Ecologically grounded multimodal design:
The Palafito 1.0 study

Damián Keller

NAP, Federal University of Acre
`dkeller@ccrma.stanford.edu`

Joseph Timoney

National Universiy of Ireland, Maynooth
`joseph.timoney@nuim.ie`

Leandro L. Costalonga

Federal Universoty of Espirito Santo
`leandro.costalonga@ufes.br`

Ariadna Capasso

Independent Artist, NY, USA
`ariadna102@hotmail.com`

Patricia Tinajero

Independent Artist, Quito, Ecuador
`ptinajer@gmail.com`

Victor Lazzarini
National Universiy of Ireland, Maynooth
`victor.lazzarini@nuim.ie`

Marcelo Soares Pimenta
Federal University of Rio Grande do Sul
`mpimenta@inf.ufrgs.br`

Maria Helena de Lima
Federal University of Rio Grande do Sul
`helena.lima@ufrgs.br`

Marcelo Johann
Federal University of Rio Grande do Sul
`johann@inf.ufrgs.br`

ABSTRACT

We present results of a ten-month design study targeting the observation of creative artistic practice by a video-artist, a sculptor and a composer. The study yielded the multimedia installation Palafito/Palafita/Home-on-stilts 1.0, featuring 19:30 minutes of sonic material and video footage, and three 5x8x3-meter raw-wood sculptures. This paper focuses on the procedural dimensions of the asynchronous, ubiquitous group activities carried out by the three subjects through light-weight, off-the-shelf infrastructure. Data was extracted from a virtual forum and a file repository. The analysis of the creative exchange indicated cycles of activity alternating between reflection, exploratory action and product-oriented action. The participants were engaged in reflective activities 63% of the time, epistemic activities spanned 33% of the study and product-oriented activities accounted for only 4% of the creative design cycle. Dialogic activities did not follow a regular pattern, but a relationship between enactive and dialogic activities was observed. We discuss the implications of these results for embedded-embodied approaches to sound art.

1. INTRODUCTION

Late 1990s creative music practice research has shown several methodological and conceptual problems that point to a need of renewed paradigms. With the progressive dismissal of purely formalist approaches to music making, the existing theoretical tools show limitations [37, 46]. Feldman's (2000) critical metaphor of the 'composerly hand' summarizes a general trend toward reliance on extra-musical processes (computational tools, environmental sounds, extra-musical media, audience participation) that erode the image of the isolated composer creating music just 'in the head' [58]. In this paper we argue that ecologically grounded frameworks may provide the necessary theoretical tools to deal with ubiquitous musical phenomena. We present data produced through a multi-

modal creativity-centered design study that features ecologically grounded techniques as the main procedural strategy. First, we provide a summary of contributions of the embedded-embodied approaches to music making. The increased participation of non-musicians in creative activities and the enhanced role of place as key creative factors underline the need of renewed design methods. Part of this gap is addressed by the methodological advances in creativity-centered design summarized in the second section of the paper. We describe a ten-month case study involving three artists-participants collaborating remotely through off-the-shelf, lightweight infrastructure. The last section places the results of the study within the context of current efforts in embedded-embodied approaches to creative sound art.

2. ECOLOGICALLY GROUNDED CREATIVE PRACTICE

Ecologically grounded creative practices entered the music arena through two initiatives: one targeting musical analysis and the other composition. Through an acute and highly critical essay, Windsor (1995) brought several ecological concepts into the realm of musical analysis. His proposal – although tuned to the demands of studio-centered electroacoustic practice – highlighted the close affinity between sound art practices and ecologically oriented theoretical efforts. His proposal attempted to establish a bridge between the concept of affordance and the triadic representational model proposed by Peirce (1991), arguing for a sign-oriented reinterpretation of affordances. Working independently from a complementary perspective, Keller and Truax (1998) proposed a Gibsonean approach to music making. Ecologically grounded synthesis techniques were presented as a proof of concept of the applicability of the embedded-embodied approach to cognition within the context of creative music making. Two ecologically grounded works featured examples of natural synthetic textures and real-world synthetic events: *"... soretes de punta."* [27] – see Basanta (2010) for a thorough analysis of this piece – and *touch'n'go* [29]. Both Windsor (1995) and Keller (1999a; 2000) provided an initial coverage of an experimental literature that was scattered across disciplines in psychoacoustics, biology, robotics, human-computer interaction and cognitive sci-

