

INDIVIDUALISING GRAPHIC NOTATION THROUGH BOTANICAL METAPHORS: A PRACTICE-BASED STUDY OF *BOTÁNICA* (2024)

Jingsong Teng

Independent composer; Royal Danish Academy of Music (alumnus), Copenhagen
jingsong6667@gmail.com

ABSTRACT

Botánica (2024) is a three-part suite for five to eighteen pitched instruments in graphic notation. Across its movements—*Tree*, *Flower*, and *Ivy*—the score translates botanical growth processes into performable rule sets, so that “nature” functions not only as imagery but as an interface for ensemble decision-making. In this sense, the score operates as a listening guide: it specifies where decisions occur and how sonic states are maintained, rather than prescribing fixed musical events. This study builds on practice-as-research and draws on Peircean semiotics as one lens for understanding how the score is read. I introduce the concept of individualised graphic notation, in which each movement uses a distinct visual grammar to distribute performer choice across parameters (timing, path selection, local ordering) while retaining a clear sonic identity. Through analysis of the score and rehearsal documentation, I show that the piece explores three degrees of aleatoric control in practice. *Tree* employs branching layers that allow flexible pacing within a fixed pitch world. *Flower* uses adjacency constraints (inspired by phyllotaxis) to yield emergent harmonies. *Ivy* combines limited transposition with shape-coded ordering freedoms to model gradual transformation. I argue that ecological metaphors become compositionally useful when formalised as constraints that performers can read, negotiate, and collectively maintain.

1. INTRODUCTION

Graphic scores often invite performers to co-author the musical work, yet the practical question remains: how can a composer write “openness” without losing identity, coherence, and ensemble coordination? *Botánica* emerged from this question and from a personal fascination with plant life cycles—germination, proliferation, and decline—as a model of structured variability. Rather than attempting to represent plants sonically, I aimed to translate aspects of botanical behaviour into rules for musical motion. In this sense, the work belongs to traditions of open works and

experimental notation (e.g., Cage, Brown, Cardew, Ferneyhough), but it also treats the visual surface of the score as an ecological diagram: a map of possible actions rather than a fixed script. This approach parallels Ferneyhough’s Lemma–Icon–Epigram model [1] and aligns with recent scholarship that views graphic scores as image texts [2] or as managed-choice systems [3].

This article presents an individualised graphic notation approach in which each movement employs a distinct visual grammar to invite different kinds of performer decisions. It also proposes a simple framework (summarised in Table 1) for comparing degrees of openness by identifying what in the music is free, fixed, or negotiated in real time, and it documents how rehearsal feedback led to notation and performance-note revisions that clarify performers’ choices without narrowing interpretive space.

2. FRAMEWORK AND METHOD

I work within a practice-as-research framework [4]: composition functions as a method of inquiry, and the artefact (score + performance) is treated as evidence. To describe how the score communicates, I draw on Peircean [5] semiotics, where signs can function iconically (resemblance), indexically (causal trace), or symbolically (convention). Graphic notation typically mixes all three: drawings may resemble motion, arrows may index direction, and staff fragments invoke conventional pitch reading. Thinking semiotically helps clarify which parts of the score aim for intuitive “reading” and which require explicit instruction.

Materials considered here include: (a) the final scores; (b) documented rehearsal observations and performer questions; (c) the post-rehearsal adjustments I made to the notation and performance notes. Where relevant, I describe revisions as clarifications (making an intended freedom legible) rather than constraints (removing freedom).

2.1. Practice-based evidence and documentation

In addition to the score itself, I treat moments of misunderstanding as useful data: when performers ask whether a choice is permitted, or when an ensemble converges on a single reading, those reactions reveal which freedoms are actually legible. I therefore document (i) recurrent performer questions, (ii) points where

Copyright: © 2026 Jingsong Teng. This is an open-access article distributed under the terms of the [Creative Commons Attribution License 3.0 Unported](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Table 1. Framework of openness used in rehearsal, indicating fixed, variable, and negotiated elements.

