The Maxwell Demon: Comprovisation in Ecologically Grounded Creative Practice

Luzilei Aliel [1] [*], **Damián Keller,** [2] **Rogério Costa** [1]

[1] ECA – Escola de Comunicaçõe e Artes da Universidade de São Paulo
Prédio Central 1, Av. Prof. Lúcio Martins Rodrigues, 443 - Butantã, São Paulo - SP, 05508-020

[2] Núcleo Amazônico de PesquisaMusical, Universidade Federal do Acre
Rodovia BR 364, Km 04, s/n - Distrito Industrial, Rio Branco - AC, 69920-900

first_luzaliel@usp.br, second_dkeller@ccrma.stanford.edu,Third_rogercos@usp.br

Abstract

This paper aims to expand the research on ecological synthesis (Keller, 1999) through the inclusion of improvisation practice. We propose a formalization of creative processes in sonic improvisatory-compositional environments (targeting comprovisation), based on ecologically grounded creative practices. Our approach entails the use of socio-ecological models that deal with complex adaptive systems [Sibertin et al., 2011]. We developed a performance/experiment called The Maxwell Demon, as a case study. The observations done during the case study indicate that imitation is an important strategy for creative activities in socio-ecological systems. Improvisation may provide a relevant source of sonic content in ecological environments, enhancing their flexibility without losing consistency.

1. Introduction

This work deals with ecologically grounded creative practice targeting both composition and sonic improvisation (comprovisation). We take as reference complex adaptive systems due to the large number of variables embedded in this type of approach. The assessment of responses of complex adaptive systems to dynamically changing scenarios are usually approached from a modeling perspective [Barreiro and Keller, 2010]. Models can be employed to observe socio-ecological dynamics, such as the one proposed by Sibertin-Blanc et al (2011) to determine the qualitative processes in complex adaptive systems. We discuss the alignments and deviations of this proposal with current ecocompositional and comprovisational practices. To account for the improvisatory elements involved in ecologically grounded creative practice, we expand the ecocompositional approach laid out by Keller (1999) with a Proposal of Modeling of Ecological Synthesis (PMES). Socio-ecological models were developed to design performances/experiments, conducted as case studies. Analytical notes include creative processes, interaction strategies, types of agents, and the production of relevant or disposable resources. We employed, tested and observed the outcomes of the model in a performance/experiment that uses ecologically grounded comprovisation, The Maxwell Demon (TMD). We use a model of adaptive complex systems to formalize the implementation of a proposal for ecological modeling (PESM) using improvisational resources.

2. Socio-Ecological Systems

Socio-ecological systems are complex adaptive systems that are characterized by self-organization and distributed control. In socio-ecological systems, social and ecological processes interact at various temporal levels. These reorganizations entail emerging structures and functions. Therefore, models usually encompass multiple agents with diverse and contrasting objectives, being observed at various spatial and temporal levels (Reed, 2008; Pahl-Wostl, 2007; Giampietro 2002). According to Sibertin-Blanc et al. (2011), a socio-

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ecological system includes *entities* and *processes*, together with relationships between the entities. The relationships among these three types of entities produce *instances of entities,* which are resources that may appear or be discarded over time, as the state of system changes. Entities are characterized by properties whose values represent the state of an instance[1]. There are two types of relationships among entities: *1. structural relationships* are associated to the entities by their nature; 2. *non-structural relationships* are created as a result of agents actions. The dynamic character of the socio-ecological system involves processes that evolve toward orderly or disorganised conditions, impacting both the internal and the external processes. Hence, it is necessary to consider the interactions between the socio-ecological system and the environment.

