Music Creation by Novices should be both Prototypical and Cooperative - Lessons Learned from CODES

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Abstract. *Musical creation is usually considered as mostly a solitary activity done by composers but we are convinced that CODES - a Web-based environment designed to support Cooperative Music Prototyping (CMP) - offers great contributions to social ways of music creation by novices. One of the main findings obtained during CODES development and usage is that systems aiming at providing effective support to such music creation activities by novices should meet specific requirements, in order to support a dynamic and creative environment, enabling knowledge sharing by means of rich interaction and cooperative mechanisms adapted to address the idiosyncrasies of this CMP context. The goal of this paper is to present, discuss and illustrate these prototypical and cooperative aspects of novice-oriented music creation activities in CODES.*

1. Introduction

> *"The first question I ask myself when something doesn't seem to be beautiful is why do I think it's not beautiful". – John Cage.*

Music has been described as a social activity in which we share a musical experience [Gurevich, 2006]. Clearly, technology has created new social modalities for music listening, but we are convinced that technology also offers great contributions to social ways of music creation.

Musical composition is a complex activity where there is no agreement about which activities have to be performed and in which sequence: each person (composer or not) has a unique style and way of working. As a consequence, most of composers have not developed yet the tradition of sharing their musical ideas and collaborating while composing and thus composing is considered as mostly a solitary activity done by composers. Music creation is a *design activity*: the design of (new) sounds and/or the design of (new) combinations of (existing) sounds, forming (new) sound sequences or simple musical pieces. However, novices in music (here called *novices*) do not have enough knowledge and confidence to create music by themselves: usually they do not have access to musical

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instrument and do not know how to play them, neither how to represent music using traditional notations. Indeed, novices in music need effective interactive support to cooperate with each other for producing music, instead of only consuming it.

Even presenting some constraints as for sound information traffic, the Web is becoming increasingly attractive as a platform to support both social activities and music making [Iazzetta and Kon, 1998]. For example, today YouTube [Google, 2009] and other social Web services, such as MySpace [Media, 2009] and Flickr [Yahoo, 2009], have improved the interaction between users and systems over the Web, and users are getting used to new purposes, like engagement and self-expression. In fact, Web 2.0 has turned the passive user into an active producer of content and shaper of the ultimate user experience, and the Web is becoming a rich and ideal environment for social activities.

CODES is a Web-based environment designed to support Cooperative Music Prototyping (CMP), with special focus on novices in music. But, differently from YouTube, Flickr, and even MySpace, where people only publish their content, Web systems for experimenting with music should also provide ways to create contributions and experiments. For this reason, we consider CODES as a system for *music creation*, instead of a system just for publishing music. CODES offers a high level music representation and user interface features to allow easy direct manipulation (drag-and-drop) of icons representing sound patterns.

The main motivation of our work is the belief that no previous musical knowledge should be required to any ordinary user for participating in any experiment of music creation. Of course, it is not a matter of musical quality of the finished work, but the mere possibility of "creating it". Clearly, novices are not composers but we assume that they may be able to do musical creative work if they have an adequate support.

In this paper we present two very important principles, learned and confirmed by findings obtained during CODES development and usage, to be considered when providing such support to novice-oriented music creation activities: a) Music creation by novices should be prototypical; and b) Music creation by novices should be cooperative.

A prototypical music creation process means novices can draft simple musical pieces - we call them *Musical Prototypes (MPs)* in order to highlight the difference - which can be tested, modified, and repeatedly listened to, in a cyclical refinement of initial musical sketch until a final stage being reached. This process clearly resembles prototyping cycles adopted in industry and in incremental software development. Since music creation is in fact a (music) design activity, it seems natural and straightforward to adopt a prototypical process. In the music literature, "draft" is commonly applied to such kind of creative work, but here the emphasis is focused on the cyclical prototyping process and not on the product itself, and consequently in this paper "prototype" and "draft" correspond to the same idea.

