Texture and Sonata Form in Classical String Quartets: A Corpus Study

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ABSTRACT: How does musical texture relate to large-scale form in classical string quartets? Are certain textural strategies associated with sections or formal functions in a sonata movement? Some music theorists have argued that contrapuntal textures are more common in developments and transitions. In their view, these medial sections would use polyphony to foster a sense of looseness, instability, and momentum. Our study tested these claims by examining a pre-existing corpus of string quartet movements in sonata form by Joseph Haydn, Wolfgang Amadeus Mozart, and Ludwig van Beethoven. We measured texture in terms of average onset synchrony, where lower onset synchrony represents greater rhythmic and textural independence among parts. Although average onset synchrony was lower in developments, compared to expositions, for most pieces in the corpus (65.22%), there was a significant interaction between section and composer, and post hoc analysis indicated that this difference in onset synchrony was significant only for Beethoven. Within expositions, transitions did not tend to have lower onset synchrony, and there was no significant effect for subsection. However, there was a significant main effect for composer here. Overall, these results imply that textural strategies in classical sonata form are complex and may vary from piece to piece and from composer to composer.

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THE classical string quartet has long been taken as a musical analogue of conversation or social interaction, largely because of the genre's characteristic textural interplay (Bakulina, 2012; Levy, 1982; Klorman, 2017). Each part is understood as an independent musical agent, alternately leading or responding, blending in or breaking away. These textural patterns are immediate for listeners, and they emerge from details of rhythm, pitch, and timbre (De Souza, 2019; Huron, 1989). Yet, texture may also be related to higher-level domains such as musical form. For example, characteristic textures might be associated with certain formal functions or sections in a sonata movement.

Development sections typically involve *Sturm und Drang* rhetoric, tonal and phrase-structural instability, sequence blocks, and hypermetric regularity (De Souza & Lokan, 2019). But as Duane (2017) argues, developments also feature recognizable textures:

> Many development sections are, for example, perceived as developmental largely because they employ active and dense counterpoint. And recapitulations are often marked by not only the restatement of original themes but also the return of a simpler, more homophonic texture. (p. 38)

Caplin (1998, p. 142) also notes that "polyphonic devices—imitation, canon, fugal entries—can contribute […] to the complexity of the musical texture" in the developmental core. These textural tendencies are reflected in the German word for a sonata development, *Durchführung*, which "was originally a term used to describe fugal or polyphonic processes" (Hepokoski & Darcy, 2006, p. 195).

Contrapuntal textures might be associated not only with developments but also with other relatively unstable formal units. According to Bakulina (2012, p. 7), "polyphony acts as a destabilizing force that contributes to the distinction between tight-knit (stable) and loose (unstable) formal categories." As such, she argues that parts are most independent during medial, in-between passages, including developments but also *transitions*. Similarly, Caplin (1998) suggests that "in an exposition, the transition can be seen as a kind of 'contrasting middle' between the main and subordinate themes" (p. 274), and he notes that a "contrasting middle" is often distinguished by changes in texture and "the use of polyphonic devices, especially motivic imitation among the voices" (p. 75). Moreover, Hepokoski and Darcy (2006, pp. 95–101) discuss "developmental transitions," which combine aspects of both sections. The presumed textural similarities shared by developments and transitions would emerge from their shared medial function. As developments and transitions drive toward a rhetorically marked dominant (at the retransition or medial caesura, respectively) that sets up an important arrival (of the recapitulation or secondary/subordinate theme), both sections typically involve various kinds of instability and intensification.

Though Bakulina (2012) and Duane (2013, 2017) make testable claims about developments, they analyze only expositions. Our corpus study empirically assesses texture and form in both expositions and developments. How do patterns of textural interaction in classical string quartets relate to formal conventions? More specifically, do instrumental parts tend to be more independent in developments than in expositions? Or in transitions, relative to other subsections in the exposition?