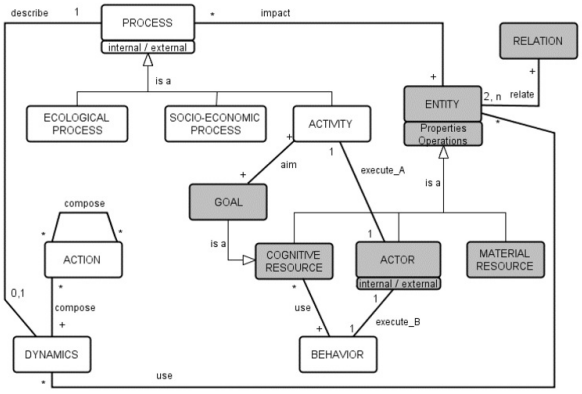

Figure 1: A model of socio-ecological systems proposed by Sibertin-Blanc et al. (2011).

3. Ecological Synthesis Models (PESM)

Keller´s (1999) ecological modeling conceptualizes the creative use of environmental sounds, proposing spatial locations consistent with the sound sources and applying ecologically viable sonic transformations. The ecological approach is based on the premise that all sonic models should be restricted to ecologically feasible events. Ecological validity is defined by observations of complex interactions occurring in the environment, i.e. by data of agents-objects interactions. The individual's actions on the environment and the influence of the environment on the individual determine a process of pattern formation. This process can be modeled by algorithmic tools [Keller, 1999: p. 23]. Keller (1999) argues that synthesized sounds can expand the compositional resources without compromising the consistency of the sampled events, hence providing unique opportunities for creative action. The author puts forth two techniques to expand the creative possibilities afforded by synthesized sounds in ecologically based scenarios: 1) Generic Physical Models, 2) Control of Meso-Level Granular Sample Sets (see Keller 1999 for a detailed description). The ecological approach places stress on the usage of material resources: 1) actual environments yield resources where the agents are located while carrying out their activities; 2) synthesized environments incorporate resources through digital audio processing; 3) *meta-soundscapes* encompass resources originated in local and remote environments [Aliel; Fornari, 2013]. The social process, in turn, generates phenomena resulting from interactions among human beings. We consider three strategies: 1) *imitation*: the ability to employ mimesis based on perception, analysis and synthesis [Mannis, 2014]; 2) *exploratory activity*: the agent's ability to discover material resources and seek to develop interactions with environment, other agents and *gelassenheit*[2] *entities*; and 3) *epistemic activity:* knowledge construction in an empirical way, through production of creative material [Keller et al., 2010].

4. Comprovisation in PESM

The practice of comprovisation is a recent

1 - This term comes from computer science. The concept of instance corresponds to the existence of an object that shares some characteristics with another individual or object. For example: despite some singularities (type of instruments, technical training, sonic preferences, etc.), all musicians have similar characteristics to other individuals of the same class (such as their musical training encompassing domain-specific knowledge).

2 - (Heidegger, 1966; Koutsomichalis, 2011). They are pure contingents in the environment that can not be quantitatively measured or evaluated: error or indeterminacy. The concept of *gelassenheit* (in a sound path Koutsomichalis, 2011) deals with the ability to describe the particular quality of a sound mass. A distinct set of conditions that only can be experienced subjectively.

artistic strategy encompassing a mix of musical composition and musical improvisation. The term comprovisation has no consensual definition and its origins can be traced back to the improvisatory proposals of the sixties - including but not limited to artistic groups such as the Scratch Orchestra or the ensemble Musica Elettronica Viva [Cardew, 1969; Curran and Teitelbaum, 1989]. Current comprovisational approaches are documented in: Fujak (2011), Hannan (2006), Bhagwati (2014), Dunes (2010) and Aliel et al. (2015/2016).

Aliel; Costa (2016) propose an ecological approach to comprovisation. Creative actions are carried out through *guideline plans* (composition) and *contingency plans* (improvisation) keeping a tight relationship between source materials and environment. The creative factor place [Rhodes, 1961] provides the milieu where actions, interactions, reactions and divergences occur. In comprovisation, the *guideline plans* establish rules of interaction that can not be changed (mass, form, condition, existence) of specific resources (such as a place, an individual, a procedure), while *contingency plans* work with volatile resources on the same level of content. Both plans are affected by the actions of the agents involved in the creative process. A recent example of a comprovisation study is SsS - *Sons sem Sino* [Aliel; Costa, 2016].