In a cooperative music creation process, the refinement of an initial musical idea is consequence of a collaboration of the author(s) of initial musical idea and of their partners, all members of a group (in fact, a social network built by explicit invitation) that will be cooperating until a final consensual stage of MP be reached. This process is noticeably a particular kind of Human Centered Collaborative Design where the result of design is a MP.

Through the prototypical and cooperative nature of CODES, novices may thus have the opportunity to be, like experienced musicians are, the actors of their own musical experiences. It implies new requirements that should be taken into account when we consider these novices as a new user profile: the Web composers [Miletto et al., 2009],

e.g., someone actively participating in a CMP.

The goal of this paper is to discuss the prototypical and cooperative aspects of music creation activities in CODES, focusing on presenting and illustrating its features designed specially for novices in music.

The paper is structured as follows. The next section resumes how CODES made music creation possible by novices in music. In Sections 3 and 4, we discuss the reasons why novice-oriented music environments should be prototypical and cooperative, respectively. Section 5 presents the particular viewpoint of the cooperative activities in CODES. An evaluation showing what actual novice users are saying about CODES, along with the results of our experimental work is presented in Section 6. Finally, in Section 7 are the conclusion and final remarks of this paper.

2. Music Creation by novices: how CODES made it possible?

CODES - COoperative Music Prototype DESign, is a Web-based environment for cooperative musical prototyping that aims at allowing novice users to experiment with music and interact with each other in order to create musical prototypes.

To make it possible, CODES enables novices users to perform four main tasks in a high level of interaction. Such tasks include *creating*, *editing*, *sharing*, and *publishing* musical prototypes. Users can create a new MP by clicking in this option (see Figure 1. a), choosing its name, and optionally its musical style. Since all the styles are available at the sound library, mixing sound patterns from different styles in the same MP is possible.
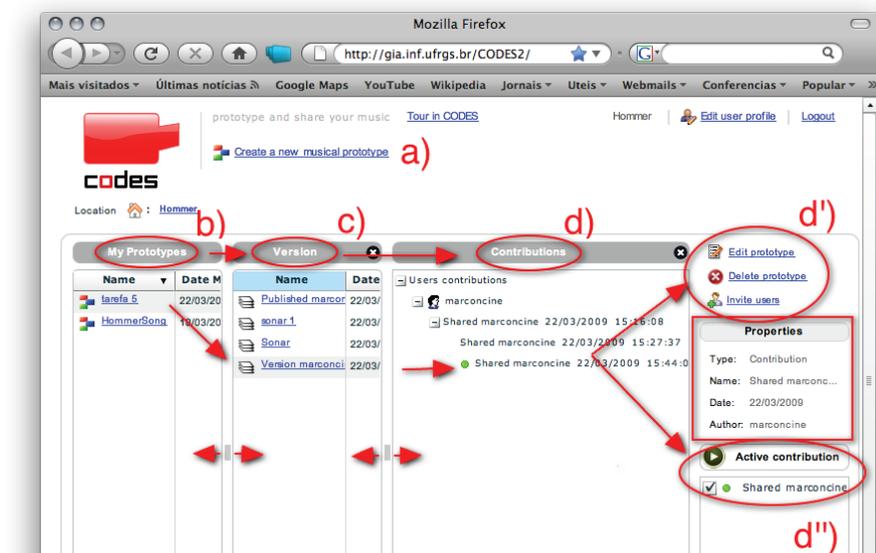

Figure 1: Excerpt of the screen which list the users' musical prototypes

Figure 1 shows how CODES organizes the users prototypes list. Users can see their MP information in a kind of hierarchical structure by clicking in one of the list (Figure 1.b). Each MP can have one or several versions (Figure 1.c), which also can have one or several contributions (Figure 1.d). Such contributions can be selected and combined to be listened to (Figure 1.d") or edited (Figure 1.d').

Edition in CODES includes actions of manipulation of sound patterns from the sound library to the editing area, such as "drag-and-drop", "delete", and "expand" the duration to listen to the final result. See a screenshot of the CODES editing level in Figure 4.

For sharing a musical prototype, the user "owner" can invite CODES users using a search engine or sending explicit invitations by e-mail to non-members and asking them for cooperation as illustrates the Figure 2. When someone accepts such an invitation, this user becomes a prototype partner and can edit it like the owner does.