These musical questions, however, prompt a methodological question: How can texture be measured? On the one hand, traditional textural categories—monophony, polyphony, homophony, and heterophony—provide a starting point (De Souza, 2019). They are relatively simple and can be understood in terms of two musical dimensions, onset synchrony and shared pitch motion, that are closely related to auditory perceptual organization (Huron, 1989). Yet as analytical tools, these four broad textural categories are not particularly subtle. Analysts often wish to compare textures within the same category or to evaluate textures that combine elements from multiple categories. On the other hand, Duane (2017) evaluates thematic and non-thematic textures via a computational model. His thematic-texture function is the additive inverse of the first linear discriminant from a logistic regression model that involved eight textural properties (pp. 44, 60–61), and some of these properties are based on further logistic regression models. For example, his first textural property (Number of Streams) is calculated via an earlier linear model that considers four cues for auditory stream segregation: onset synchrony, offset synchrony, pitch co-modulation, and harmonic overlap (Duane, 2013). Moreover, Duane (2017, p. 61) emphasizes that texture might involve further cues or features. His computational model is not complete and might be made even more sophisticated. For present purposes, then, basic textural categories might seem too simple, and Duane's model too complex.

An analytical approach based on onset synchrony might strike an appropriate balance here. When two parts attack notes at the same time, they are more likely to cohere into a single textural stream. In other words, monophonic and chorale-like homophonic textures have a high amount of onset synchrony, whereas polyphonic textures have a low amount of onset synchrony (for discussion of onset synchrony and heterophony, see De Souza, 2021). For example, the amount of onset synchrony in Johann Sebastian Bach's two-part inventions is significantly lower than would occur by chance, and this supports the parts' perceived independence (Huron, 1993). Our approach in the present study is admittedly reductive, and onset synchrony is not the only factor that shapes textural grouping. Still, empirical and theoretical research suggests that onset synchrony is the most salient cue for listeners (Bregman, 1990; De Souza, 2019; Duane, 2013; Huron 1989, 2016, pp. 97–101; Rasch, 1981). Onset synchrony is also relatively easy to conceptualize, and it can be analyzed with or without computational assistance. Insofar as onset synchrony indexes the parts' rhythmic-textural integration (or, conversely, their rhythmic-textural independence), it can help us examine musically interesting distinctions.

This corpus study uses onset synchrony to investigate texture in sonata-form movements from classical string quartets. It tests two related predictions, which are based on a more general hypothesis linking polyphony and medial function. First, we predict that the instrumental parts should be more independent in development sections, as indexed by lower average onset synchrony. Second, we expect that transitions will have lower average onset synchrony than the other subsections of the exposition. At the same time, the study compares music by Joseph Haydn, Wolfgang Amadeus Mozart, and Ludwig van Beethoven—the three composers discussed in Caplin's (1998) book on classical form. It is possible that these three composers will employ distinct textural-formal strategies.

METHOD

Sample

We used Duane's (2017) corpus of 23 string quartet movements in sonata form (pp. 62–63), which comprises 9 movements by Haydn, 9 by Mozart, and 5 by Beethoven (see Table 1). Pieces in the corpus were composed between 1781 and 1800.

Table 1. Corpus of string quartet movements in sonata form (Duane, 2017)

Composer	Piece	Year
Haydn	op. 33, no. 1	1781
Haydn	op. 33, no. 2	1781
Haydn	op. 33, no. 3	1781
Haydn	op. 33, no. 4	1781
Haydn	op. 33, no. 5	1781
Haydn	op. 33, no. 6	1781
Haydn	op. 76, no. 1	1797
Haydn	op. 76, no. 3	1797
Haydn	op. 76, no. 4	1797
Mozart	K. 387	1782
Mozart	K. 421	1783
Mozart	K. 428	1783
Mozart	K. 458	1784
Mozart	K. 464	1785
Mozart	K. 465	1785
Mozart	K. 575	1789
Mozart	K. 589	1790
Mozart	K. 590	1790
Beethoven	op. 18, no. 1	1799
Beethoven	op. 18, no. 2	1799
Beethoven	op. 18, no. 4	1799
Beethoven	op. 18, no. 5	1799
Beethoven	op. 18, no. 6	1800

Procedure

For each movement in the corpus, we identified measure numbers for relevant formal sections (Exposition, Development) and subsections (First Theme, Transition, Second Theme, and Closing). Measure numbers for exposition subsections were based on Duane's analysis, though we corrected for an error in his Example 22: values for Mozart's K. 590 were repeated for Beethoven's op. 18, no. 1, so measure numbers for all of the Beethoven quartets appeared one row lower than intended, and the measure numbers for the final piece in the list (op. 18, no. 6) were omitted (Duane, 2017, p. 63). Because of this error, we supplied our own analysis for the exposition of Beethoven's op. 18, no. 6. For consistency with Duane (2017, p. 63), our analysis followed Caplin (1998), rather than Hepokoski and Darcy (2006), and treated the second theme as separate from the closing, despite potential ambiguities in the distinction between these formal categories (see Caplin, 1998, pp. 122–123). Table 2 presents measure numbers for all formal sections and subsections.