A close look at the model proposed by Sibertin-Blanc et al. unveils alignments and deviations from ecologically grounded models applied in music making [Di Scipio, 2014; Ferraz and Keller, 2014; Keller et al., 2014]. Figure 2 highlights the correspondences between both approaches. Eco-based models encompass resources (1), activities (2) and by-products (3). These elements are common to both models (despite minor differences in terminology). Resources are consumed during the execution of activities, thus yielding by-products (entities in Sibertin-Blanc´s nomenclature). A key contribution of eco-based practices is a raised awareness of the mutual relationships among agents behaviors and material resources. This is usually expressed by feedback paths linking the agents' actions and the environmental impacts. The implication being that resources are not just consumed, they are also produced by the agents. This feature is lacking in Sibertin-Blanc´s model. Furthermore, recent eco-based proposals have stressed the long-term impact of creative activities on the environment - most notably through the incorporation of sustainable support strategies. This is usually represented by a separation of three different types of by-products: creative products, new resources and creative waste. Creative waste encompasses by-products not incorporated in the final creative results [Ferraz and Keller, 2014]. Hence, these by-products may be used by the same stakeholders in other activities or by other agents through sharing. But the rejected outcomes also have the potential to accumulate, with harmful effects on the local environment.

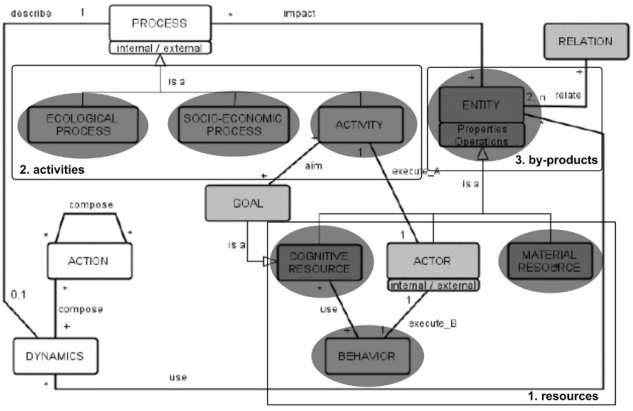

Figure 2. Establishing conceptual parallels between Sibertin-Blanc´s and coauthors´ model (2011) and the ecocompositional proposals (Keller, 1999; Keller and Capasso, 2006; Keller et al., 2014).

The use of the term *activity* proposed by Sibertin-Blanc can be questioned. The assumption that the agents' activities imply simple and clear goals corresponds to a problem-oriented view of social interactions (teleological - Keller et al. 2014). Creative activities encompass a large amount of actions that target the increase of knowledge of the resources at hand. No effective outcome can be achieved without a previous acquaintance with materials. These conditions are better described as exploratory or epistemic activity [Keller et al., 2014].

5. Case Study: The Maxwell Demon: Materials and Methods

5.1 Proposal

The Maxwell's Demon (TMD) is a comprovisation inspired by James Clerk Maxwell's 1871 experiment. In this experiment, the Maxwell Demon is an imaginary creature designed to contradict the second law of thermodynamics, the tendency of every system towards entropy. Maxwell's experiment can be represented as a box with a divider placed in the middle, separating it two compartments, left and right. This partition has a door that can be opened and closed by an imaginary being, called Maxwell's Demon. The demon opens the door to allow only the fastest molecules to flow to one side of the chamber. Only the slower molecules flow to the other side, gradually causing one side to warm up, while the other remains cool. Thus entropy is reduced. We use TMD as an artistic metaphor focused on sound (rather than thermodynamics) to simulate an imaginary being - in our case, a stochastic algorithm - that seeks to control the sonic outcome to increase or reduce its entropy. Conceptually, we treat stochastic algorithms as *Gelassenheit entities* [Heidegger, 1966; Koutsomichalis, 2011]. A Gelassenheit entity has an "independence" in time and space, its dynamics are established by stochastic processes.