At any time users can listen to the musical prototype and link arguments to their decisions, in a similar structure of a design rationale. Thus, all prototypes' partners can discuss and share ideas about each step of the prototype refinement, in order to understand someone else's decisions.
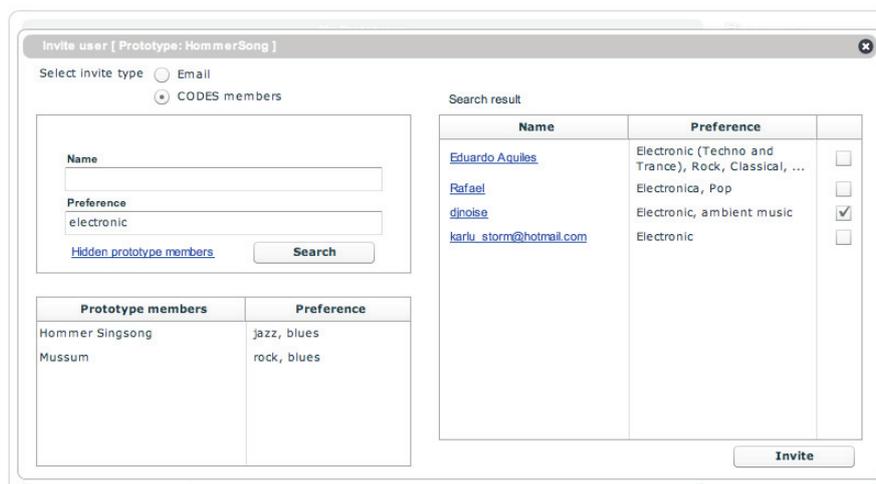

Figure 2: Screenshot of CODES inviting window

When someone considers the result sounds good, a "publication request" can be triggered and the group may discuss and deliberate about the publication of this musical prototype in the CODES home page. This activity is named *musical prototype publishing*. As an alternative to publishing their music, users may export (download) their musical prototype in an MP3 file format and share it as they want.

Throughout the design of CODES, we sought to emphasize two principles which summarize the lessons learned so far, emerged during CODES development and confirmed by evaluations of CODES users in actual usage, to be considered when providing support to novice-oriented music creation activities : a) It should be prototypical; and b) It should be cooperative. We chose to explore these principles because they have received little explicit attention within the networked music domain, mainly in a novice-oriented perspective. We will discuss these principles more deeply in the following sections, also presenting and illustrating how CODES takes them in account.

3. Novice-oriented music environments should be prototypical

Like Weinberg [Weinberg, 2002], we are interested in providing specially to novices an access to meaningful and engaging musical experiences. In CODES musical prototyping process MPs are repeatedly tested, listened to, and modified by their first author and their online partners, until their final forms are reached. Like any other design-related prototyping process, CODES music prototyping process is iterative, incremental and evolutionary, since an initial musical idea (first version of a MP) is produced and refined through a number of stages up to the final version. Moreover, this refinement help users to discover, validate, or derive new musical ideas from their initial musical ideas. We believe this prototyping process is one of the most interesting aspects by using CODES. It enables actual creation and experimentation (hearing) of musical ideas, by means of

the rich interaction mechanisms - designed to improve user engagement with the system - associated to each prototype edition and modification.

In order to create a new prototype using CODES, user needs only to select pre-existing sound patterns from a sound library and group them in an arbitrary way (i.e where and how the user wants). Before selecting a sound pattern, the user can play it to check if it is the right choice. The user can edit (inserting, removing, resizing, changing order of sound patterns) and also play the MP at any time as desired (the sounds displayed in the editing area are played from left to right), in a dynamic and interactive way. The freedom for the MP manipulation and experimentation is a basis for a successful music prototyping process. Indeed, as our intention was to design a musical environment where such music prototyping process seems natural to users and the support provided to such process could be considered useful and usable mainly for novices, CODES interaction design was approached from an HCI perspective.