Table 2. Measure numbers for formal sections in Duane's string-quartet corpus

Composer	Piece	First Theme	Transition	Second Theme	Closing	Exposition	Development
Haydn	op. 33, no. 1	1–10	11–17	18–32	33–37	1–37	38–58
Haydn	op. 33, no. 2	1–12	13–18	19–28	29–32	1–32	33–62
Haydn	op. 33, no. 3	1–17	18–26	27–55	56–59	1–59	60–107
Haydn	op. 33, no. 4	1–12	13–16	17–25	26–30	1–30	31–51
Haydn	op. 33, no. 5	1–24	25–48	49–88	89–95	1–95	96–181
Haydn	op. 33, no. 6	1–18	19–26	27–48	49–58	1–58	59–70
Haydn	op. 76, no. 1	3–32	33–47	48–71	72–88	3–88	89–139
Haydn	op. 76, no. 3	1–4	5–12	13–37	38–44	1–44	45–78
Haydn	op. 76, no. 4	1–21	22–36	37–59	60–68	1–68	69–107
Mozart	K. 387	1–10	11–24	25–38	39–55	1–55	56–107
Mozart	K. 421	1–8	9–20	21–24	25–41	1–41	42–69
Mozart	K. 428	1–11	12–24	25–55	56–68	1–68	69–100
Mozart	K. 458	1–26	27–46	47–76	77–90	1–90	91–137
Mozart	K. 464	1–16	17–36	37–83	84–87	1–87	88–161
Mozart	K. 465	1–22	23–33	34–68	69–84	1–84	85–132
Mozart	K. 575	1–17	18–32	33–63	64–77	1–77	78–116
Mozart	K. 589	1–20	21–38	39–60	61–71	1–71	72–131
Mozart	K. 590	1–11	12–15	16–62	63–74	1–74	75–111
Beethoven	op. 18, no. 1	1–28	29–56	57–100	101–114	1–114	115–178
Beethoven	op. 18, no. 2	1–20	21–35	36–60	61–81	1–81	82–148
Beethoven	op. 18, no. 4	1–12	13–33	34–70	71–77	1–77	78–135
Beethoven	op. 18, no. 5	1–15	16–24	25–66	67–79	1–79	80–135
Beethoven	op. 18, no. 6	1–18	19–44	45–79	80–91	1–91	92–174

We assembled MusicXML files for each movement in the corpus. Four of the files were drawn from the music21 corpus (Cuthbert & Ariza, 2010). For the remaining movements, we imported open-access MIDI files into music notation software, reviewed them for accuracy, corrected errors, and exported them in MusicXML format.[2]

We collected data from these MusicXML files via Python 3 code that used key features from music21 (Cuthbert & Ariza, 2010). Given a certain measure range, the code created a list of onsets for each part. Onsets were represented in terms of their distance from the beginning of the measure range. With tied notes, only the initial, sounding onset was included. Next, each part's list of onsets was successively paired with every other part's list. For each ordered pair, the number of shared offsets was divided by the total number of offsets in the first part to produce a measure of average onset synchrony (a percentage of shared onsets, always between 0 and 1). This method calculated what we call *directed onset synchrony*, going *from* one part *to* another. For example, if the Viola plays a series of sixteenth notes while the Cello plays a series of quarter notes, then the average onset synchrony from the Viola to the Cello would be 25% (i.e., every fourth onset in the Viola would align with an onset in the Cello). But the average onset synchrony from the Cello to the Viola would be 100% (i.e., every onset in the Cello would align with an onset in the Viola). Finally, the code averaged all of the pair-based averages, creating a single onset-synchrony value for the entire measure range. This average of averages is our dependent variable in the present study. We repeated this process for every formal section in the corpus.