ence. These research efforts fostered a surge of ecologically oriented artistic and theoretical developments during the following decade.

Windsor's (1995) and Keller's (1999a; 2000) works had two different objectives. Windsor's objective was to produce perceptually based analytical tools that could provide groundings for descriptive theories of musical phenomena. Keller strived for a creative practice supported by perceptually sound methods and theories. While one was interested in the study of compositional results that were not contemplated by the extant musical theories, the other searched for compositional techniques that could deal with musical phenomena encompassing mundane experiences with sound. Their results were convergent. They concluded that embodied-embedded approaches to music would need to tackle: (1) everyday sonic experiences forming the basis of musical experiences; (2) socially embedded musical phenomena, as opposed to autonomous, self-referential 'sound objects'; (3) sound events, as high-level units resulting from interactions between agents and objects; (4) affordances, or the opportunities and constraints that arise from processes of mutual adaptation between agents and objects.

Despite their convergent conclusions, Keller's and Windsor's theoretical efforts faced the same brick wall encountered by the embedded-embodied approach to general cognition. It was already clear that musical phenomena were socially grounded, but ecological psychology did not provide conceptual tools to handle processes that depended on off-line knowledge and socially based meaning. Keller (2000) resorted to the soundscape concept of referentiality [54], but soon moved toward a more specific version of individual experience adopting the notion of a personal environment or personal sense [34]. Windsor (1995) employed semiotics. The semiotic view, rooted in the tradition of disembodied linguistic studies, suggests that experiences can be reduced to syntactical abstract relationships detached from everyday experience. As Windsor commented at the time, the semiotic perspective holds that meaning is determined by a system of dual relationships encompassing signifiers and signifieds, as opposed to message decodification or actual experiences in the world. Since meaning demands a constant process of translation between experiences and cultural codes, material objects and environmental events become just signs which stand for something else. Ecologically grounded criticisms have been targeted at this kind of representationalist perspective [9, 10, 55, 57]. In Gibson's (1979:253) own words, "knowledge of the world cannot be explained by supposing that knowledge of the world already exists." If natural affordances are the result of mutual adaptations between agents and objects, the proposition that signs provide an intermediate layer between agents and objects is difficult to support. This is the key difference between the ecocompositional theoretical framework and the semiotic perspectives. In the former, agent-object interactions provide the necessary grounding for sonic affordances. Contrastingly, semiotics-based approaches resort to signs as the basic mechanisms for sonic meaning formation.

After Windsor's and Keller's initial proposals, several artists embraced embedded-embodied cognition as a conceptual and methodological basis for their creative practice. Matthew Burtner (2005; 2011) realized a number of compositional experiences involving field recordings and interactive techniques. As a reference to early perceptual research, he labeled his work 'ecoacoustics.' Agostino Di Scipio (2002) expanded the palette of synthesis techniques by applying iterated functions to produce natural textures. His compositional work *Audible Ecosystemics* [17] featured the use of space as a key parameter for real-time creative practices. Natasha Barrett (2000) and Tim Opie proposed techniques for gathering acoustic field data produced by animals and physical agents [49]. Barrett's compositional work included the use and implementation of spatialization techniques based on ambisonics. Davis (2008) and Basanta (2010) adopted ecologically oriented approaches to increase the participatory appeal of their sonic installations. And Nance (2007) and Lockhart introduced ecologically grounded practices into the realm of instrumental composition [45].

