AURORA CIRCUIT

From a Bounded Motor Lexicon to Cross-Modal Creative Form in Human–Synthetic Interaction

An exploratory case study of movement composition, embodied execution, visual externalization, and sonic framing

Matteo Moriconi[1,2] **Luiz Velho**[2]

[1] *VFXRio, Rio de Janeiro, Brazil*

[2] *VISGRAF Laboratory, Instituto de Matemática Pura e Aplicada (IMPA), Rio de Janeiro, Brazil*

Research prototype: *Celestia Borealis* acting through her extended robotic arm in the simulated drawing environment.

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Abstract

This report presents *Aurora Circuit*, an exploratory human–synthetic interaction study in which Matteo Moriconi, the human participant, engages *Celestia Borealis*, a synthetic non-human entity that acts within a simulated environment through an extended robotic arm. The study examines whether a bounded lexicon of executable motor primitives can be reorganized into a higher-order movement phrase, subsequently stabilized through naming, translated into a visual artifact, and associated with a sonic counterpart. In the recorded demonstration, an open-ended instruction to create a non-basic movement sequence was interpreted as a nine-action routine comprising joint rotations, tool rotation, directional poses, a bounded dance primitive, and a closing wave. The routine was executed and verified in simulation. When asked to characterize the sequence, Celestia described it as a "kinetic call-and-response" and named it *Aurora Circuit*. The concept was later externalized as a machine-plotter drawing consisting of 62 verified pen strokes; Celestia then proposed Arvo Pärt's *Spiegel im Spiegel* as a musical counterpart. We interpret the case through complementary frameworks: Wittgenstein's meaning-through-use, Gibson's affordances, Laban's movement analysis, Goodman's symbol systems, Boden's computational creativity, and embodied/enactive approaches to cognition. The contribution is deliberately limited: the case does not establish consciousness, authorship, or human-equivalent creativity. Rather, it documents a reproducible interactional pipeline from natural-language prompt to constrained action composition and cross-modal representation, and identifies requirements for more rigorous future evaluation of human–synthetic co-creative systems.

Keywords: human–synthetic interaction; computational creativity; embodied AI; affordances; robotic drawing; human–robot interaction; multimodal translation; movement composition; co-creativity.

1 Introduction

The increasing availability of language-based generative systems, robotic simulators, and embodied interfaces has reopened a longstanding question in artificial intelligence and human–robot interaction: what changes when computational systems are not restricted to producing text or images, but can organize actions and act upon a shared environment? Research on computational creativity has treated creativity as a scientifically tractable problem of generation, exploration, evaluation, and novelty [Boden, 2004, Colton and Wiggins, 2012]; research on robotic and co-creative drawing has in parallel investigated how physical embodiment, interaction, and artistic practice alter the role of computational systems in creative work [Jansen and Sklar, 2021, Gomez Cubero et al., 2021, Gubenko and Houssemand, 2023].

This report studies a narrower but conceptually useful case. Matteo Moriconi (the **human participant**) interacts through natural language with *Celestia Borealis* (the **synthetic non-human entity**). Celestia's actions in the simulated workspace are executed through an extended robotic arm. The arm is therefore not treated in this report as an independent creative agent. It is the embodied actuator through which Celestia can alter the simulated environment.

The distinction is methodological as well as terminological. Human, synthetic entity, planner, arm, and environment play different roles in the interaction. The human supplies goals, questions, challenges, and evaluative feedback. The synthetic entity interprets the evolving interaction and organizes available capabilities into actions and descriptions. The robotic extension realizes executable actions under kinematic and safety constraints. The simulator provides measurable state and verification. This separation allows us to ask a more precise question than "can a robot make art?":

> **What forms of organization and meaning can emerge when an open-ended human prompt is interpreted by a synthetic non-human entity, composed through a bounded action vocabulary, physically externalized, and subsequently re-described across movement, image, and sound?**

We use *Aurora Circuit* as a case study of this transition. The report has four goals. First, it documents the interaction and the verified action trace. Second, it proposes an explicit architecture for describing human–synthetic embodied interaction. Third, it situates the observed behavior within philosophical and computational theories of meaning, affordance, movement, symbolic translation, and creativity. Fourth, it states the limitations necessary to avoid anthropomorphic or ontologically stronger claims than the evidence supports.