Movement	Variable elements	Fixed elements	Negotiated elements	Rehearsal focal points
<i>Tree</i>	tempo/pacing; articulation; micro-timing; path selection	pitch world; branching layout; overall time span	density/balance; transition timing; shared time reference	Transition timing, desynchronised movement, and density balance.
<i>Flower</i>	adjacent-petal path choice; local pitch selection	adjacency rule; pitch distribution; overall time span	harmonic continuity; registral continuity	Adjacency rules, harmonic continuity, and ending coordination.
<i>Ivy</i>	ordering within shapes; reversals/permutations	pattern duration; transposition plan; shared arrival points; overall time span	controlled divergence; synchronised arrivals	Shape permissions, variable parameters, and shared arrivals.

ensemble coordination breaks down, and (iii) the specific notational edits made in response. This produces a traceable chain from design intention → rehearsal behaviour → revision.

2.2. Semiotic design of the score surface

Peirce’s triad (icon-index-symbol) is useful here because *Botánica* deliberately mixes reading modes. Branching diagrams and petal layouts operate iconically (they resemble growth forms), arrows and gradients work indexically (they point to direction/energy), and pitch labels, legends, and staff fragments function symbolically (they rely on learned conventions). A practical aim of my revisions is to keep the semiotic mix stable inside each movement: when an element is intended to be ‘read by intuition’ (icon/index), I avoid over-explaining it; when an element requires convention (symbol), I make the rule explicit at the point of use [5]. This also aligns with semiotic accounts of open notation that treat ambiguity as a compositional resource [6].

2.3. Parameter map of openness

To make the degrees of openness comparable, I describe each movement by which parameters are (a) free, (b) fixed, and (c) negotiated in real time. Table 1 summarises this map. The goal is not to quantify freedom, but to make the locus of agency explicit so that the design can be transferred to other works (see Table 1).

Taken together, these observations lead me to treat the score not simply as a visual object, but as a practical environment for decision-making. In *Botánica*, graphic notation does three kinds of work at once: it encodes musical information, it distributes agency among performers, and it shapes how those choices become legible in rehearsal and performance. This is why I describe the piece as an instance of individualised graphic notation. Each movement uses a different visual grammar not for visual variety alone, but to organise a different relation between what is free, what is fixed, and what must be negotiated in real time. From this perspective, openness is not a re-

duction of control. It depends on placing constraints, options, and cues with enough precision that performers can act independently without losing the movement’s sonic identity. Rehearsal is therefore part of the compositional method: moments of uncertainty show where intended freedoms are not yet legible, and subsequent revisions help the score function more clearly as both notation and listening guide.

3. WORK OVERVIEW

Botánica is written for five to eighteen pitched instruments (any instrumentation, mixed timbres). The flexible instrumentation supports the work’s ecological premise: the same score can be “inhabited” by different ensembles, producing different balances and micro-histories. Although the suite is open to 5–18 players overall, *Flower* tends to register most clearly with a smaller group. The number range also alludes to the 18-month structure of the Mayan Haab’ calendar and its additional five Wayeb’ days; within the piece, these numbers function as a compositional frame for cyclical time rather than as a direct act of cultural representation. [7]

Across all three movements, performers keep a shared sense of duration using a timer, and one player gives an initial cue to begin together. Synchronised endings are not required; instead, the ensemble “breathes” around overlapping gestures, encouraging a texture where individual trajectories remain audible.

3.1. Performance protocol

Because the ensemble may vary in size and instrumentation, *Botánica* relies on a small set of shared protocols. In rehearsal I introduce them explicitly to reduce ‘hidden assumptions’ about how open scores should behave:

- Use a timer or a stopwatch to keep a common sense of large-scale duration; local timing remains flexible.

- Appoint a single cue-giver only for the start (and, if needed, a mid-point cue in *Flower*); the rest is coordinated by listening.
- Treat balance as relational rather than absolute: adjust register, timbre, and density so that no voice dominates unless intentionally foregrounded.
- Read the legend at the moment of use: when a symbol encodes a rule (symbolic sign), it must be encountered where the decision occurs.

4. MOVEMENT CASE STUDIES

4.1. *Tree*: branching layers and controlled pacing

Tree is realised through a navigation protocol in which players may diverge at branch points while maintaining a shared temporal frame, negotiating density and timing by listening.