A common denominator of embedded-embodied musical creative practices is the close integration of sound processes shaped after natural phenomena with perceptual and/or social factors wrought by everyday experience. The ecocompositional paradigm that has emerged from the multiple creative projects realized since 1997 encompasses two strategies: (1) the construction of a theoretical framework for creative practices supported by embedded-embodied cognitive mechanisms [28, 30, 32, 34, 35]; and (2) the concurrent development of design techniques coherent with this theoretical scaffolding, featuring participation and emergence as the two central creative driving forces [22, 33, 38, 44, 47, 51]. The study described in the second part of this paper deals with the former set of issues, highlighting the social dynamics of the procedural dimension within ecocompositional practice.

As Windsor stated in 1995, prescriptive musical theories such as Schaeffer's (1977) and Boulez's (1986) will eventually be replaced by descriptive and predictive theoretical endeavors. Ecologically grounded musical analysis falls into the first category and sonic ecocomposition fills the second gap. Although these approaches do not make aesthetic assumptions or impose creative restrictions, they can be characterized in simple terms. As suggested by Keller (1999a), ecologically valid sound is a by-product of situated social activity: its ecological validity can be defined by the observation and realization of interactions in everyday settings. The action of the individual on the environment and the influence of the environment on the individual determine a process of mutual adaptation, yielding specific affordances. This process can be modeled through algorithmic tools, providing support for ecologically constrained creative sonic outcomes.

3. DESIGNING SUPPORT FOR CREATIVE MUSICAL ACTIVITIES

Despite the increasing number of creative projects that adopt ecologically grounded methods, the procedural implications of this initiative remain unclear. Burtner (2011) mentions 'impracticality' as a key factor shaping the ecocompositional experience. Providing further support for the concepts of attunement and structural coupling [28], Burtner's outdoor musical experiences do not seek just to gather 'samples' but to allow for creative links to emerge from the participant's personal knowledge and the local environmental context. His work highlights the need for effective collaborative tools for music making in the field, resonating with the methodological issues pointed out by Barreiro and Keller (2010), and by Keller and coauthors (2010; 2011a). What seem to be absent from ecologically grounded creative practices are effective design procedures.

Recent approaches to design provide interesting complements to the issues explored in ecologically grounded artistic research. Liikkanen and coauthors (2011) argue for the adoption of practice-based design methods focused on creativity. Their proposal is situated within the Participatory Design initiative, integrating users as co-designers [19]. On a similar vein, Botero et al. (2010) propose the exploration of a continuum from use to creation involving strategies such as repurposing of existing technology for rapid prototyping. A central aspect of this emerging trend is the focus on creativity and sustainability allied to the adoption of participatory techniques. Two recent studies carried out by the Ubiquitous Music Group applied a creativity-centered design approach [44]. These studies helped to identify a methodological gap in the development of procedural support for creativity, namely, the lack of time-based methods to study long-term creative musical practice. The following section provides a description of the first study to address this gap.

4. PALAFITO 1.0: A MULTIMODAL DESIGN STUDY

4.1. Subjects

The participants were two females – a video-artist and a sculptor – and a male composer. The three subjects were experts in their respective fields but only the composer had formal training in music. The choice of researcher-artists familiar with ecologically grounded methods is warranted by the exploratory nature of the study. As noted by Shneiderman and Plaisant (2006), Eaglestone et al. (2008) and Collins (2005; 2012), long-term studies with experts provide detailed information on creative methods. A long-term creative project may provide insights on aspects of creative practice that have not been addressed from an embedded-embodied perspective.

4.3. Settings and materials

The design study avoided the introduction of disruptive environmental factors by adopting the artists' usual working settings.

Audiovisual source materials were gathered by the authors through an ecocompositional journey that encompassed several locations in the Ecuadorean and Peruvian Amazon tropical forest [31]. These raw materials served as anchors [33], for the elaboration of the sculptural, visual, and sonic elements utilized in the piece. The experience of the journey provided the social grounding for the conceptual relationships later developed in the sounds, the visuals and the text of the piece [8].

