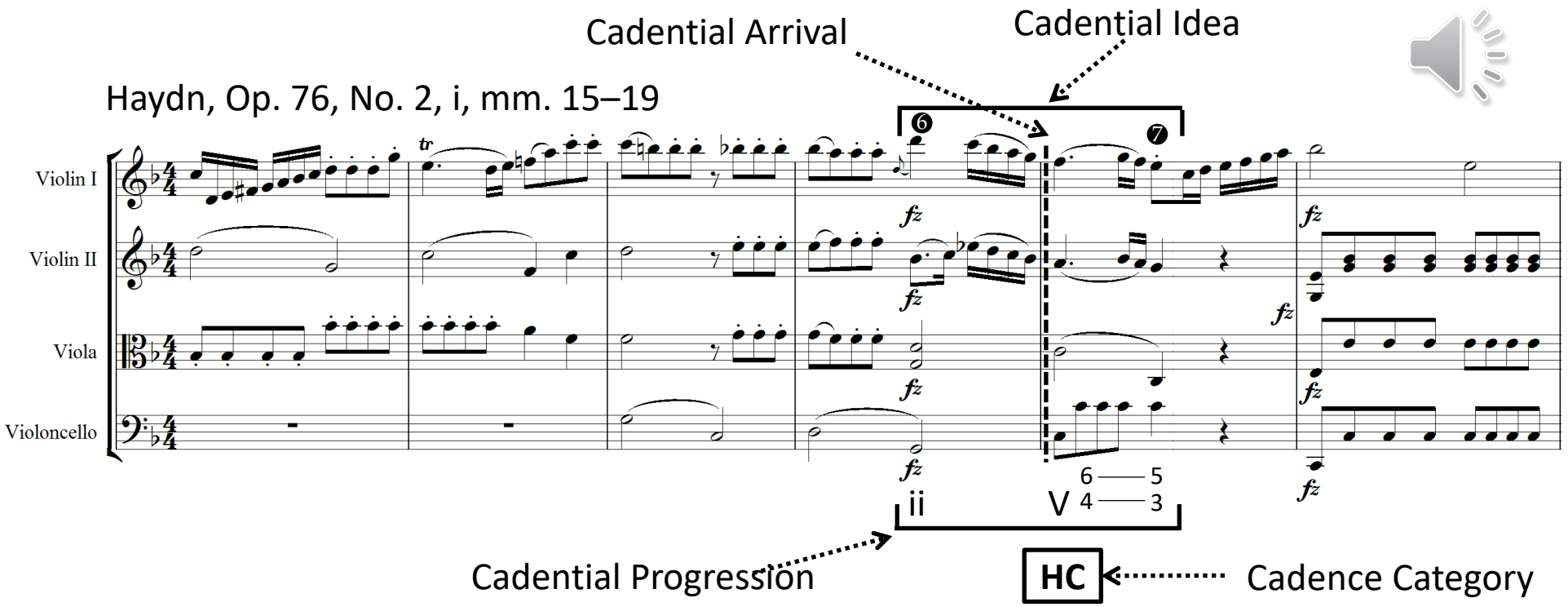
Evaded (EV)	Melody leaps up, Typically to 5 V – ?

(Examples courtesy of David Sears)

Haydn, Op. 20/4, i, mm. 22–24.



An example of the characteristics of a cadence



A Reprise

- These cadence labels help us to uncover the larger hierarchical structure of the music.

- Cadences act as signposts:
  - They can help to delineate sections, and different types of cadences serve different functions regarding the types of sections.

- Cadences serve as style markers:
  - Statistical learning questions.
  - Could inform genre classification.

- There are these categories, but they are not absolute.
  - There are likely incidents that won't get labeled by a human analyst.
    - False positives that the analyst will ignore.
    - We need to approach this in a holistic way.