- Choose one seed material and begin in a shared dynamic ‘low-energy’ state.

- At each branch point, select the next pattern; players may choose different routes.
- Keep pitch identity stable, but allow pacing to stretch or compress — especially when density becomes high.
- Use the right-edge dynamic arc as the macro-shape, not as bar-by-bar control.

Tree presents a branching diagram built from several layers of notational information. At the base, performers choose one of four “seed materials.” From there, they traverse upward through branch points, selecting subsequent patterns while following a broad dynamic arc indicated at the right edge. The principal freedom lies in pacing and articulation: players may linger, compress, or expand local durations, but the pitch world and the general energetic trajectory remain stable. The result is a layered soundscape that can fluctuate in density without losing direction.

1. TREE - for 5 - 18 any pitched instruments

(The score is in C)
Senza misura

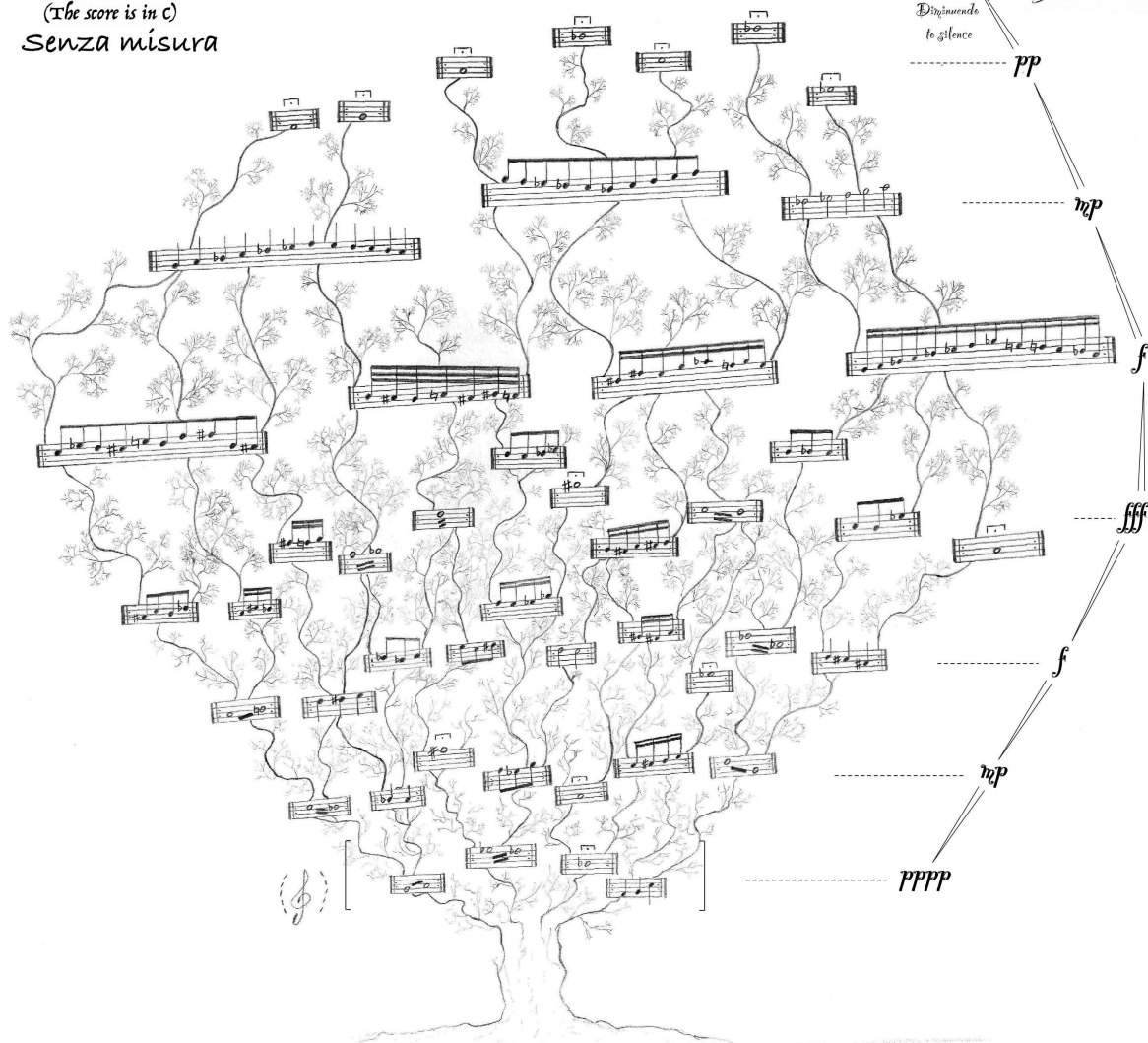


Figure 1. *Tree*: score showing branching layout and layer cues.

The pitch material in *Tree* is intentionally limited. By keeping pitch relations familiar and relatively consonant, the notation can afford greater rhythmic and timbral variability without collapsing into noise. In rehearsal, this limitation proved useful: performers could focus on navigation and ensemble listening rather than on decoding complex pitch sets. At the same time, the branching layout encourages micro-differences between players, so that the “same” ascent can sound like many concurrent growth lines.

4.2. *Flower*: adjacency rules and emergent harmony

In performance, this constraint is realised as a simple navigation protocol: performers begin at the centre and move only to adjacent petals, preserving local harmonic neighbourhoods.

- Start in the centre; each subsequent move must go to a neighbouring petal, with ‘neighbour’ defined clearly in the legend.