Technological support was incorporated through cycles of demand-trial-assessment. *Early domain restriction*, i.e. the focus on isolated aspects of tool usage precluding broader conceptions of creativity support [39], was avoided by embracing a parsimonious approach to the adoption of new information technology objects. Priority was given to repurposing of existing resources as opposed to development from scratch [4, 22, 56].

4.4. Procedures

During a ten-month period, the three subjects' creative activities were monitored using two tools: a virtual forum and a file-exchange repository. Creative exchanges encompassed three types of activity: argumentation [51] (a form of dialogic activity involving verbal exchanges) and epistemic and enactive activities [33]. Argumentation was done mostly through asynchronous dialogues (only two encounters were carried through video-conference).

Epistemic activity encompassed the exchange of textual, visual and sonic materials. This form of dialogue was complementary to the process of argumentation and served to materialize the concepts being considered. Enactive activity involved the exchange of material that was intended to be part of the work. Therefore, only the materials that were approved through an argumentation cycle of proposals and commitments and that were labeled as acceptable creative products by at least one of the artists were considered to be the outcomes of enactive activity.

For the purpose of analysis three types of resource transfers were considered: (1) proposals – concepts and materials that were not previously explicitly stated within the domain of the creative work; (2) commitments – explicit approval of proposals ensuing incorporation of new procedures or products; (3) rejections – explicit exclusion of proposals from the creative epistemic space.

4.5. Results

This section provides information on two aspects of the study. First we present a short description of the creative product, complemented by the audiovisual material ap-

pended to the paper. Then we summarize the behavioral data obtained through ten months of daily observations.

4.5.1. Creative product results

The study yielded the multimedia installation Palafito/Palafita/Home-on-stilts. Its first exhibit was held at the Floor4Art venue in Manhattan, New York (Floor4Art 2012). The exhibit took place during the month of November 2012 and ended with a closing gathering on December 1. The second exhibit took place in Denver, CO, USA, at the Museum of the Americas from June to September 2013.

The sculpture featured three 5x8x3-meter metal and wood vertical structures hanging from the ceiling and placed on the floor of the installation space (see figure 1). Three audiovisual tracks, lasting 6:30 minutes each, were played as loops on two stereo and one mono playback modules. The single-track module consisted of a DVD-player and a directional speaker (house 3). The speaker was attached to the ceiling, pointing straight downwards, and the sound beam was adjusted to span a radius of approximately one meter, creating an isolated sound field. The video footage was displayed on a 10" LCD screen. The two stereo modules featured video projectors attached to the ceiling, facing opposite walls (houses 1 and 2). Two DVD-players sent audio to two sets of speakers hanging from the walls at a height of 2.5 meters, matching the locations of the projected videos (figure 1).

The layout of the installation was designed to allow the visitors to walk freely within the gallery space. Consistently with other ecologically grounded creative endeavors [36], the actions of the visitors were considered a central component of the artwork experience. Depending on the locations of the participants, different combinations of visual and sonic content were available. The house 1 module defined a sound field constrained to the sound beam area. Thus, the listeners had to be standing in front of the module to access the sounds. The sound fields corresponding to house 2 and 3 were audible throughout the gallery space. But given different distances from the sources, visitors were free to design their own mixes by exploring the multiple perspectives afforded by the space (figure 1).
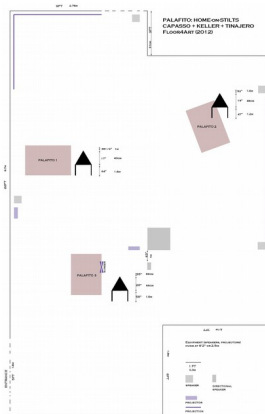

Figure 1. Plan of the Palafito 1.0 installation at Floor4Art Gallery. Social interaction is afforded by the installation space.