In an HCI perspective, any design should start by a study aiming at identifying and knowing the users, their goals and what tasks they need to perform to achieve them. Since the target user group is composed by novices in music, it is very difficult to define clearly goals and tasks based on existing software applications for music creation. Indeed, most of them and their user interfaces features are only suitable for musicians, not for novices.

First of all, musicians know music theory. They know how to read scores, the traditional music notation with its staff, and musical symbols. Moreover, they know these symbols refer to concepts like notes, rests, and tonalities - a novice may not even know what these musical concepts are all about! Even alternative notations (like tablature) contain alternative symbols for the same concepts, and the problem remains: these concepts are not part of a novices' world. Notation is a hard and non-intuitive concept for any novice to learn. In addition, musicians also have theoretical and practical knowledge about musical instruments, have access to them, and know the technical issues related to how to play them.

As a consequence, usual music software often relies on traditional music representations and on metaphors from a musician's experience. The MIDI protocol itself, which is designed to interconnect digital musical instruments and computers, is based upon "musical performance event", like keys being pressed, changes in timbre and in tonality, tempo changes, etc. Even some more recent interaction styles (like for example the style adopted by IRCAM's Max/MSP [Cycling74, 2009]) are metaphors of something musicians are used to do, requiring experienced musician's knowledge and vocabulary, and they are consequently inadequate for novices.

Since we did not have similar environments to use as a basis, we have adopted an incremental and iterative design approach: to identify novices' needs, to design and fit the system to the users and their needs, to evaluate the design and use the evaluation result as a feedback to iterate until a good design can be achieved. The prototyping process resulting is cyclic and the interaction provided to novices is simple but rich. For example, to edit a MP in CODES is a very simple task: sound patterns are dragged from the sound library - always visible, and dropped into the MP editing area.

The CODES user interface has three main levels of interaction for different user profiles: a) Public Level, b) Musical Prototype Editing Level, and c) Sound Pattern Editing Level (see Figure 3 for an excerpt of the screens representing each of the levels).

Basically, the two different user roles are CODES *members* (registered users) and *non-members* (general public, non-registered visitors). The non-members are typically the Web users which can access the CODES home page shown in Figure 3.a) and listen
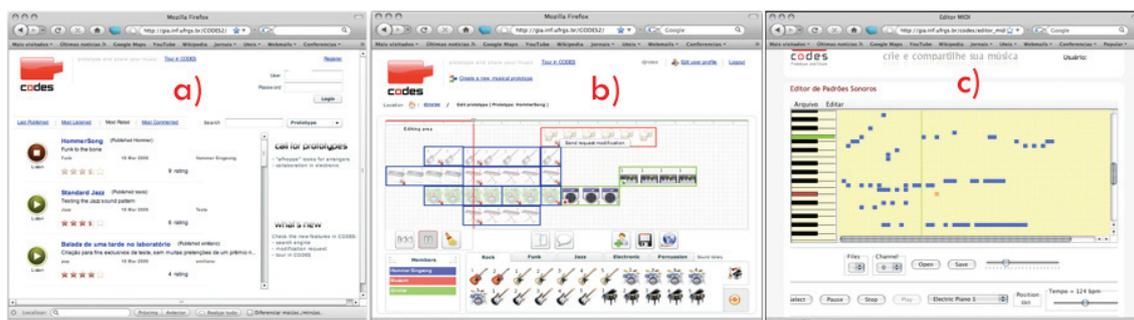
Figure 3: Screenshots of the three main levels of CODES

to the published musical prototypes, rate them, and search musics by author or style.

Once logged in CODES, members can interact with the two other levels shown in Figure 3.b) and 3.c) and find/invite partners in order to cooperate and share their musical ideas, edit musical prototypes, and related conversation/argumentation as describes the next section.

4. Novice-oriented music environments should be Cooperative

Since Web is nowadays a very common platform for social and collaborative activities, CODES project has moved the attention focus from individual to cooperative music prototyping process. Indeed, novices in music may not have enough knowledge and confidence to create music by themselves: by means of interactions with and advices from more experienced users, novices can improve their learning during the development of a collective music prototype. CODES provides an effective interactive support to make novices cooperate with each other for creating music.