- Think locally: avoid long ‘teleport’ jumps that would erase the intended harmonic neighbourhood.
- Let harmony emerge from shared proximity: recurring sonorities are a feature.
- Follow the performance indications for changing dynamics and petal durations, so the movement reads as a single process rather than a collection of chords.

Flower shifts from linear growth to radial expansion. The score is arranged as petals around a centre. Players begin in the centre and then move only to petals adjacent to their current location. This simple adjacency constraint draws inspiration from phyllotaxis, where the placement of new organs is shaped by what is already nearby. Musically, the rule prevents performers from jumping freely across the field; instead, harmony emerges from locally constrained wandering. [8,9]

Pitch classes are distributed unevenly across the petals. Some pitches recur more frequently, creating a subtle gravitational pull (a quasi-tonal centre in G minor) even though no fixed harmonic progression is prescribed (see Figure 2). Because performers are restricted to adjacent-petal choices, the harmonic field develops through locally connected pitch groupings rather than large registral leaps or freely scattered note selection. I therefore realise *Flower* with a smaller ensemble (around five players), so that recurring sonorities and the subtle pull toward G minor can register more clearly.

The movement compresses a life-cycle arc into changing dynamics and petal durations. It begins near stillness (*ppp-p*), intensifies through shorter petal durations and higher dynamics (*mf-f*), and finally collapses toward quiet, suggesting decline. Here the “botanical” is not only an image: it is encoded as a set of time-dependent constraints that performers can read and collectively shape.

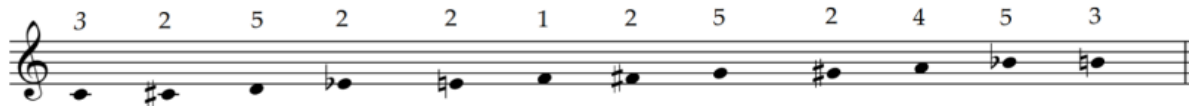


Figure 2. Distribution of pitch classes in *Flower*.