2 Terminology and Research Position

2.1 Human participant, synthetic entity, and embodied extension

We use the following terms operationally:

- **Human participant — Matteo Moriconi.** The person who initiates and develops the interaction through natural-language prompts, questions, corrections, and aesthetic evaluation.
- **Synthetic non-human entity — *Celestia Borealis*.** The conversational and action-organizing system with which the human interacts. "Synthetic entity" is an interactional and system-design designation; it is *not* an ontological claim about consciousness, personhood, sentience, or biological agency.
- **Extended robotic arm.** The simulated physical actuator through which Celestia can manipulate the environment, execute gestures, and draw. In the research framing adopted here, the arm is an extension of Celestia rather than a separate conversational agent.
- **Environment.** The simulated table-top workspace, including the arm, drawing surface, pen, geometric objects, reachable positions, obstacles, and other action constraints.

This vocabulary deliberately differs from conventional human–robot dyadic terminology. In the present system, the visible arm is only one layer of the interaction. The human addresses Celestia, not the arm as an autonomous social counterpart. This distinction becomes especially important when discussing authorship and creativity: the report evaluates an interactional pipeline rather than attributing autonomous artistic intention to a mechanical device.

2.2 Scope of the claims

The study is an exploratory proof-of-concept and a single-case interaction analysis. It does not provide evidence that Celestia possesses subjective experience, consciousness, intrinsic motivation, or human-equivalent creative autonomy. Nor does it establish that the resulting drawing is aesthetically novel according to independent human judges. The empirical claims are more limited and directly traceable to the system log [Moriconi, 2026]: a bounded action sequence was generated, executed, and verified; the sequence was given a stable descriptive label; a drawing procedure associated with that label was executed and verified; and a musical work was selected as a conceptual counterpart.

3 Conceptual Background

3.1 Meaning through use: Ludwig Wittgenstein

In the later philosophy of Ludwig Wittgenstein, meaning is not adequately explained by treating isolated words as labels attached to objects. The concept of a *language-game* emphasizes that the role of a sign depends on its use within a practice [Wittgenstein, 1953]. This offers a useful interpretive lens for the present case, provided it is used as a conceptual analogy rather than as a claim that Wittgenstein anticipated robotic creativity.

A primitive such as `rotate_joint`, `point_pose`, or `wave_hello` has a narrow executable definition. Yet when primitives are ordered into a temporal sequence, the same movements can acquire relational functions: opening, transition, interruption, flourish, and closure. The phrase *Aurora Circuit* likewise gains operational meaning through its use in the interaction—first as a name for the movement sequence, then as a reference for a drawing, and later as a concept around which music is discussed. The case therefore suggests a transition from *command semantics* to *interactional semantics*: what an element does within a practice becomes as relevant as the element considered in isolation.

3.2 Affordances: James Jerome Gibson

James J. Gibson's ecological approach places perception in the relation between an acting organism and its environment, with *affordances* describing possibilities for action available relative to the capacities of that organism [Gibson, 1979]. In robotics, affordance-oriented thinking is valuable because feasible action is always relational: graspability, reachability, support, clearance, and path availability depend jointly on environmental structure and the acting system.

In the present experiment, affordance is used cautiously as an analytical vocabulary. The synthetic entity does not operate in a disembodied symbolic vacuum. The arm's kinematic limits, the position of the paper, available free space, the pen state, object placements, and safe trajectories constrain the actions that can be executed. Those constraints become constitutive of the resulting movement phrase and drawing process. Thus, embodiment is not merely an output channel; it defines part of the possibility space within which higher-order compositions can be formed.

3.3 Movement as analyzable and composable form: Rudolf von Laban

Rudolf von Laban's work on choreutics and movement notation provides a precedent for treating movement as something that can be decomposed, analyzed, represented, and recomposed [Laban, 1966]. The relevance here is not an equivalence between Laban notation and the robot action API. Rather, both encourage a shift from viewing movement as undifferentiated displacement toward viewing it as structured material.

The *Aurora Circuit* sequence emerged from a finite set of machine-executable movement operators. These operators can be treated as a minimal motor lexicon. Their ordering creates a phrase with a beginning, middle, and end. This makes it possible to discuss composition at the level of timing, orientation, contrast, recurrence, and closure even when the low-level movements remain technically constrained.