5.2 Design/Implementation - Guidelines Plan and Contingency Plan

Materials/Equipments: We designed of a tool capable of producing sounds: 1) easy to manipulate; 2) accessible to all agents (through deployment on mobile platforms based on Android and IOS systems). All participants (musicians/non-musicians) were given a mobile phone with a *Pure Data* (PD) [Puckette, 1997] patch adapted for *MobMuPlat* [Iglesia, 2016]. The mobile screen features four rectangles that act as controllers of additive synthesis oscillators. Simultaneous control of up to four banks of oscillators is possible. Four FM synthesis oscillators feature control parameters for frequency, duration and delay. Random processes are controlled by tapping the phone's screen and can be turned on and off at any time. The frequencies vary from 220 Hertz to 1320 Hertz. Frequency increments are associated with gestures from left to right. Beside each rectangle there are three oscillators switches (on/off buttons) and two envelope controllers. One with a condition of attack, decay, sustain and release short and another with envelopes in longer conditions. The left button at the top of the screen controls a stochastic algorithm connected to all the oscillators frequencies. This triggers random changes in each oscillator. The remaining three buttons control delay processing of the sound material. From left to right, there are fixed delay rates of 150 ms., 300 ms. and 750 ms.

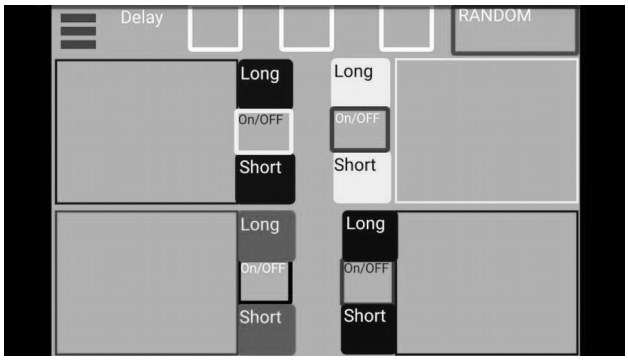

Figure 3. Interface of the The Maxwell Demon mobile patch.

The computer running the automated algorithm is connected to four loudspeakers. The loudspeakers were placed at the four corners of the studio where the performance/experiment[3] took place. The agents moved around the perimeter of the environment. We developed a patch (PD) that runs on a desktop computer with similar sonic features as the algorithms for the mobiles. Rather than being controlled by the participants, stochastic automated processes determine when and how sound events will occur. With the touch of the green start button, the entire performance/sound experiment occurs in an automated way. At the ringing of the bell begins the artistic narrative finalizes.

Sonic materials - We use an emulated bell (based on FM) that plays at the beginning of the

3 - Experiments developed to assess artistic results qualitatively or quantitatively.

performance/experiment and ends it when it is heard again. This sound is triggered by a PD patch. The entire performance takes seven minutes. All sound content that occurs between the ringing of the bells are contingencies resulting from interactions and sound discovery.

Location and participants - The experiment was performed in a small-sized studio, approximately 10x07 meters. Having Maxwell's procedures as inspiration, we use two types of agents, those with traditional knowledge of music and those with little or no knowledge. Participants included five musicians and two non-musicians. All participants had college education. Non-musicians possessed familiarity with basic musical concepts but had no formal training. Among the non-musicians, there were three women - ages 25, 32 and 35. The musicians were four men, ages 26 to 58 and one woman (22 years old). Music training and previous musical experience varied from 10 to 30 years.

Assessment - Data was collected through interviews with the participants, on site observations and analysis of audio and video recordings. The objective was to assess the interactions among the agents and how the resources are used, and to expose the behavioral effects of the socio-ecological system, including: 1) initial state of the entities; 2) internal process dynamics; 3) impact of external processes on entities. The integrated assessment of the scenarios is performed by analyzing the values of the indicators derived from the performance/experience process and from the final state of the entities.