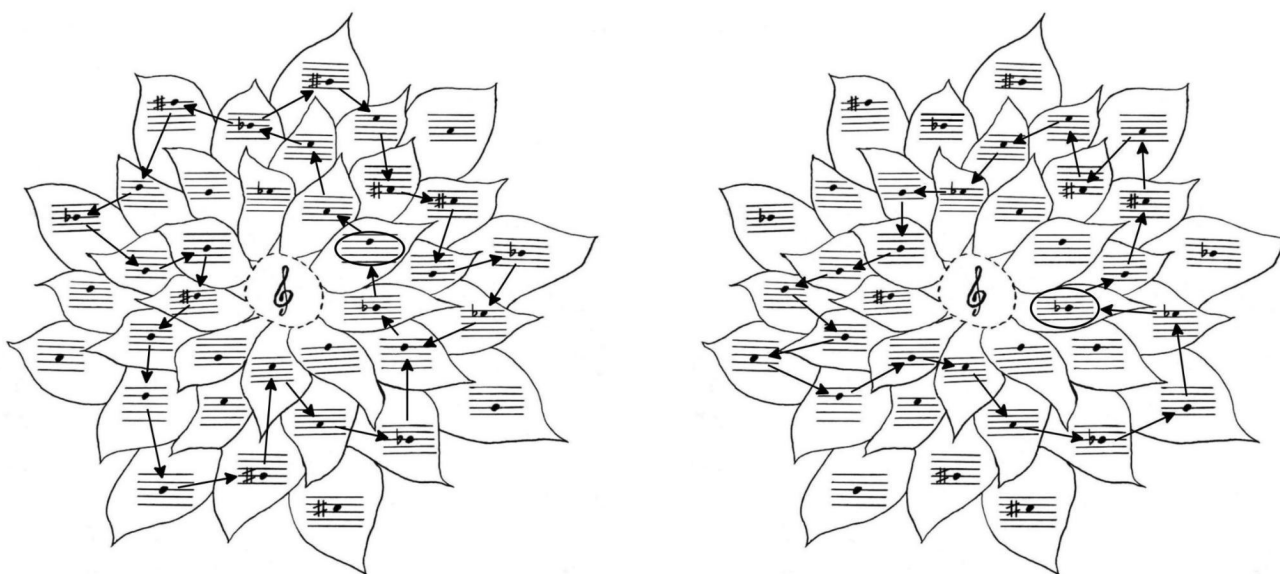


Figure 3. Two examples of possible playing orders in *Flower*.

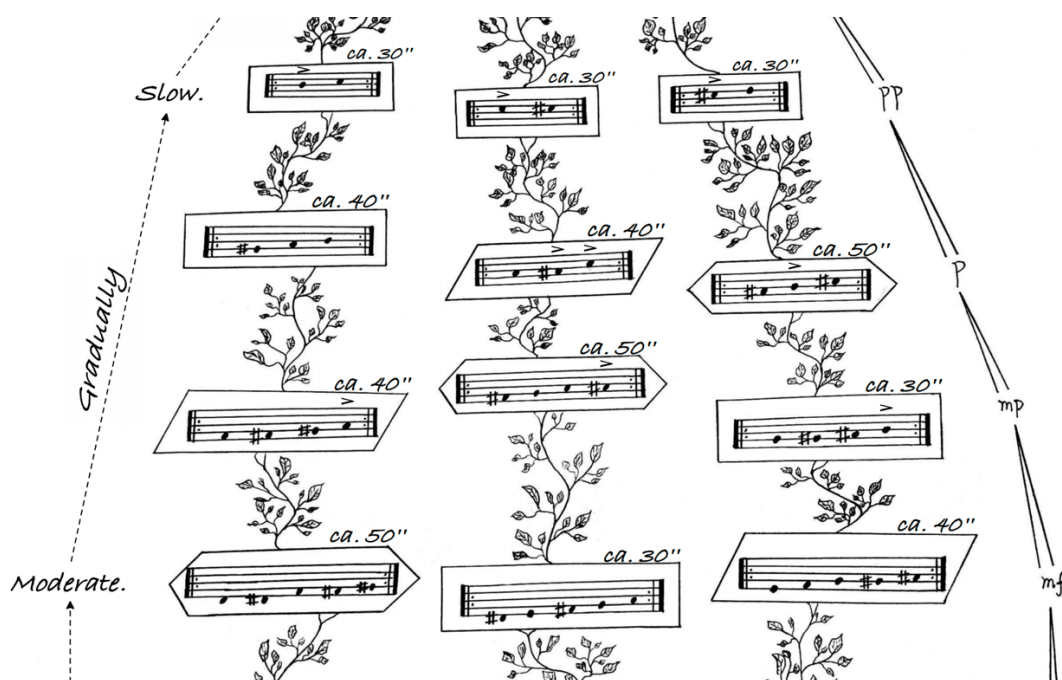


Figure 4. *Ivy*: Excerpt showing shape-coded patterns and transposition steps.