RESULTS

Average onset synchrony values for each section in the corpus are presented in Table 3. Data analysis was conducted using R, v. 4.3.2 (R Core Team, 2023), and we set an α level of .05 to assess significance.

Table 3. Average onset synchrony for formal sections in Duane's string-quartet corpus

Composer	Piece	First Theme	Transition	Second Theme	Closing	Exposition	Development
Haydn	op. 33, no. 1	.506	.578	.549	.533	.589	.636
Haydn	op. 33, no. 2	.454	.450	.725	.416	.557	.454
Haydn	op. 33, no. 3	.406	.460	.424	.343	.435	.516
Haydn	op. 33, no. 4	.817	.741	.548	.354	.651	.582
Haydn	op. 33, no. 5	.616	.650	.564	.540	.606	.603
Haydn	op. 33, no. 6	.576	.563	.501	.529	.541	.619
Haydn	op. 76, no. 1	.542	.692	.861	.621	.701	.559
Haydn	op. 76, no. 3	.785	.588	.587	.555	.594	.440
Haydn	op. 76, no. 4	.459	.555	.646	.564	.574	.456
Mozart	K. 387	.598	.558	.462	.633	.571	.592
Mozart	K. 421	.511	.627	.523	.423	.494	.353
Mozart	K. 428	.599	.533	.489	.539	.523	.443
Mozart	K. 458	.598	.492	.565	.643	.570	.507
Mozart	K. 464	.753	.581	.468	.617	.554	.591
Mozart	K. 465	.473	.559	.471	.558	.501	.604
Mozart	K. 575	.384	.609	.433	.369	.457	.418
Mozart	K. 589	.516	.394	.361	.547	.453	.506
Mozart	K. 590	.624	.563	.417	.524	.469	.538
Beethoven	op. 18, no. 1	.757	.541	.582	.535	.599	.473
Beethoven	op. 18, no. 2	.740	.543	.700	.478	.612	.462
Beethoven	op. 18, no. 4	.712	.581	.683	.886	.679	.604
Beethoven	op. 18, no. 5	.525	.730	.701	.658	.665	.527
Beethoven	op. 18, no. 6	.385	.639	.685	.676	.606	.476
Mean (*SD*)		**0.580** *(0.130)*	**0.575** *(0.083)*	**0.563** *(0.122)*	**0.545** *(0.121)*	**0.565** *(0.074)*	**0.520** *(0.076)*

On average, onset synchrony was higher in expositions ($M = .57$, $SD = .07$) than in developments ($M = .52$, SD = .08). We observed this pattern in 15 of 23 pieces (65.22%). Average onset synchrony was analyzed via a mixed-design analysis of variance (ANOVA), using the *rstatix* package (Kassambara, 2023), with formal section as the within-piece variable and composer as the between-piece variable. There was a significant interaction between section and composer ($F(2,20) = 3.60$, $p = .046$, $\eta^2 = .108$), a significant main effect of section ($F(1,20) = 10.88$, $p = .004$), and a non-significant main effect of composer ($F(2,20) = 2.89$, $p = .079$). To follow up on this interaction, we calculated estimated marginal means (pairwise comparisons), using the *emmeans* package (Lenth, 2024). Bonferroni-corrected pairwise comparisons showed a significant difference between exposition and development for Beethoven (2.85, $p = .00685$); there was no significant difference between sections for Haydn (1.32, $p = .195$) and Mozart (0.141, $p = .888$). Figure 1 and Table 4 summarize average onset synchrony by section and composer.