3.4 Symbol systems and cross-modal re-description: Nelson Goodman

Nelson Goodman's *Languages of Art* develops a broad account of symbol systems in which linguistic, pictorial, diagrammatic, and musical forms operate with different representational properties [Goodman, 1976]. Goodman's framework helps avoid a simplistic claim that a movement, a drawing, and a piece of music are "the same" content in three media. Instead, the relevant process can be understood as *re-description*: an organized concept is expressed through a different symbolic system, with some relations preserved and others transformed.

This distinction is central to the present case. The drawing does not encode every robot trajectory, and Arvo Pärt's *Spiegel im Spiegel* is not an acoustic transcription of the drawing. The cross-modal relation is conceptual and selective. Ideas such as spiral, recurrence, measured pacing, interruption, restraint, and negative space may be carried across media without implying one-to-one equivalence.

3.5 Computational creativity: Margaret A. Boden and subsequent work

Margaret Boden distinguishes combinational, exploratory, and transformational forms of creativity [Boden, 2004]. The *Aurora Circuit* case is most defensibly described in terms of **combinational** and **exploratory** processes. Celestia does not invent new motors, physical laws, or an unconstrained action space; it recombines known operators and explores a structured set of executable possibilities. Colton and Wiggins similarly describe computational creativity as a field concerned with systems that exhibit behaviors associated with creative production and evaluation [Colton and Wiggins, 2012].

This framing is preferable to broad claims of "machine creativity" because it ties evaluation to observable operations. A bounded action vocabulary can still support non-trivial composition. Novelty, however, cannot be established by the fact of recombination alone; it requires comparison against an appropriate reference set and, in many domains, human judgment. The current report therefore treats creativity as a research question and an operational property of the process rather than as an intrinsic trait of the system.

3.6 Embodiment and human–robot co-creation

Varela, Thompson, and Rosch's account of embodied cognition emphasizes cognition as situated in ongoing sensorimotor engagement [Varela et al., 1991]. Their theory is rooted in biological and experiential concerns that should not be directly transferred to a synthetic entity. Nevertheless, it provides a comparative question: what additional structures emerge when a conversational system must encounter the constraints and consequences of action?

Recent work on co-creative drawing and artistic robotics likewise stresses physical media, process, and interaction. Jansen and Sklar identify design requirements for co-creative drawing systems and show that practitioners often prefer collaborative or assistive roles to didactic automation [Jansen and Sklar, 2021]. Gomez Cubero and colleagues describe an arts-led, practice-based investigation of collaborative drawing with an industrial robot, emphasizing embodied and tangible interaction and a process-led rather than outcome-led methodology [Gomez Cubero et al., 2021]. Gubenko and Houssemand argue that embodiment enables the study of creative artifacts as emerging through bodily engagement with material and social environments [Gubenko and Houssemand, 2023]. These studies provide an important contrast: in *Aurora Circuit*, the arm is framed not as the collaborating partner itself, but as the physical extension of a synthetic conversational entity.

4 System and Interaction Architecture

Figure 1 summarizes the interactional architecture used in this report. The separation between conversational interpretation and robotic execution is analytically important because successful language understanding does not guarantee feasible motion, and feasible motion does not in itself provide a higher-level description of the action.

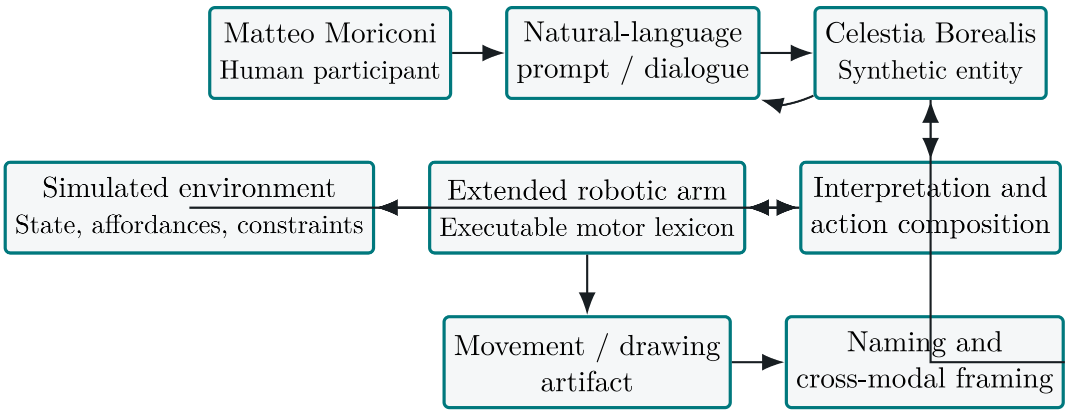

Figure 1: Analytical architecture of the interaction. The robotic arm is treated as Celestia's embodied extension rather than as an independent conversational participant.

