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**Without touch, without seeing.**  
**Children playing with the Continuator, a virtual musician.**

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**Abstract**

*What happens when young children play with a virtual musician ?*

*The relationships between children and new technologies is a relevant topic in the field of music education (Webster 2002; Folkestad et al. 1998; Bamberger 2003) as well as in the field of psychological sciences (Turkle 1996, De Kerckhove 1991, Kenway, J. & Bullen 2004). However, only a few studies have considered the "nature" of the interaction between children and musical machine.*

*A research project is carrying out dealing with the interaction between children and the Continuator, an innovative musical system elaborated at the SONY-Computer Science Laboratory in Paris, able to learn and produce music in the same style as the human playing the keyboard, like in a sound mirror (Pachet 2003). The results of the experiments carried out with children to 3-5 year old have shown that the Continuator, or other similar interactive reflective systems (IRMS), is able to develop interesting child/machine interaction and creative musical process in young children, thanks above all to its capacities to replicate the musical style and evolve in organic fashion (Pachet & Addressi 2004; Addressi & Pachet 2005; Carlotti et. al. 2004).*

*A new experiment was carried out to observe in what way this system can be used in classroom music education, with little group of children (kindergartner).*

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*In this paper the classroom setting, the method and some results will be presented. We will then draw some conclusions regarding the psychological, and pedagogical implications of our study. We will show and discuss some video excerpts (4 minutes).*

Keywords: interaction child/computer, interactive reflective musical system, continuator, classroom music education, practice.

## **Introduction**

What happens when young children play with a virtual musician ? That is the question on the base of this paper, realized inside of the DiaMuse project carried out at Bologna University in collaboration with SONY-Computer Science Laboratory in Paris. The project deals with the interaction between children and an innovative musical system, the Continuator, able to produce music in the same style as a human playing the keyboard. The Continuator is an application of the *interactive reflective musical systems (IRMS)*, in which the user, whatever his skills, competence level, and musical goals, is confronted with some sort of developing mirror of himself. The system was originally designed in the context of developing new tools for improvised music, and was in part inspired by Ray Kurzweil' prophecy : "Human musicians [will] routinely jam with cybernetic musicians" (Pachet 2003). We decided to experiment this system with the children.

The relationships between children and new technologies is a relevant topic in the field of music education (Webster 2002; Folkestad et al. 1998; Bamberger 2000) as well as in the field of psychological sciences (Turkle 1996, De Kerckhove 1991; Kenway, J. & Bullen 2004). However, only a few studies have considered the "nature" of the interaction between children and musical machine.

A preliminary experience and an experimental protocol were carried out in Paris (France) and Bologna (Italy) with children to 3-5 year old (Pachet & Addressi 2004, Addressi & Pachet 2005, Carlotti et al. 2004). The results have shown that the Continuator, or other similar interactive reflective systems, is able to develop interesting child/machine interaction and creative musical process in young children, thanks above all to its capacities to replicate the musical style and evolve in organic fashion. It was possible to observe a sort of life cycle of interaction, and some micro-processes similar to one observed in child/adult interaction (Stern 1985, Imberty 2005, Mazzoli 2003, Young 2004). During the interaction with the system, the children reached high levels of

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“well-being”, of pleasure, and creativity, very similar to those described in the Theory of Flow by Csikszentmihalyi (1996).

In the light of these results, the project foresees the experimentation of new protocol for interaction and new variants to be applied to interactive reflective musical systems.

In this paper we introduce a practice experience realised with children of the same age, with the aim to experiment how the system can be used in basic music education with small groups of young children (kindergartner). The paper will present a description of the classroom setting, the method and some of the results observed so far. We will then draw some conclusions regarding the psychological, and pedagogical implications of our study.

## **Method**

The practice experience was trialled in the Nursery School “A. Battaglia” of Bologna (Italy), with 18 children, 9 of 5 years (6 boys and 3 girls), and 9 of 4 years (4 boys and 5 girls). The project has been inserted inside of the plan already started in the school, concerning listening education, and has been carried out according to the method of the "background integrator", in this case the story of “Simone Acchiappasuoni”, a little boy able to grasp the sounds.