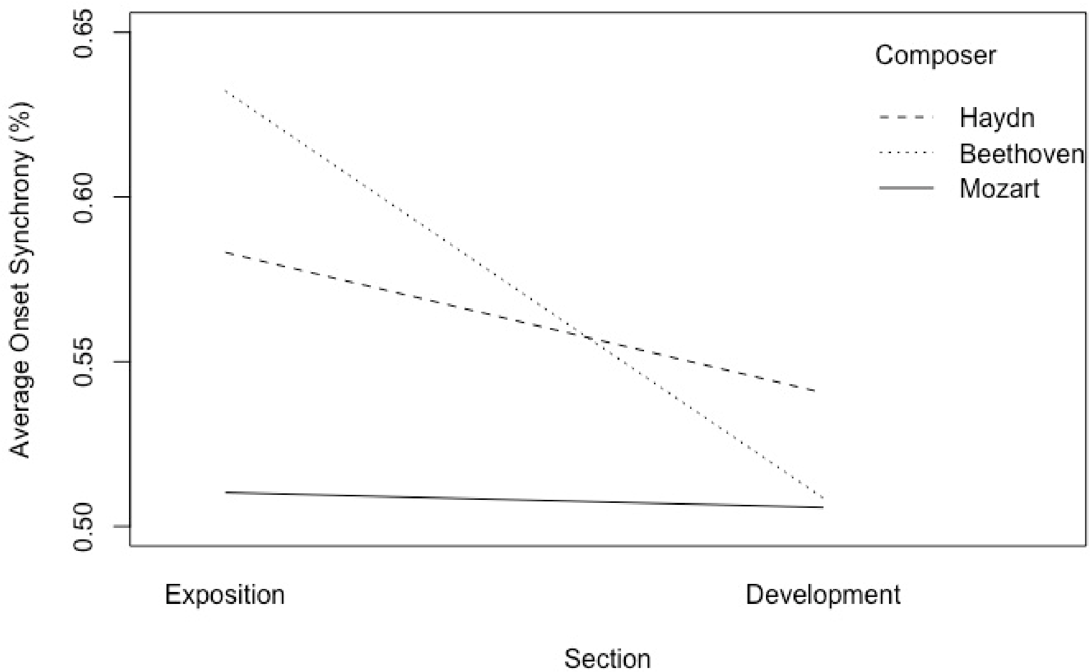

Fig. 1. For average onset synchrony, there is a significant interaction between formal section (exposition vs. development) and composer (p = .046).

Table 4. Average onset synchrony by section and composer

	Exposition		Development	
Composer	*M*	*SD*	*M*	*SD*
Haydn	.583	.074	.541	.076
Mozart	.510	.047	.506	.087
Beethoven	.632	.037	.509	.059
Total	.565	.075	.520	.074

Table 5 reports average onset synchrony values for exposition subsections in the corpus: on average, onset synchrony was highest for first themes and steadily decreased in later subsections. In 2 of 23 pieces (8.70%), the transition had the lowest value for onset synchrony; in 7 of 23 (30.43%), it had the highest value for onset synchrony. To evaluate onset synchrony across subsections, we used another mixed-design ANOVA, with subsection as the within-piece variable and composer as the between-piece variable (see Figure 2). Subsections did not significantly differ in average onset synchrony ($F(3,60) = 0.27$, $p = .849$), and there was no significant interaction between composer and subsection ($F(6,60) = 1.76$, $p = .124$). There was a significant main effect of composer ($F(2,20) = 4.75$, $p = .020$, $\eta^2 = .142$). Post hoc comparisons using Bonferroni-corrected t-tests indicated a significant difference in onset synchrony between Beethoven and Mozart ($t(31.66) = 3.66$, $p = .003$) but not between Beethoven and Haydn ($t(41.12) = 2.23$, $p = .094$) or Haydn and Mozart ($t(64) = 1.43$, $p = .474$).