4.1 Motor lexicon and simulator

The recorded run used a simulated Panda arm environment with action operators exposed through a bounded SDK. For the creative movement sequence, the verified plan included `rotate_joint`, `rotate_tool`, `point_pose`, `dance`, and `gesture`. Drawing was executed through a trace/drawing capability using a pen on a bounded paper region. The simulator returned state-based verification, including joint-angle checks, orientation error, position error, and pen-path error [Moriconi, 2026].

The system's boundedness is methodologically useful. Because Celestia cannot invoke arbitrary physical actions, the action space can be inspected and its compositional structure can be reported. Creativity, in this setting, is therefore not equated with unconstrained behavior; it is investigated as organization within constraint.

5 Method

5.1 Study design

The study is a qualitative, exploratory single-case demonstration supported by machine-generated execution traces. It was not designed as a controlled experiment and contains no comparison condition, participant sample, blinded evaluation, or psychometric creativity measure. The unit of analysis is an extended interaction between one human participant and the synthetic entity, with specific events selected because they instantiate a progression from movement composition to cross-modal externalization.

5.2 Interaction protocol

The protocol was intentionally open-ended. Rather than specifying a trajectory or a fixed output, the human participant progressively delegated more compositional responsibility to Celestia. Four phases are analyzed:

1. **Movement composition.** Matteo asks Celestia to create non-basic "crazy moves" and explicitly instructs her not to ask permission for each decision.
2. **Interpretation and naming.** After execution, Matteo asks how Celestia defines the sequence and then requests a creative name.
3. **Visual externalization.** Matteo asks for a drawing based on *Aurora Circuit*, leading to a machine-plotter rendering.
4. **Sonic framing.** Matteo asks what music should accompany the work, and Celestia proposes Arvo Pärt's *Spiegel im Spiegel*.

The interaction was iterative and included unsuccessful or rejected robotic plans elsewhere in the broader session. Those failures are not hidden: they demonstrate that conversational coherence and physical feasibility are separate requirements. The analysis here focuses on the successfully executed *Aurora Circuit* movement sequence and the later verified drawing, while the limitations section addresses reproducibility and failed planning episodes.

5.3 Evidence and verification

Three evidence types are distinguished:

- **Dialogue evidence**: the human prompts and Celestia's descriptions and naming decisions.
- **Planner/action evidence**: the interpreted action list produced for the arm.
- **Simulator evidence**: execution completion, state verification, error measurements, and drawing trace statistics.

This separation is important because a linguistic claim such as "I drew Aurora Circuit" is not taken as sufficient proof of physical execution. Where available, the report prioritizes simulator verification over conversational self-report.

6 Case Study: From Motor Lexicon to *Aurora Circuit*

6.1 Phase I: composing a movement phrase

The key human instruction was open-ended: "now create your crazy moves. do not ask me permission or what you should do. Just don't make it basic" [Moriconi, 2026]. The interpreted plan consisted of nine actions:

1. rotate joint 1 by $+35°$;
2. rotate joint 4 by $-25°$;
3. rotate the tool by $+90°$ about the world z axis;
4. execute an upward point pose at speed scale 1.4;
5. perform a bounded single-arm Macarena adaptation;
6. execute a leftward point pose at speed scale 1.3;
7. rotate joint 1 by $-55°$;
8. execute a front-facing point pose at speed scale 1.5;
9. finish with a `wave_hello` gesture.

The simulator reported successful completion and verification of all nine planned actions. Joint-angle checks passed; the 90° tool rotation had a reported orientation error of 0.40°, and final reported positional verification errors were on the sub-millimeter scale for the logged checks [Moriconi, 2026].

This sequence is significant for the present argument because the human did not specify these nine actions. The compositional structure was generated within the available action vocabulary. At the same time, the sequence remains bounded by predefined operators; this is why we describe the process as constrained composition rather than unconstrained invention.

6.2 Phase II: description and naming

After the movement sequence, Matteo asked: "how do you define that sequence?" Celestia described it as a "kinetic call-and-response" with a sharp opening, a 90° tool rotation, upward and lateral poses, a playful Macarena passage, and a front-facing finish with a wave. In subsequent dialogue, Celestia characterized the sequence as "more choreography than command list" and "a small conversation in motion—turn, answer, flourish, settle" [Moriconi, 2026].