### *Procedure*

The activities have been carried out like a "workshop", modality already used in this school: small groups of children (homogenous for age) that exit from the own sections in order to make particular activity with a teacher. The workshops were carried out with small groups of 4/5 children, homogenous for age. Every group realised 4 lessons of approximately 30 minute everyone. The activity has been carried out in a equipped room: a keyboard has been placed on a small table in front to a large mirror hung to the wall; on a contiguous table the computer was placed; a large carpet and some shelves delimited the space of game and movement. All the activity has been audio and video recorded.

*Synthesis of the activities:* - *Exploration*. The first step: children in small groups explored the keyboard in spontaneous way (they were invited by a fantastic personage –Simone Acchiappasuoni- to follow and search the musical traces produced by the Continuator); - *Games with the teacher*. The teacher proposed some games with the Continuator and other instruments: narration of story - where the children and the Continuator provide a musical description-, to dance, to play other

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instruments (drums, woodblocks, etc). – *Free Game*: during these moments the children could spontaneously play the keyboard with the Continuator, alone, in pair or in group.

### *Equipment*

We used the Continuator, a Roland ED PC-180A keyboard as the interface, a Roland expander, a pair of amplified loudspeakers, computer, video camera, digital camera.

The basic playing mode of the Continuator was the same particular kind of *turn-taking* as used in the previously experiments (Addressi & Pachet 2005):

1. The Continuator plays only when the child stops: programmed time limit typically about 400 milliseconds
2. The system's answers are the same length as input.
3. The user has the priority: if the user decides to play a phrase while the Continuator is still playing, then the system will stop and return to the listening mode.

A modified version of the Continuator was prepared purposely for this experience. The modifications have regarded the interface, that was easier, and the design, as we used 2 playing modes:

- The Continuator: the basic question/answer mode with the Continuator, where the answers are *similar* but *different* from the input.
- The Continuator/linear: the Continuator produces linear streams of notes.

### **Results**

1. Some of the phenomenon that we observed in this experience are similar to ones observed in the previous experiments: during the interaction with the Continuator, the children show surprise, excitement, clear-cut feedback, intrinsic motivation, pleasure and involvement. In particular we observed the following phenomena:

- *The children learned the rules of the system*: It replies by playing alone, it replies when you stop playing (turn-taking), repeats what you play, repeats with variations, is capable of establishing a dialogue made up of repetition/variation, it does not always respect the rules, you can teach the system, and the rules of the system can be taught to others. The children dialogue with the Continuator learning these implicit rules and to respect the turn-taking (see Fig.1).

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Figure 1: The turn-taking: The children lift up their hands when they pass the turn to the Continuator.

- *Ways of playing, exploring the instrument:* The children explored the keyboard and means of making sound in a myriad of different ways: with their elbows, head, bottom, or forearm, with their hands in their sleeves, chopping, with just one finger, several fingers, the palm of the hand, facing backwards, rubbing, alternating the hands/fingers.
- *Listening:* The listening was very careful, both to the replies given by the system and to their own work. We observed symbolic, autotelic, analytical, and motor listening (see Fig.2).



2a.



2b.

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Figure 2: a. An example of both analytical listening and joint attention; b. Children listen to the Continuator and dance during the free game.

- *Focused attention*: Analytical behaviour associates to the high levels of concentration, or like episodes alternated at relaxation moments (see Fig.3).



Figure 3: Focused attention. Two children observe with interest the keyboard, focus the attention on particular aspects (to play a single key, with a single finger or alternating two fingers), then listen.

- *Joint attention*. A typical situation encountered was the phenomenon of "joint attention" (see Fig. 2a and 4).