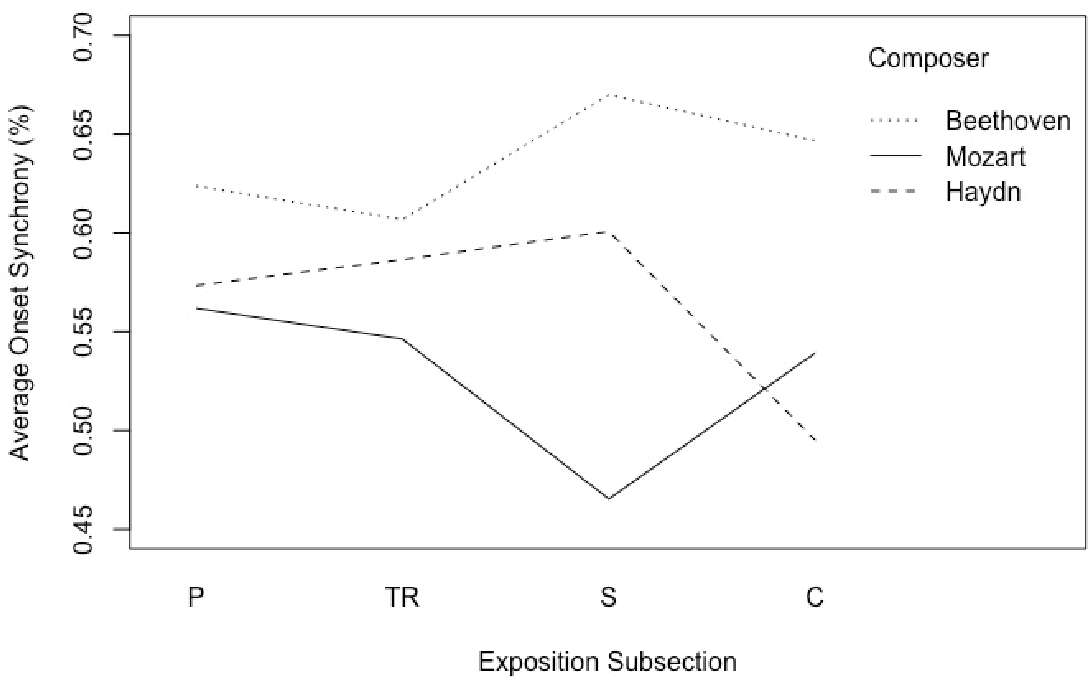

Fig 2. Within the exposition, average onset synchrony differed by composer (p = .020), but there were no significant differences among subsections (p = .849).

Table 5. Average onset synchrony by exposition subsection and composer

	First theme		Transition		Second theme		Closing	
Composer	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Haydn	.573	.144	.586	.097	.601	.129	.495	.099
Mozart	.562	.105	.546	.070	.465	.059	.539	.093
Beethoven	.624	.163	.607	.080	.670	.050	.647	.158
Total	**.580**	**.130**	**.575**	**.083**	**.563**	**.122**	**.545**	**.121**

DISCUSSION

This study used average onset synchrony to investigate textural aspects of sonata form in classical string quartets. We predicted that developments would have lower onset synchrony (i.e., greater rhythmic and textural independence among parts), relative to expositions. Although average onset synchrony was lower in the development for almost two thirds of the pieces in the corpus and in the mean values for all three composers, this difference was significant only for Beethoven. To some degree, it appeared in every Beethoven quartet in the corpus. For Haydn and Mozart, there was no significant difference. So, across these pieces and composers, we did not find a consistent relationship between onset synchrony and large sonata sections.

We also predicted that transitions would typically have the lowest onset synchrony within the exposition, based on hypotheses about texture destabilization and medial formal function. But we found no significant associations between onset synchrony and exposition subsection. The transition was the subsection with the lowest onset synchrony in only two works: Mozart's "Hunt" Quartet, K. 458, and Beethoven's op. 18, no. 4. The opposite pattern—where the transition had the highest onset synchrony in the exposition—was more common in this corpus. It is possible that transitions were more homophonic than expected because of the gesture that Hepokoski and Darcy (2006, p. 94) call the "tutti affirmation," which often marks a transition's beginning. However, there was a significant main effect for composer, apparently driven by a significant difference between Beethoven and Mozart. Note, for example, that mean onset synchrony for every exposition subsection was highest in Beethoven's quartets, while it tended to be the lowest for Mozart. Future research, then, might consider the use of onset synchrony and compositional style.

This corpus study focused on onset synchrony, which is only one aspect of musical texture. Other methods—including those that emphasize other cues, imitative counterpoint (Bakulina, 2012), or information content (Duane, 2017)—might detect textural conventions associated with transitions and developments, and such investigations would go beyond the independence of parts.

The study was also limited to a small corpus of classical string quartets. A larger corpus might reveal other relationships or historical trends. Additionally, textural aspects of sonata form might vary with instrumental genre, and future studies might investigate piano sonatas or symphonic sonata movements. Development-like medial sections might also appear in other formal types, such as the trio in a minuet-and-trio movement or episodes in a rondo. But generic defaults are not necessarily shared across formal types. For example, an earlier corpus study found that the openings of sonata movements and rondos differ in various stylistic features, involving meter, dynamics, average pitch height, and attack rate (De Souza, Roy, & Goldman, 2020). With texture, however, that study's results were inconclusive. This prompts further research, which might reveal textural differences both within and between formal types in classical and other repertoire.