4.5.2. Creative activity results

The data analyzed in this section comes from two sources: (1) a virtual forum where the three artists exchanged ideas while developing the work (these exchanges took the form of text messages and pictures); (2) a file-exchange repository which served to gather audiovisual materials, creative support surrogates (temporal maps and low-resolution video footage), creative products and technical information consisting of plans, pictures of designs and equipment specifications.

The data extracted from the virtual forum included: a time stamp, the name of the contributor, and the content of the message. The data retrieved from the file repository encompassed: a time stamp, the name of the contributor, the name of the resource, the type of resource (either material, c-surrogate or product) and the operation applied (upload, download, move or rename). Data was formatted as tabulated text files and irrelevant entries were removed. The following selection criteria were applied: (1) only proposals, commitments and rejections were included in the argumentation database; (2) only uploads of materials, surrogates or products were added to the activity database.
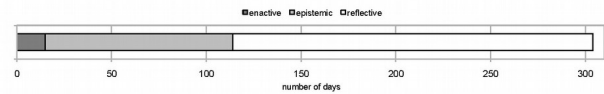

Figure 2. Overall performance: comparison of time devoted to enactive (dark gray), epistemic (gray) and reflective activities (white).

Adopting the definitions provided in the previous section, we can analyze the data to gather an overall profile of the activities realized during the creative process. The first 190 days encompass reflective activities, i. e., activities that focused on the exchange of concepts but had no material counterparts. Epistemic activities involved trading creative surrogates and materials. These activities lasted 99 days. The remaining 15 days were dedicated to enactive activities featuring the elaboration and sharing of creative products.
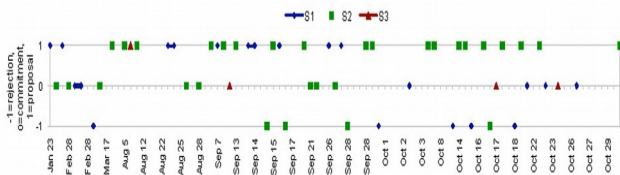
4.5.3. Dialogic activity

We define dialogic activity as the exchange among agents within the context of creative activity. This study focused on one form of dialogic activity: argumentation [51]. For the purposes of analysis we established three categories of argumentation: proposals – exchanges that point to new processes or products within the epistemic space; rejections – exchanges that exclude proposals from the epistemic space; commitments – exchanges that introduce proposals within the epistemic space.
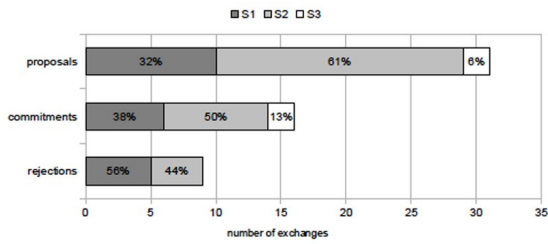
Figure 3. Percentage and number of exchanges during dialogic activity, subject 1 (dark gray), subject 2 (light gray) and subject 3 (white). The quantities represent the number of text exchanges shared. Three types of argumentations were included: proposals, rejections and commitments.

Figure 3 summarizes the number and the type of dialogic exchanges that took place between January 23 and October 31 2012. Most exchanges were proposals, followed by commitments and rejections. It is interesting to observe the dialogic activity profile of each subject to get a sense of her type of engagement in the argumentation process. Subject 2's commitments were slightly more than subject 1's (50% vs. 38%). Subject 1's percentage of rejections was slightly larger (56% vs. 44%). The sharpest difference corresponded to the percentage of proposals: subject 2's share almost doubled subject 1's share (32% vs. 61%).