Procedures - Procedurally, TMD is a comprovisation [Aliel et al, 2016]. Hence, we create a guideline plan and contingency plan to outline which events will be designed and tested (composed resources) and leave other aspects to occur in an unpredictable manner (improvised resources). The experiment adopts a socio-ecological approach where agents and algorithms relate sonically. The performance/experience is guided by the definition of scenarios [Sibertin-Blanc et al. 2011]. A performance/experiment is defined as a scenario featuring a free improvisation with cell phones lasting approximately seven minutes. The only guidelines given to the agents are: “move through space and use mobiles to produce sounds”. After ringing the first bell, the computer starts the pre-set parameters and selects the number of oscillators, pitches, dynamics, durations and delay processing.

6. Results of The Maxwell Demon Case Study

Contingencies - We consider interactions and behaviors leading to sound discovery as sources of contingencies. Much of the material produced in the TMD sessions was rarely repeated, providing conditions of low sonic pregnancy. The sounds produced by the algorithm were dynamically related to the actions of the agents. Nevertheless, a *Gelassenheit entity* produces sound content that may or may not be imitated by or contrasted with the outcomes produced directly by the agents. In this sense, this guideline seems to be analogous to Maxwell's imaginary entity.

Behaviors - The agents explored various material resources contained in the environment, generating new forms of interaction. Their mobility - in addition to the low dynamic range of the sounds produced by the mobile devices - provided a sonically dynamic and highly concentrated environment in which the focus of attention changed constantly.

Musical Expertise - Although there were disparities of musical knowledge among the agents, all showed similar technical ability while trying to produce sounds. We observed similarities in the three performances/experiments, involving intense agent interactions. The exchanges encompassed: algorithms x agents, agents x agents and agents x environmental resources.

Imitation - We observed that a large part of the interaction process was driven by imitation (a strategy pointed out by Mannis, 2014). Choices of processing types and dynamic changes of parameters were predominant. In general, there was a prevalence of imitation of processes suggested by musicians, but contents managed

by non-musicians were also present.

6.1 Implications of the Artistic Outcomes

Socio-ecological systems - By introducing ecologically grounded sound synthesis strategies in improvised contexts, we target unique conditions for each performance. The performance/experiment TMD thus integrates the electronic sound structures into socially dynamic forms of interaction, approaching the complexity of biophonic ecologies. When introducing an ecological synthesis model within a socio-ecological system, the sonic outcomes may follow deterministic rules (composition) or adopt strategies based on contingencies (improvisation). By adding resources such as sound synthesis and audio processing based upon the actions of agents within a sound ecology, we introduce material and cognitive resources that are characteristic of socio-ecological systems. Aligned with the comprovisation methodologies, the PESM features material resources that can be used as guidelines or contingency plans.

Exploratory behavior. The materials collected in previous case studies [Aliel et al, 2015a and 2015b] indicate that the generation, maintenance and disappearance of sound material in improvisatory ecological contexts is linked to imitative cognitive exchanges [Mannis, 2014], exploratory or epistemic activities [Keller et al., 2010] targeting an increased knowledge of material resources by the agents. These exchanges may be limited by the adaptability of the behaviors indicated by Sibertin-Blanc et al. (2011) (see introduction).

7. Final Considerations

Taking into account the socio-ecological system prerequisites, we elaborated a Proposal for Ecological Synthesis Model (PESM) based on Keller's (1999) notes. While expanding the range of ecocompositional applications, we highlighted the possibility of including improvisation in sonic ecologies. The PESM was applied in a case study called The Maxwell Demon. Three sessions were carried out with the objective of collecting information on the agents behaviors, the sonic resources and the technological support. These observations yielded proposals applicable to ecologically grounded artistic works that target both musicians and non-musicians. Future studies may evaluate the actions of the agents while attempting to deal with unpredictable conditions, such as those found in alternative and outdoor venues.

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