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[2] These MusicXML files are available in this article's supplementary materials at https://doi.org/10.17605/osf.io/ez67m.

REFERENCES

Bakulina, O. (2012). The loosening role of polyphony: Texture and formal functions in Mozart's "Haydn" Quartets. *Intersections: Canadian Journal of Music*, *32*(1–2), 7–42. http://doi.org/10.7202/1018577ar

Bregman, A. S. (1990). *Auditory scene analysis: The perceptual organization of sound.* MIT Press. http://doi.org/10.7551/mitpress/1486.001.0001

Caplin, W. E. (1998). *Classical form: A theory of formal functions for the instrumental music of Haydn, Mozart, and Beethoven*. New York: Oxford University Press. https://doi.org/10.1093/oso/9780195104806.001.0001

Cuthbert, M. S., & Ariza, C. (2010). music21: A toolkit for computer-aided musicology and symbolic music data. In J. S. Downie & R. C. Veltkamp (Eds.), *Proceedings of the 11th International Society for Music Information Retrieval Conference (ISMIR 2010)* (pp. 637–642). International Society for Music Information Retrieval

Duane, B. (2013). Auditory streaming cues in eighteenth- and early nineteenth-century string quartets: A corpus-based study. *Music Perception*, *31*(1), 46–58. https://doi.org/10.1525/mp.2013.31.1.46

Duane, B. (2017). Thematic and non-thematic textures in Schubert's three-key expositions. *Music Theory Spectrum*, *39*(1), 36–65. https://doi.org/10.1093/mts/mtx007

De Souza, J. (2019). Texture. In A. Rehding & S. Rings (Eds.), *The Oxford handbook of critical concepts in music theory* (pp. 160–183). Oxford University Press.

De Souza, J. (2021). Analyzing heterophony. *Intersections: Canadian Journal of Music*, *41*(1), 9–27. https://doi.org/10.7202/1114849ar

De Souza, J., & Lokan, D. (2019). Hypermetrical irregularity in sonata form: A corpus study. *Empirical Musicology Review*, *14*(3–4), 138–143. https://doi.org/10.18061/emr.v14i3-4.6906

De Souza, J., Roy, A., & Goldman, A. (2020). Classical rondos and sonatas as stylistic categories. *Music Perception*, *37*(5), 373–391. http://doi.org/10.1525/mp.2020.37.5.373

Hepokoski, J., & Darcy, W. (2006). *Elements of sonata theory: Norms, types, and deformations in the late-eighteenth-century sonata*. Oxford University Press. http://doi.org/10.1093/acprof:oso/9780195146400.001.0001

Huron, D. (1989). Characterizing musical textures. In *Proceedings of the 1989 International Computer Music Conference* (pp. 131–134). Computer Music Association.

Huron, D. (1993). Note-onset synchrony in J. S. Bach's Two-Part Inventions. *Music Perception*, *10*(4), 435–443. https://doi.org/10.2307/40285582

Huron, D. (2016). *Voice leading: The science behind a musical art*. MIT Press. https://doi.org/10.7551/mitpress/9780262034852.001.0001

Kassambara, A. (2023). *rstatix: Pipe-friendly framework for basic statistical tests.* R package version 0.7.2. Retrieved from https://CRAN.R-project.org/package=rstatix

Klorman, E. (2016). *Mozart's music of friends: Social interplay in the chamber works*. Cambridge University Press. https://doi.org/10.1017/CBO9781316145302

Lenth, R. (2024). *emmeans: Estimated marginal means, aka least-squares means*. R package version 1.10.5. Retrieved from https://CRAN.R-project.org/package=emmeans

Levy, J. M. (1982). Texture as a sign in classic and early romantic music. *Journal of the American Musicological Society*, *35*(3), 482–531. https://doi.org/10.2307/830985

R Core Team. (2023). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. Retrieved from https://www.R-project.org/

Rasch, R. (1981). *Aspects of the perception and performance of polyphonic music* [PhD dissertation]. University of Groningen.