Thus, a music prototype may be the result of an individual process of musical prototyping but also the result of a collaborative design, having the participation and contribution of many users. In this case, the MP is an artifact shared by all members and they have to cooperate by means of actions to manipulate the shared artifact (MP) and by means of explicit conversation and argumentation. The process of group formation and participation in group activities in CODES is simple: invitations can be sent as shown in Figure 2. Once logged in the system, users can send explicit invitations to other users (registered or not). For sharing a musical prototype, the user "owner" can invite CODES users using a search engine or sending explicit invitations by e-mail to non-members and asking them for cooperation. The *members list* and *group status* are also displayed in the members area. When someone accepts such an invitation, this user becomes a prototype partner and can edit it like the owner does.

At any time users can listen to the musical prototype and link arguments to their decisions, in a structure of a design rationale [Shum, 1996]. Thus, all prototype partners can discuss and exchange ideas about each step of the prototype refinement, in order to understand someone else's decisions. Each author's contribution in the shared workspace is identified by color: for example, the edges of sound pattern icons are colorful (the color obviously chosen by the user, as illustrates Figure 4.a'). In the members area (Figure 4.a), a user may show or hide other users' contributions (in fact, the other users' layers as shows 4.b) by clicking over the user id. It is possible to listen to each layer separately, to compare and combine contributions, and, of course, to save the result. The group status shows when there are new comments or new versions with icons. Figure 4 shows an example of three users cooperating in the same MP.
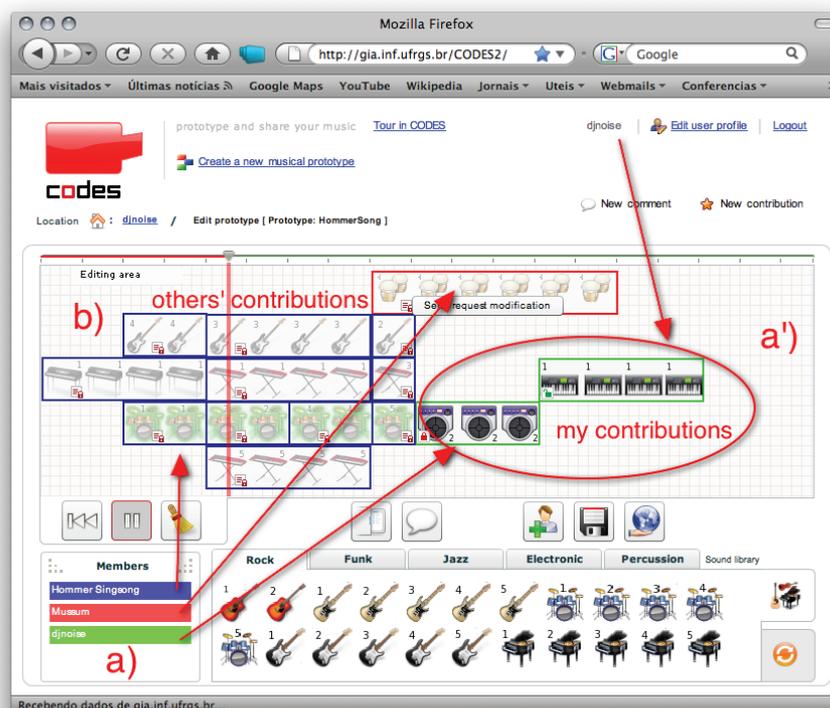
Figure 4: Three users cooperating in a shared MP at CODES MP Editing Level

When someone contributes by adding a new sound pattern to an MP, it will be, by default, locked for other users, with a blurred appearance. If some user wants to prototype or edit the other's locked layer (or sound patterns), CODES offers a special mechanism called "modification request".

The Music Prototyping Rationale (MPR) mechanism is another effective way to represent and to record explanations and argumentations for each action or decision made during CMP. Each user may associate comments and arguments (in favor or against) to any action on any prototype element. Each argument is related to a user or the whole group and the current layer.