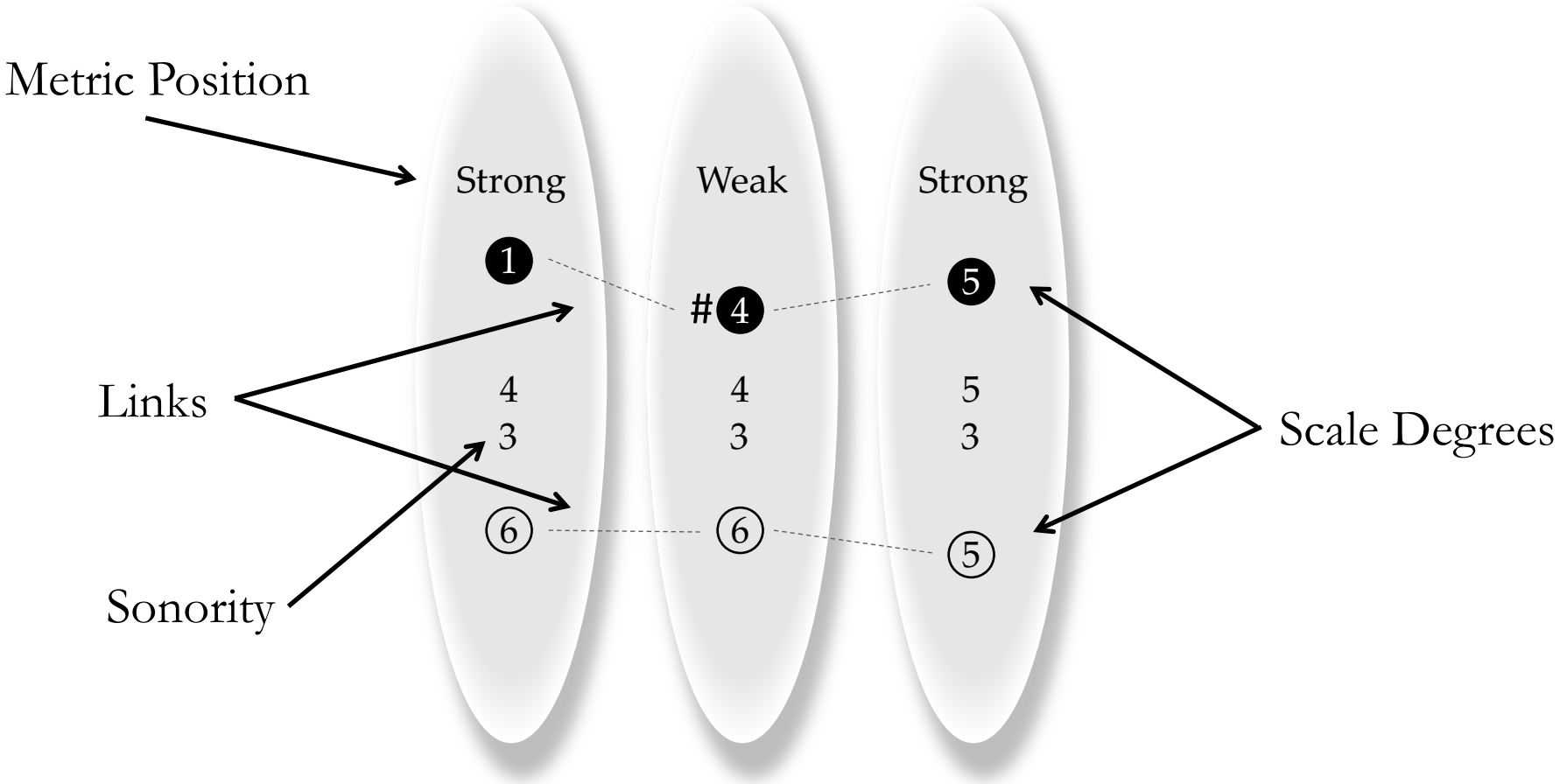
Recent Approaches to Cadence Finding

- Cadence or Not?
  - Duane (2019)
    - Uses n-gram models and HMMs to model the learning of cadences in Classical string quartets.
    - Supervised learning task was successful, but unsupervised was not.
  - Feisthauser, Bigo, and Giraud (2019)
    - Trained a model to find medial caesuras. Had decent success considering the many types of possible MCs, and the relatively small corpus
  - Bigo, Feisthauser, Giraud, Levé (2018)
    - Used 44 features to train an SVM classifier on two corpora from Bach and Haydn (162 PACs and 70 HCs)
    - HC or not; PAC or not.

Recent Approaches to Cadence Finding

- Distinguishing types of cadences
  - Finkensiep, Déguernel, Neuwirth, and Rohrmeier (2020):
    - Used skipgrams to identify schema candidates.

The cadence visualized as a closing schema using Gjerdingen's framework



Computational Approaches to Cadence Finding

- Expectation Based Models
  - Sears, Pearce, Caplin, McAdams (2018)
    - Used IDyOM; terminal events from cadences are more predictable than those from non-cadential contexts; typical theoretical models of cadential strength are related to schematic expectations.

Let’s Take a Quiz!