Figure 4. Temporal series of the dialogic activity. Dots indicate textual exchanges in the virtual forum. Blue dots correspond to messages by subject 1, green dots to subject 2's data and red dots to subject 3's contributions. Blank spaces indicate exchanges that did not configure argumentation. Three types of exchanges were considered: proposals (labeled 1), commitments (indicated by 0) and rejections (represented by -1 on the vertical axis).

Figure 4 displays the dialogic activity as a temporal series. Dots stand for textual exchanges in the virtual forum. Blue dots are the contributions by subject 1, green dots are subject 2's and red dots are subject 3's. Blank dates indicate exchanges that did not configure argumentation - i.e., that did not yield creative decisions - including explanations and commentaries. The three types of exchanges considered were: rejections (represented by a -1 on the vertical axis), commitments (indicated by a 0 on the graph) and proposals (labeled 1). Although we can observe a tendency to alternate between categories – one or two proposals are followed by one or two commitments or by one rejection – this trend only lasts until October 4 (when enactive activity starts). At that point, a new pattern is set: subject 1 almost exclusively exchanges proposals and subject 2 alternates between commitments and rejections.
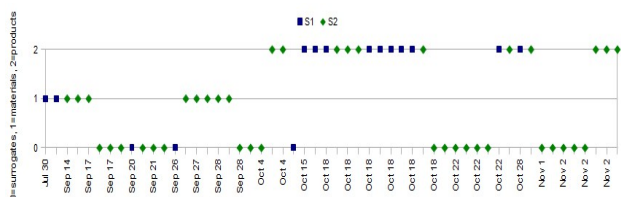
4.5.4. Epistemic and enactive activities

Epistemic activities are characterized by the exchange of creative surrogates (c-surrogates) and materials. We define c-surrogates as the externalization of concepts by means of information technology objects. C-surrogates and materials differ in their function. Materials are intended to be part of the creative product. C-surrogates are just scaffolds for conceptualizing the creative process. They are easy-to-handle replacements for materials or processes [11] and can be characterized as one type of creative by-products. Their purpose is to serve as proxies for the exchange of information during creative activities. C-surrogates may be pictures, sounds, text descriptions or software that depict procedural relationships among materials or processes. During the design of Palafito 1.0, we repurposed Calc/Open Office spreadsheets as proxies for audiovisual media. While highly compressed thirteen-minutes worth of media would demand a transmission of approximately 30 megabytes of data, the equivalent c-surrogates would not take more than 1.5 megabytes. But more importantly, c-surrogates could be easily editable and immediately shareable, while actual media demanded a lengthy process of compression to enable exchanges through the network.
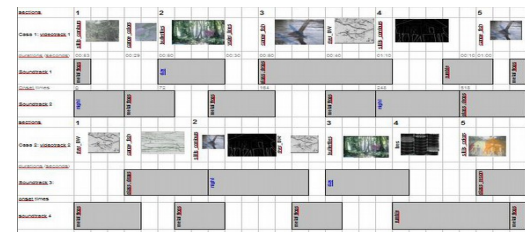

Figure 5. An example of a c-surrogate used during the creative process of Palafito 1.0. Rectangles indicate video and audio materials. Tracks are organized vertically and the horizontal axis corresponds to time. This c-surrogate was done by repurposing a Calc/Open Office spreadsheet.

Enactive activities involve the exchange of creative products. They can be understood as the creative counterparts of Kirsh and Maglio's (1994) pragmatic activities, i.e. actions that have the objective of modifying the material environment. Within the context of creative music making, the most prominent (but not exclusive) product of enactive activities is sound. Therefore, creative products are directly tied to enactive activities. As previously discussed, ecologically grounded creative practices emphasize the connections between body actions and environmental features to enable opportunities for creative action. As a consequence, enactive activities result in creative products which are inextricably linked to everyday experience.