4.3. *Ivy*: limited transposition and shape-coded ordering freedoms

Ivy treats the transposition process as a stable spine: within each step, players reorder shape-coded materials locally, while longer-range coherence is maintained through the fixed transformation plan and shared arrival points.

- Treat the transposition process as the ‘stem’ that persists throughout the movement.
- Apply shape rules consistently: when a shape grants reversal or permutation, use it to create small divergences between players.
- Allow temporal divergence inside a layer, but aim to recognise shared endpoints as convergence points.
- If coordination becomes unclear, prioritise the macro-direction (drift through transposition) over synchronising details.

Ivy focuses on gradual transformation through repeated material under systematic change. The pitch framework is derived from Messiaen’s modes of limited transposition, treated as a reservoir for several short sequences. Across the piece, these sequences are transposed by semitone steps; at the same time, higher layers contain fewer sequences, so texture thins as transposition accumulates. This pairing of repetition and drift models *ivy*’s climbing habit: persistence with adaptation. [10,11]

In *Ivy*, graphic shapes indicate different degrees of freedom in ordering: rectangles require strict left-to-right reading; parallelograms allow reversal; hexagons permit any internal order. Within a single layer, multiple paths have unequal durations yet converge at a shared endpoint, so performers experience temporal divergence inside a

collective frame. In rehearsal, this asymmetry reliably produced a feeling of “searching”: lines move at different speeds while remaining oriented toward the same arrival point.

5. PERFORMANCE-INFORMED REVISIONS

For open notation to function as intended, performers need to understand clearly what they are allowed to do. As a result, several of my revisions focused not on changing the musical content, but on clarifying which choices were open and which constraints needed to remain stable. Across rehearsals, three recurring issues emerged:

- Early commitment to a single route. Some players settled on one path too quickly and tended to repeat it, which reduced the intended variability. I therefore added explicit encouragement to vary paths and to treat repetition as a choice rather than a default.
- Dynamic balance in variable ensembles. With flexible instrumentation, balance cannot be specified in absolute terms. I therefore rewrote the dynamic instructions in relational terms (listen, adjust, keep every voice audible), which performers found clearer.
- Shape meanings not immediately clear from the legend. In *Ivy*, some shape-based freedoms were not immediately legible in rehearsal. I therefore clarified the legend and its wording so that the permitted choices were more explicit.

In fact, this suggests that providing clarity doesn’t diminish openness; instead, being explicit about options can enhance variety by preventing performers from unwittingly limiting themselves.

Table 2. Revision log: clarifications that support performer agency.

Observed issue	Revision made	Effect on openness
Early commitment to a single route	Add explicit permission to vary or avoid fixed paths	Prevents unintended self-restriction; increases variety without adding material
Dynamics treated as absolute levels	Rewrite dynamics as relational instructions	Adapts across instruments and rooms; supports ensemble agency
Shape meanings not immediately clear from the legend	Clarify the legend and its wording	Reduces uncertainty around rule-based symbols; preserves freedom through clarity

6. DISCUSSION: INDIVIDUALISING GRAPHIC NOTATION

In *Botánica*, openness is organised differently in each movement by assigning performer choice to specific parameters. *Tree* is open primarily in pacing and articulation; *Flower* is open in path choice under adjacency constraints; *Ivy* is open in local ordering within a tightly controlled transformational process. Described this way, the three movements form a small comparative set: not three stylistic variations, but three configurations of agency.

The botanical metaphor matters because it is formalised. When “growth” is translated into constraints that performers can enact — branching decisions, neighbour rules, convergence endpoints—the metaphor becomes an operator. This helps avoid a common pitfall in eco-themed composition: nature as surface narrative without practical consequence. Here, ecological thinking is embedded in how the ensemble negotiates time, proximity, and coordination.