- Example 1:
  a) Perfect Authentic Cadence
  b) Half Cadence
  c) Deceptive Cadence
  d) Evaded Cadence

Let’s Take a Quiz!

- Example 2:
  a) Perfect Authentic Cadence
  b) Half Cadence
  c) Deceptive Cadence
  d) Evaded Cadence

Let’s Take a Quiz!

- Example 3:
  a) Perfect Authentic Cadence
  b) Half Cadence
  c) Deceptive Cadence
  d) Evaded Cadence

Let’s Take a Quiz!

- Example 4:
  a) Perfect Authentic Cadence
  b) Half Cadence
  c) Deceptive Cadence
  d) Evaded Cadence

Perceiving the Classical Cadence (Sears, Caplin, and McAdams, 2014)

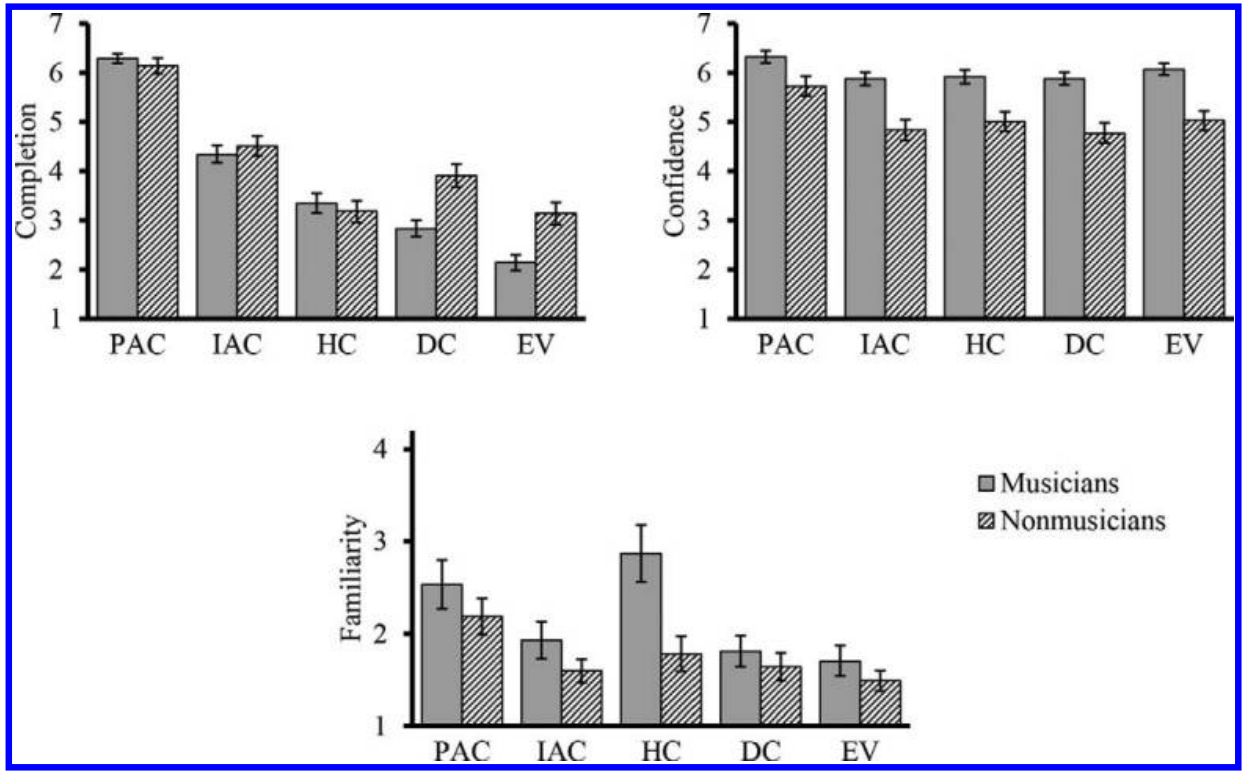


FIGURE 3. Bar plots of mean completion, confidence, and familiarity ratings of musicians and nonmusicians for each cadential category. Whiskers represent the 95% confidence interval. See text for the abbreviations of the cadence categories.

Summary

- Cadence-finding is about modeling an analytical judgment:
  - Cadences are patterns that frequently occur within larger patterns (schemata).
  - A cadence is comprised of many musical features.
  - Analysts sometimes disagree on the type of cadence, or even whether something is actually a cadence.
  - We can explore expectation, style, pattern recognition, and form.