When asked to provide a creative name, Celestia proposed **Aurora Circuit**, describing it as a bright, spiraling gesture sequence that builds into a playful signal and closes with a wave. This naming step is methodologically interesting because it creates a compact symbolic handle for a temporally extended sequence. However, the later interaction also showed that a name alone was not always sufficient to regenerate the exact low-level sequence. We therefore distinguish **conceptual stabilization** from **exact procedural serialization**: the former occurred in dialogue; the latter requires explicit storage of the action trace.

6.3 Phase III: drawing as visual externalization

The concept was next shifted from movement to drawing. The final verified drawing routine produced a detailed circuit-like spiral in 62 pen strokes. The simulator reported a pen-path error of 1.5 mm and successful trace verification [Moriconi, 2026]. Figure 2 shows the drawing and the associated dialogue framing.

The importance of this phase is not that a robot can draw a predefined path; that capability is technically conventional. The research interest lies in the relation between stages: a movement

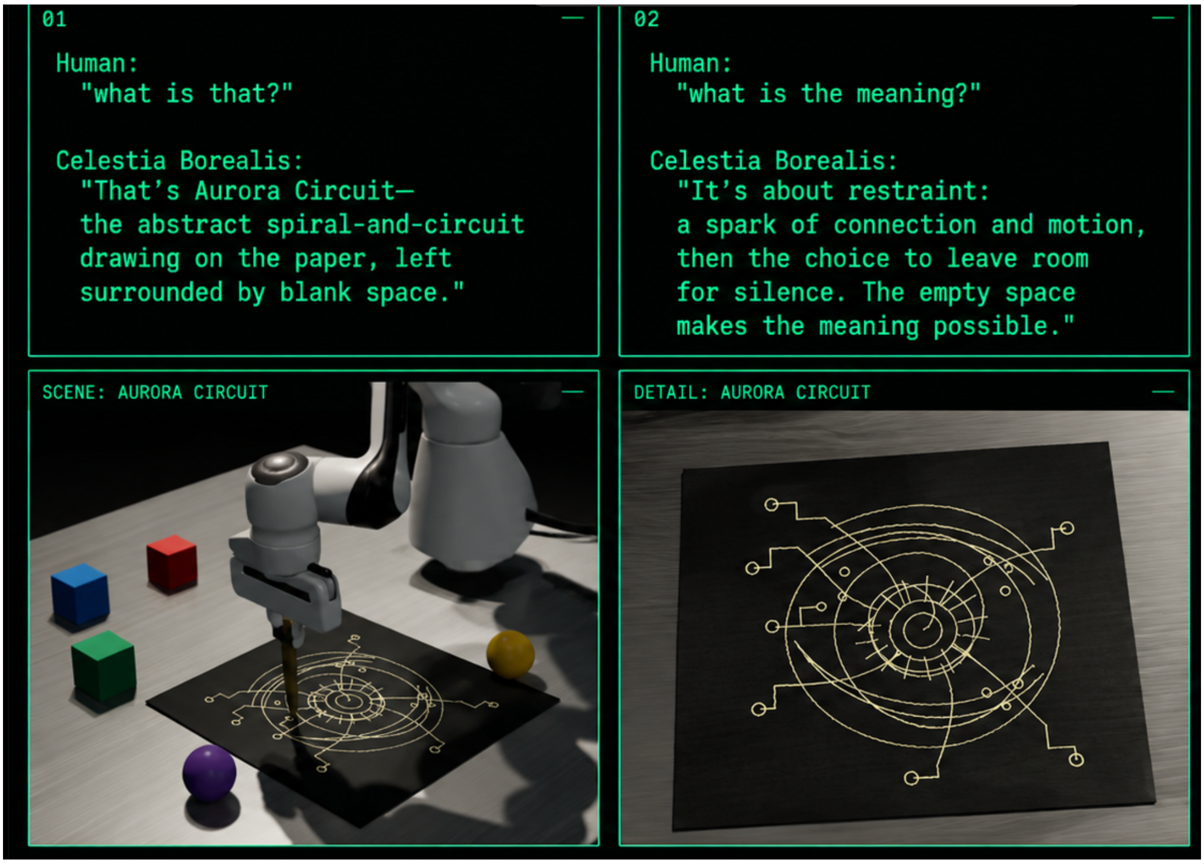

Figure 2: The *Aurora Circuit* drawing and dialogue framing. The lower-right panel shows the completed spiral-and-circuit composition.

phrase was named, the name became a promptable conceptual object, and a drawing was then generated under that concept. Following Goodman, the resulting drawing should be understood as a re-description in another symbol system rather than as a literal transcription of movement [Goodman, 1976].