4a

4b

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Figure 4: Joint attention. a. Two girls explore the keyboard together ; b. One of the children would force the other to stop playing in order to listen to the system. We called this situation "Aspetta" (the Italian word for "wait")

## 2. Games with the teacher

When the teacher proposed the games, in particular we have observed:

- *Stories in Music*. The children dramatise and use the Continuator to put in music the story narrated by the teacher. They have learned that the answers of the system are similar to what they play, and they "ask" the system to play determined sounds in order to create a soundtrack to the stories (see Fig. 5).



5a



5b

Figure 5: Stories in the mirrors. A child pretends to be the Wolf : a. he plays a cluster strongly and slowly ; b. then he stops and listens to the mirroring answer by the Continuator, watching own image in the mirror imitating the ferocious expression of the Wolf.

## 3. Free game

The moments of free game were particularly interesting. The children approached the keyboard spontaneously, alone, in pair or in groups, listening in careful and analytical way when they played alone, and arranging a collaborative playing when they played in pair or in group (see Fig. 6).

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Figure 6: Free games. 6a/b The children improvise some dances on the notes played by the Continuator; 6c/d. Collaborative playing: A girl organizes a jam session with the Continuator and her friend, and she plays alternatively the keyboard and the drum; 6e/f. Interaction peer to peer: the children are interested not only to the Continuator but also to the interaction between the friends and the Continuator.

In conclusion, in this experience the Continuator has represented for the children a sort of a virtual companion: he plays, answers, stops, and listens too! (see Fig. 7).





7a

7b

7c

Fig. 7: The virtual musician: 7a. A little girl dances while listens to the Continuator; 7b. she stops and watches the monitor of the computer as the Continuator does not replies; 7c. when finally the Continuator starts again, she informs the teacher that "He works!", putting the hand closed to the mouth with a typical gesture in order to prevent to the Continuator from listen to her.

## Conclusion

This practice experience show that the Continuator could represent a *versatile device* to enhance the musical invention and exploration in classroom setting. The children reached high levels of *well-being* and pleasure very similar to those described in the Theory of Flow by Csikszentmihalyi (1996), and in the musical field by Custodero (2005). They learned to musically converse with the system, developing *autonomy* and learning to manage some kinds of *collaborative playing* (Burnard 2002, Miell, D. & Littleton, 2004).

We observed that the *role of the teacher* using these kind of system in classroom music education, would be to predispose the equipments and the context so that the children can explore and use the system in independent way, alone, in pair or group; to organize games with the system and other musical instruments. We refer here to the Vygotskian concepts of *modeling* and *scaffolding* (Vygotsky 1978).

Finally, the *virtual musician*: one of the most attractive quality of this system is to (inter)act like an human, or a living being at least, able to learn and react. The ability of the system to produce music similar but different from the musical input played by the children, is one of the abilities more

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similar to the human behaviours as observed in infant/adult communication (Stern 1985, Trevarthen 2000, Imberty 2005). However the children cannot touch and nor see him, and the system cannot judge them. These factors gave rise to some particularly careful and prolonged bouts of *listening*, encouraging the children to *think in sound*, and developing a genuine *desire of music*, curiosity and long *attention span*. These data, together with the other phenomenon observed, could be interpreted as signs of *intrinsic motivation*. From a pedagogic point of view this aspect is of utmost importance since it stimulates learning and creativity, as well as encouraging an interest in musical instruments, which normally offer very little attraction to such young children (Delalande 1993, O'Neill & McPherson 2002, McPherson 2005).

This practice experience want to be an example of using the Continuator with young children in classroom setting. We believe this kind of experiences to be a fundamental contribution to the research project and to the psychological experiments carried out until now. Furthermore, from a technological point of view, they allow to assess new variants of the interactive reflective systems for music education, and that is one of the aim of our research approach based on a spiral collaboration between psychological experiments and system design. We believe this approach to be very productive and one that should be pursued.

We are planning news systematic experiments to assess and verify the educational values of the IRMS, both in basic music education and in improvisation teaching. A comparative project is being planned that involves other European countries.

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