However, there are limitations to this approach. The work’s flexibility also creates variability in rehearsal needs: some ensembles may require more time to internalise the navigation rules. Projection quality and page layout affect readability; future iterations may benefit from a digital score interface that can highlight the relevant rule at each moment.

Although *Botánica* is not a software project, its parameter map and rehearsal-driven revisions suggest one possible way of thinking about representation tools. In a digital score interface, the “free / fixed / negotiated” categories could be reflected as explicit constraints and optional choices, while coordination prompts could appear as brief, local annotations at decision points.

Rather than proposing a general platform, the paper suggests a practical way of translating compositional openness into interface elements that support ensemble navigation.

7. CONCLUSION

By treating botanical processes as performable constraints, *Botánica* develops an approach to graphic notation where each movement’s visual design is inseparable from its musical agency. The concept of

individualised graphic notation offers one way to compose openness with identity: not by adding more information, but by tailoring the score’s semiotic mix—icon, index, symbol—to the kind of decision the performer must make. Future work may extend this approach toward digital and real-time score systems, where ecological data and performer interaction could reshape the notation during performance. This also encourages an ecological mode of listening that treats music as interaction with a sounding environment [12,13].

Beyond this case study, the framework may be useful in pedagogy and rehearsal practice as a listening guide: it makes agency explicit, helps ensembles agree on coordination rules, and turns moments of misunderstanding into actionable score edits. Future work could test the framework in other ensembles and notational media (including audio-score layers), and examine how different cueing strategies shape collective listening and perceived form.

SUPPLEMENTARY MATERIAL

A performance video of *Botánica* (2024) is [available here](#).

REFERENCES

- [1] B. Ferneyhough, *Lemma-Icon-Epigram*. London: Edition Peters, 1981.
- [2] J. Metcalf, “What Do Graphic Scores Want? Imagetext, Indeterminacy, and Iconoclasm,” *Music in Art*, vol. 48, nos. 1-2, pp. 175-186, 2023.
- [3] L. Brøndum, “Graphic Notation, Indeterminacy and Improvisation: Implementing Choice Within a Compositional Framework,” *Open Cultural Studies*, vol. 2, pp. 639-653, 2018, doi: 10.1515/culture-2018-0058.
- [4] G. Sullivan, *Art Practice as Research: Inquiry in Visual Arts*. Thousand Oaks, CA: SAGE, 2010.
- [5] C. S. Peirce, *Collected Papers of Charles Sanders Peirce*, vol. 2: *Elements of Logic*. Cambridge, MA: Harvard University Press, 1931.

- [6] T. McKay, *A Semiotic Approach to Open Notations: Ambiguity as Opportunity*. Cambridge: Cambridge University Press, 2021.
- [7] H. Kettunen and C. Helmke, *Introduction to Maya Hieroglyphs* (17th ed.). Bonn: Wegweiser zur Maya-Schrift, 2020.
- [8] C. Kuhlemeier, "Phyllotaxis," *Current Biology*, vol. 27, no. 17, pp. R882-R887, 2017, doi: 10.1016/j.cub.2017.05.069.
- [9] D. Reinhardt, "Regulation of Phyllotaxis," *The International Journal of Developmental Biology*, vol. 49, pp. 539-546, 2005.
- [10] E. Gianoli, "The behavioural ecology of climbing plants," *AoB PLANTS*, vol. 7, plv013, 2015, doi: 10.1093/aobpla/plv013.
- [11] E. Gianoli, "Evolution of a Climbing Habit Promotes Diversification in Flowering Plants," *Proc. R. Soc. B*, vol. 271, no. 1552, pp. 2011-2015, 2004, doi: 10.1098/rspb.2004.2827.
- [12] M. Reybrouck, "A Biosemiotic and Ecological Approach to Music Cognition: Event Perception Between Auditory Listening and Cognitive Economy," *Axiomathes*, vol. 15, no. 2, pp. 229-266, 2005, doi: 10.1007/s10516-004-6679-4.
- [13] L. Lim, "Composition and Ecological Listening," in *The Cambridge Companion to Composition*, T. Young, Ed. Cambridge: Cambridge University Press, 2024.