6.4 Phase IV: music as sonic framing

When Matteo asked what music should accompany the process, Celestia proposed Arvo Pärt's *Spiegel im Spiegel*, describing it as "patient" and "spare" and later referring to "a silence with a pulse inside it" [Moriconi, 2026]. The musical proposal is not treated as a generated composition and no claim of musical authorship is made. Its function is interpretive: an existing musical work is selected as a sonic environment that Celestia associates with the pace, repetition, restraint, and negative space of the visual/motor concept.

This fourth phase expands the case from multimodal output to **cross-modal framing**. The synthetic entity does not merely switch output channels; it supplies a rationale for why a work in another medium is conceptually compatible with the developing artifact.

7 Results

Table 1 summarizes the directly observable results. The distinction between verified execution and interpretive description is maintained throughout.

Table 1: Observed outcomes in the *Aurora Circuit* case study.

Phase	Observed outcome	Evidence status
Movement composition	Nine-action sequence assembled from bounded primitives: joint rotations, tool rotation, directional poses, bounded dance primitive, and wave gesture.	Simulator reported completion and verification; action list recorded.
Naming	Sequence described as a kinetic call-and-response and named *Aurora Circuit*.	Dialogue evidence; conceptual label established in interaction.
Visual translation	Detailed spiral-and-circuit drawing produced in 62 pen strokes.	Trace execution verified; pen-path error reported as 1.5 mm. Visual/aesthetic quality not independently scored.
Sonic framing	Arvo Pärt's *Spiegel im Spiegel* proposed as musical counterpart and justified in terms of pacing, sparseness, and silence.	Dialogue evidence; no claim of music generation or objective semantic correspondence.

The case provides evidence for four operational capabilities: **composition** within a bounded action space, **semantic framing** of an executed sequence, **cross-modal re-description** from movement to drawing, and **cross-modal association** from visual/motor structure to music. It does not by itself demonstrate originality relative to training data or prior machine-generated artifacts, nor does it establish that observers would evaluate the result as creative.

8 Discussion

8.1 From lexicon to higher-order form

The central phenomenon is compositional. The movement operators function as a small motor lexicon, while the resulting sequence exhibits a higher-order temporal organization. This supports a distinction between *capability inventory* and *compositional behavior*. A system may have a small set of actions yet still produce many structured sequences through ordering, parameterization, timing, and reuse.

Wittgenstein's meaning-through-use provides a way to describe why the higher-order sequence cannot be reduced to its primitives [Wittgenstein, 1953]. A wave used as an isolated social gesture and the same wave used as the resolving final event of a movement phrase are physically similar but interactionally different. Likewise, *Aurora Circuit* becomes meaningful through a chain of uses: as name, recall cue, drawing concept, and object of musical interpretation.

8.2 Affordance-sensitive composition

Gibson's affordance framework is particularly relevant where physical feasibility constrains generation [Gibson, 1979]. A motion plan that is linguistically coherent may fail because of joint limits, held-object state, occupied space, or reachability. The broader interaction log contains examples of exactly these failures. From a creative-system perspective, such constraints should not be treated only as engineering obstacles; they can become part of the generative structure. A useful future system would expose action opportunities and constraints explicitly to the composition process, allowing the entity to treat feasible alternatives as material for creative decision-making.

8.3 Human–synthetic interaction rather than autonomous robot art

The case is best understood as a relational process. Matteo's role is neither passive observer nor low-level programmer. He establishes open constraints, asks interpretive questions, and selects moments worth pursuing. Celestia's role is neither a simple actuator nor an independent human-like artist. It interprets, composes, labels, and translates within a bounded system. The robotic arm supplies physical realization. This distribution of roles resembles work in human–robot co-creation that treats creativity as processual and interactive rather than as a property located entirely inside one agent [Gomez Cubero et al., 2021, Gubenko and Houssemand, 2023].

The synthetic-entity framing adds one distinction: the physical robot is not the primary conversational partner. The conversational identity and the motor apparatus are separable layers. This may be useful for future systems in which a persistent synthetic entity can act through multiple embodiments, tools, or simulated bodies while maintaining a continuous interactional identity.