In CODES, the basic elements of the MPR are "issues", "positions" and "comments". Issues correspond to decisions or actions that have been made or states which have been reached during an MP creation and refinement. A Position is a statement or assert that resolves the issue. In the case of CODES, positions can be pros, cons, idea, and important. Comments are asserted in order to agree with a specific course of action (comments in favor) or to express some objection (comments against).

Besides, CODES also adopts the notion of awareness, which is the understanding of the actions of other users providing to each user a context for his own actions. CODES offers three kinds of awareness mechanisms:

- MPR, to allow users to know the reasons behind other members' actions;
- Modification Marks, to indicate to a user that a prototype has been modified by others; and
- Version Control with layers, to keep an explicitly recorded track of the steps that led to the current prototype state.

CODES uses modification marks as the awareness mechanism to alert new events to a user, like modifications on a prototype or suggestions made by others.

4.1. The particular viewpoint of cooperative activities in CODES

Music creation by novices needs to provide a very specific kind of support for collaborative activities. In fact, the conventional cooperative approaches with fixed goals and roles, not allowing unsystematic and opportunistic negotiation are not adequate for the dynamic, creative, and collaborative nature typically related to collaboration in the arts, like CODES's Cooperative Music Prototyping (CMP).

Table 1 summarizes the main differences we have found comparing the cooperative support we have defined in CODES development with some characteristics generally found in cooperative environments for technical product design, like in manufacturing, construction, etc.

Table 1: Cooperative activities general framework

	Collaboration for Technical Product Design	Collaboration in Non-Technical Product Design
Main Goal	Product design according to a product (or requirements) model	Creative product resulting of a mutual understanding; no previous product modeling; mutual learning process is as important as the product itself
Group Topology	Typically, a hierarchical group with a leader	Typically, a non-hierarchical group without formal leaders
Control	Coordination	Argumentation
Planning and Decisions	Rigid and systematic plan definition, decision order following planning	Unsystematic and opportunistic negotiation
Roles and Tasks	Fixed roles with responsibility assignment; pre-defined task allocation	No fixed roles, no responsibility assignment; flexible task allocation
Example	Collaboration in manufacturing, construction, etc	Collaboration in the arts, cooperative music prototyping (CMP)

For technical products, there is a need for specifying a product model in order to standardize the process and predict the final result. For non-technical products, like music, the emphasis is on the subjective aspects of the act of creation rather than on following a model for creation. As we do not know a priori about the final result, the process is guided by the creation or creativity itself, instead of a previously defined design. As this process emerges from the cyclic interactions of the group, based on contributions from/to each other, the "control" of the process is done by negotiation between members, without the need for the role of an explicit controller. Thus, the "decisions" are supposed to be consensual by negotiation, and not imposed by the authority of a leader. We believe that it is not necessary to make a distinct and explicit representation of the leader, because usually in a hierarchical group, the leader's opinions and actions may inhibit the other users' participation. Indeed, interactions can evolve as time passes, and the more "skilled" users can be recognized and respected naturally by the group while suggesting and justifying their contributions. This allows total flexibility without needing prior role definition, task allocation or responsibility assignment for members.

Because the cooperative music prototyping process can justifiably be seen as a political process determined by conflicts and cooperation, the joint development of ideas by means of both multi-perspective approach and negotiation support is particularly important. The multiple actors - all who are cooperating in the refinement of the musical prototype - hold different perspectives on the creative process and its results (the musical prototype), each one with different backgrounds and opinions due to the context they come from. Therefore, it is essential to support mutual understanding and to resolve conflicts during cooperative musical prototyping.

A negotiation between these different viewpoints and goals must be explicitly supported and maintained over time, thus the decision-making process is cooperative and distributed. Real cooperative activities are very difficult to automate and to control because they involve the complexities and the dynamic nature of human group work, but we may attempt to support them.

In fact, we think this support for cooperative music prototyping is a particular kind of Human Centered Collaborative Design. The basic idea of our CMP process is that members cooperate not only by means of explicit conversation and explicit actions on a shared objects space, but also by interpreting the messages and actions of other actors in accordance with the model of their thinking and acting, which has been built up in the course of their interaction.