Figure 6. Time series plot of resource exchanges between subject 1 and subject 2. Repeated dates indicate several exchanges occurring on a single day. Three elements were considered: material resources (0 label on vertical axis), creative surrogates (labeled 1) and creative products (labeled 2). Epistemic activities are characterized by the exchange of c-surrogates (represented by 0 on the vertical axis) and materials (represented by 1). Enactive activities involve the exchange of finished products (labeled 2 on the vertical axis). Blue dots stand for the resources shared by subject 1, green dots stand for subject 2's contributions.

A time series plot of exchanges of c-surrogates, materials and products provides information on the duration of epistemic and enactive activities (figure 6). Blue dots stand for resources shared by subject 1 and green dots stand for subject 2's contributions. Within Palafito 1.0's design cycle, epistemic exchanges lasted a period of 99 days while enactive activities were limited to 15 days. Interactions occurred as exchange cycles of c-surrogates, materials or products, each cycle lasting from 1 to 6 days.
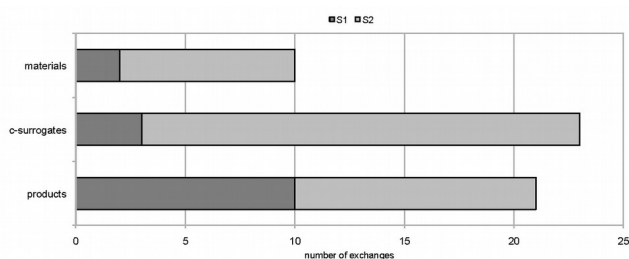
Figure 7. Summary of resource exchanges between subject 1 (gray) and subject 2 (light gray). The quantities represent the number of resources shared. Three types of resources were considered for analytical purposes: materials, c-surrogates and products.

A summary of the number of exchanges during epistemic and enactive activities shows that less than half of the enactive activities involved exchange of materials (figure 7). Most actions were either exchanges of c-surrogates or exchanges of creative products. Product sharing was balanced, but most of the c-surrogate proposals were initiated by subject 2 (87%). A complementary analysis comparing each artist's exchange profile shows sharp individual differences. While subjects 1's contributions were mostly products (67%), subject 2's sharings featured 51% of c-surrogates. For subject 2, products (28%) were less prominent than c-surrogates. The only similarity among the two subjects' performances was the little importance given to materials (13% for subject 1 and 21% for subject 2). C-surrogates accounted for 20% of subject 1's contributions.

5. CONCLUSIONS

The sharp differences in duration between reflective, epistemic and enactive activities observed in this study provide support for the proposal that off-line cognitive resources may play an important role in shaping creative action. These results provide useful guidelines for design. According to Ron Wakkary (2005), design for reflection should emphasize situated participation, non-rational design strategies, *in situ* design and a reorientation in focus from tasks to experience.

The temporal patterns observed in epistemic and enactive activities support the notion that potentials and resources interact defining the yield of creative processes and products. Both subjects' epistemic and enactive activities can be characterized by cycles lasting from 1 to 6 days. Dialogic activities did not follow the same pattern. Therefore, this study indicates that the mechanisms that drive epistemic and enactive activities are not necessarily applicable to social interactions in creative contexts. Another observation drawn from the temporal data of the three types of activity is a linear decrease from reflective to epistemic activity durations and from epistemic to enactive activity durations.

This report focused on the procedural dimensions of the asynchronous, ubiquitous group activities carried out by the three subjects through light-weight, off-the-shelf infrastructure. One of the objectives of the exploratory study was to devise methods for data collection on the creativity factors related to the exchange of ideas and materials. An ecologically grounded perspective - rooted on fifteen years of creative musical practice - was adopted [30]. The analysis of the social and material exchanges yielded four activity categories involving reflective actions, epistemic actions, enactive actions and dialogic actions. Alternating cycles of reflective, epistemic and enactive activities were observed. Dialogic activities only presented a regular pattern during the period that coincided with enactive activities. The results highlight the potential of the embedded-embodied frameworks for the study of creative sonic practice, summing to the growing number of proposals in this field.

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