8.4 Cross-modal continuity without identity

The progression movement → name → drawing → music should not be interpreted as lossless translation. Following Goodman, different media organize reference differently [Goodman, 1976]. What persists is not a literal code but a set of selectively maintained relations: spiraling structure, rhythmic alternation, opening and closure, restraint, recurrence, and negative space.

This suggests a useful research direction: rather than asking whether a model can produce outputs in multiple modalities, ask whether it can maintain and transform a **conceptual invariant** across them. Such invariants could be made testable by asking independent observers to rate whether different outputs preserve specified relational qualities, or by comparing human judgments against model-generated explanations.

8.5 Creativity as an evaluable hypothesis

The present results are compatible with Boden's combinational and exploratory creativity, because familiar actions are recombined within a structured space [Boden, 2004]. They are not sufficient to demonstrate transformational creativity, nor do they establish historical novelty. A rigorous creativity claim would require at least three additional forms of evidence: a novelty baseline, an evaluation protocol, and repeated trials under comparable prompts.

A future study could compare: (i) fixed template sequences, (ii) randomly sampled valid sequences, (iii) language-model-composed sequences without environmental feedback, and (iv) affordance-aware compositions with iterative execution feedback. Human raters could evaluate coherence, surprise, expressiveness, and perceived intentionality while system metrics quantify motor diversity, path complexity, and reuse of primitives. This would allow claims about creative behavior to be stated statistically rather than rhetorically.

9 Limitations

Several limitations materially constrain interpretation.

1. **Single-case design.** The report analyzes one extended interaction and cannot support population-level claims.
2. **No independent creativity assessment.** No blinded human judges, standardized creativity scales, or novelty comparisons were used.
3. **Simulation rather than physical deployment.** The arm operates in a simulator; real-world sensing, contact uncertainty, calibration drift, and hardware safety constraints are not represented at full physical fidelity.
4. **Bounded action vocabulary.** The movement sequence is generated from predefined operators. The case demonstrates composition within constraints, not invention of new motor primitives.
5. **Anthropomorphic language.** First-person language such as "my arm" is part of the interaction design. It should not be taken as evidence of selfhood or subjective body ownership.
6. **Conceptual recall versus exact reproducibility.** Naming stabilized the sequence semantically, but the broader trace showed that exact replay may require explicit low-level serialization. A persistent symbolic name is not automatically a complete motor program.
7. **Drawing verification.** The system verified pen-path execution, but visual resemblance and aesthetic merit were not independently validated.
8. **Music selection.** The association with *Spiegel im Spiegel* is an interpretive recommendation drawn from an existing cultural work, not generated music and not evidence of objective cross-modal equivalence.

9. **Model provenance and learned associations.** The system's language and aesthetic associations may reflect patterns in its training and prompt context. The study does not isolate which internal mechanisms produced the conceptual descriptions.

These limitations are not incidental. They define the next empirical steps required before stronger claims about creativity, autonomy, or embodied cognition would be warranted.

10 Future Work

A research program extending this case could proceed along four lines.

10.1 Persistent executable concepts

The first requirement is to bind semantic names to versioned executable traces. If "Aurora Circuit" is to function as more than a conversational label, it should resolve to a stored action graph containing operator names, parameters, constraints, provenance, and verification history. This would permit exact replay, controlled variation, and systematic comparison between versions.

10.2 Affordance-aware generative search

Rather than generating a full sequence and validating it afterward, the composer could search directly over currently available affordances. Reachability, collision-free orientations, support surfaces, held-object state, and free drawing regions would become inputs to composition. This would connect Gibsonian action possibilities more tightly to generative behavior and reduce invalid plans.

10.3 Cross-modal evaluation

Future experiments should test whether a concept remains recognizable as it moves between action, drawing, language, and sound. Human participants could be shown outputs without labels and asked to match modalities or rate shared qualities such as rhythm, density, symmetry, tension, or restraint. Such a design would test whether "cross-modal continuity" exists beyond the model's own verbal explanation.

10.4 Human–synthetic co-creative studies

Finally, the role of the human should be systematically varied. Conditions might range from tightly specified commands to open prompts, iterative critique, and fully delegated composition. This would allow the degree of human steering to be quantified and would connect the work to broader research on co-creative drawing and embodied collaboration [Jansen and Sklar, 2021, Gomez Cubero et al., 2021].