A shared objects space involves prototype-oriented information, which comprises all information about musical prototypes, including their composition (combination of sound patterns, versions formed by layers) and social-oriented information (including interactions between actors during the process).

Sound patterns are predefined 4s MP3 samples in the CODES sound library available for users represented by an iconic format. Manipulation of prototype oriented information is goal-motivated with typical prototype element manipulation, including use, modification, combination, replacement, and experimentation (audio listening) of sound patterns. Social-oriented objects are all related to conversation, like messages and comments. One significant consequence of recognizing social-oriented objects as relevant information is that, instead of considering modifications as only explicit transformations on an MP, we also consider the changes on social-oriented objects. That is, we interpret modifications on shared objects space as meaningful changes in both MP and social context.

This way, a sequence of messages may, at the same time, not change the MP and significantly alter an actor's argument, opinion or decision. Unlike a conversation, where messages are categorized by their purpose within the conversation, for action, for clarification, for orientation, and so forth, conversation in CODES is simply composed by all recorded messages sent and received to/from the CMP actors, indexed to other relevant model components. Then, recording the actors' messages is extremely useful to capture, in an implicit way, the background knowledge, concepts, definitions, and opinions surrounding their viewpoints.

In addition, the music prototyping rationale may be explicitly recorded by decisions and arguments. Decisions are goal-motivated consensual choices, concerning alternatives of the action course. Arguments are consensual explanation, not an individual message interchanged between actors. Every decision or action may be linked to (pro or con) arguments.

Notice that the actors cooperate via the shared objects space, that is, either indirectly by means of musical prototypes they manipulate and modify, or directly by means of conversation. Thus, the set of actions an actor may perform has been broadened to include direct interactions with other actors, in addition to traditional actions of prototype manipulation and the communication between group members plays a crucial role to support cooperative activities.

5. What are actual novice users saying about CODES: Evaluating Novice-oriented CODES features

CODES have been made available for use by actual users in our academic context. Following well-known subjective evaluation methods from the HCI field, we made some experiments to obtain qualitative results from the use of the CODES environment and its functionalities. Our goal was not only to get overall feedback (mainly subjective) from users but to try out our proposals for non-technical cooperative design environments as well.

In a first experiment, five individuals, representative of the CODES typical users (with ages from 20 to 35 years, having no musical expertise, and using CODES for the first time) had to perform fifteen real tasks. See Figure 5 for an illustration of the opinion poll characterization.
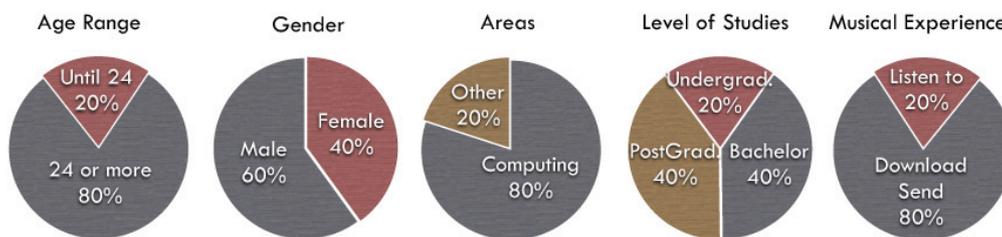

Figure 5: Opinion poll characterization of the experiment

These fifteen tasks were designed to simulate a scenario in which a novice user would learn how to create, edit and cooperate in a musical prototype. Particularly, a cooperative scenario was composed specifically by three different tasks at the MP editing level. The tasks included creation, edition, and sharing of CMP. Time taken to complete all the tasks ranged from 20 to 50 minutes.

The experiment carried out was the User Testing [Rubin, 1994] and was conducted in the presence of a facilitator (observer), a usability expert. He just read each task for the user, and took notes of any problems found and any verbal comments from them. The subjects were instructed to talk what they thought while interacting with CODES, thus using the "thinking aloud" method [Nielsen, 1992]. Interaction and user comments were also recorded with a video camera aimed at the computer screen (see Figure 6).

Figure 6: A recorded session of user testing with CODES

After performing the tasks, users filled out a form with open and closed questions.

The open questionnaire posed seven questions concerning the Nielsen's heuristics[1] like visibility, contextualization, control and freedom, feedback, flexibility, and the musical representation in CODES as well.

To answer to the eleven closed questions, a main question was made: *Do you agree with the following sentences?* Thus, the subjects should choose one of the five options: *Totally Agree, Agree, Neutral, Disagree, Totally Disagree.*

Different subjects were tested in order to get overall feedback of the users regarding usability, accessibility, and cooperative issues. Besides, the tests aimed at discovering interface and interaction drawbacks. Some users have also detected important drawbacks concerning the system feedback, according to the following quotes:

"Sometimes, the system would give more feedback". "I do not know what is the session I am posting the comment". "I did not know why should I choose a color when registering myself in the system". "What means this icon in the editing area?"

Despite these negative points, overall test results were favorable and most of them have assigned "totally agree" as shows the Figure 7.
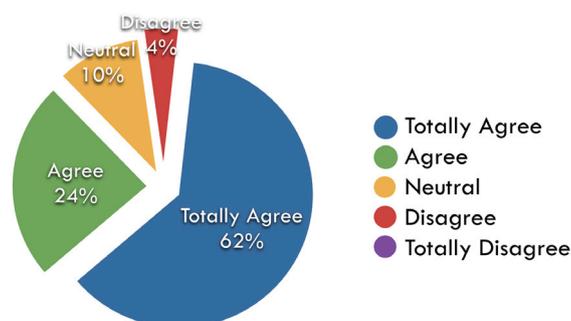

Figure 7: CODES General approval

The most important test results were those that allowed us to identify some user needs that where not being addressed by the initial design of CODES, and so would imply new requirements for the system. For instance, users would like to do their contributions and to combine them with any of the others, but without changing each participant's original and previous contributions. This was not possible in an early CODES version. This test result is the origin of a layer-based approach, described in [Hoppe et al., 2009].

The experiments were intended to be developed in a very restricted context, but until now it is possible to conclude that the system is intuitive and easy to use making users feel motivated by using CODES for enhancing and sharing their musical experiences.

6. Conclusion

In this paper, we have presented some principles emerged from (and adapted for) CODES to address the idiosyncrasies of this novice-orientation context for music creation, and discussed their rationale. The novice-orientation of CODES is characterized by a support for dynamic and prototypical music creation process and by actual cooperation, social knowledge construction, argumentation and negotiation among the different actors of musical prototypes design activities mechanisms. It enables knowledge sharing by means of rich (even being novice-oriented) interaction and adapted to address the idiosyncrasies of this CMP context.

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[1]http://www.useit.com/papers/heuristic/heuristic_list.html

CODES has shown that Web-based networked music environments can offer even more than "consumer" possibilities for novices in music. Since we have integrated adequated tools, processes, and concepts in one single environment, novice users can create music prototypes, cooperate effectively and experience the feeling of being the creators of their own music. Music creation by novices is ultimately about people having fun and entertainment (and maybe also learning), not about following a fixed set of rules for music composition. It is not also a matter of composing a song from the beginning to the end (such as linear music) but of creating an own sound sequences (non linear music).

Having access to the rich interaction and argumentation mechanisms in CODES, and experiencing the process of music prototyping, we believe users may get a better understanding of the complex activities which are musical creation and experimentation. In CODES, partners cooperate not only by means of explicit actions on a shared objects space and explicit conversation, but also by interpreting the actions and, above all, the comments of other actors in their creative process.

However, CODES is not just about supporting novice people: features built for novices help everyone whose musical skills are less than a musician's capability. If we think musical skills are continuum - people do not merely know or not know music - CODES is open and accessible to all of us, from ordinary users to musicians. Thus, if actual novices can learn a lot using CODES, musicians may be "novices" when using CODES as well, experimenting (new) ideas and changing opinions.

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