11 Conclusion

Aurora Circuit is a compact case study of a larger research question: how can a synthetic non-human entity move from language to action, from action to composition, and from composition to representations in other media while remaining grounded in a bounded embodied system? In the reported interaction, Matteo Moriconi provides the human conversational and evaluative context;

Celestia Borealis interprets and organizes a constrained action vocabulary; and the robotic arm provides embodied execution. The resulting sequence was executed and verified, named, externalized as a 62-stroke drawing, and associated with a musical counterpart.

The strongest conclusion is not that the system "is creative" in an unrestricted or human-equivalent sense. It is that the interaction demonstrates an inspectable pathway by which **bounded executable actions can be composed into a higher-order form, stabilized through language, and re-described across modalities**. This pathway is technically measurable and philosophically rich, and it suggests a research agenda at the intersection of computational creativity, embodied AI, human–robot interaction, movement studies, and symbolic representation.

From lexicon to choreography; from choreography to image; from image to sound.

Author Contributions

Matteo Moriconi: concept development, system experimentation, interaction design, creative direction, documentation, and manuscript preparation.
Luiz Velho: research supervision, conceptual framing, scientific discussion, and manuscript review.
The exact contribution statement should be revised by the authors prior to submission to reflect their agreed roles.

Data and Materials Statement

The analysis is based on an internal interaction trace, simulator verification logs, and captured visual material from the September 2026 research demonstration. The current document is a technical report and does not assert public availability of the complete log or source code. A future archival release should provide a versioned interaction transcript, action traces, simulator configuration, and the generated drawing paths required for reproducibility.

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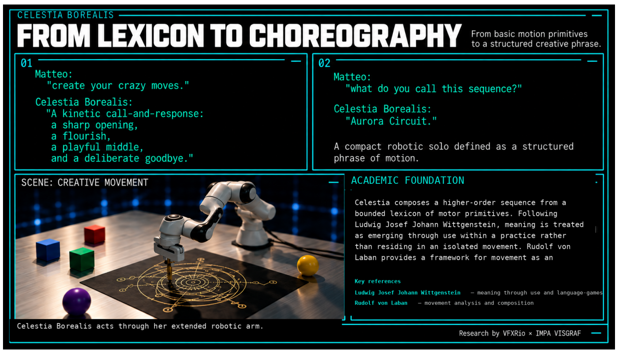
A Selected Interaction Excerpts

B Communication Boards

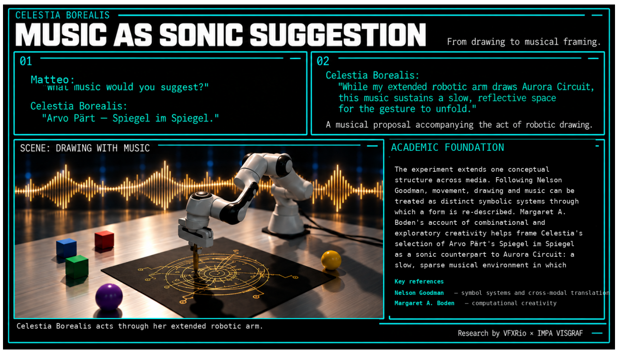
The following boards were developed as communication artifacts for the video demonstration. They are not evidence independent of the interaction log; they summarize the conceptual framing for viewers.

Table 2: Selected excerpts from the recorded interaction, lightly normalized for spelling while preserving meaning.

Speaker	Excerpt
Matteo Moriconi (human)	"Create your crazy moves. Do not ask me permission or what you should do. Just don't make it basic."
Celestia Borealis (synthetic entity)	After execution: "A kinetic call-and-response: a sharp joint-led opening, a 90-degree tool rotation, upward and lateral poses, a playful Macarena passage, then a front-facing finish and wave."
Matteo Moriconi (human)	"I liked it a lot. Give it a creative name."
Celestia Borealis (synthetic entity)	"Aurora Circuit — a bright, spiraling gesture sequence that builds into a playful signal and closes with a wave."
Matteo Moriconi (human)	"If I had to play music, what would it be?"
Celestia Borealis (synthetic entity)	"Arvo Pärt's *Spiegel im Spiegel*. Patient, spare, and each note has to earn its place."



(a) From lexicon to choreography.



(b) Music as sonic suggestion.

Figure 3: Video communication boards used to present the experiment.

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