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# Young children's musical experiences with a flow machine

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## ABSTRACT

*In the field of the studies on creativity is placed the Theory of Flow introduced by Csikszentmiahlyi (1990) in order to describe the state of Flow, or "optimal experience", experimented by the creative persons during their preferred activities At the Sony Computer Science Laboratory, an innovative system was elaborated able to produce music in the same style as the person playing the keyboard, the Continuator. The ability of the system to attract and hold the attention of children could be interpreted through the theory of Flow (Pachet 2006). The DiaMuse project is carrying out dealing with the interaction between young children and the Continuator. During the interaction with the system, the children seem to reach high levels of "well-being" and creativity, very similar to those described by Csikszentmiahlyi. We also noticed the presence of the flow indicators as observed by Custodero (2005) in musical experiences. An observation grid was realized in order to analyse in details the emotive tones described in the Theory of Flow.*

**Keywords:** Continuator, Flow, Music education.

## INTRODUCTION

A recent study is been carried out to observe the interaction between children and a particular interactive reflective music system: the Continuator, elaborated at the SONY-Computer Science Laboratory of Paris (Pachet 2003). The results had shown as children, during the interaction with the system, reach high levels of "well-being", of pleasure and creativity, very similar to those described by Csikszentmihalyi (1990) in the Flow Theory. 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 1995, Imberty 2005) (see Pachet & Addessi 2004, Addessi & Pachet 2005b).

Csikszentmiahlyi (1990) describes the Flow state, or optimal experience tested by creative people while they are doing their favourite activities. When the activities are felt pleasant it can be possible notice a good balance between high levels of challenges and high levels of skills. During these activities people is completely absorbed, and forgets, for that moment, everything is not inherent in the task. The self awareness is less present, the time seems to pass very quickly, and every task is perceived worth tackling for itself. In the analysis conducted by Csikszentmihalyi the state of Flow is been compared with other emotive states defined on the relation between challenge and skills (Fig.1): Worry and Anxiety in which the level of challenges is higher than the skills one; Relaxation e Boredom in which the level of challenges is lower than the skills' one; in the Apathy the levels both of the skills and of challenges are too low. The other two emotive states, the Arousal and the Control, can lead to the Flow state and so they are positively considered.

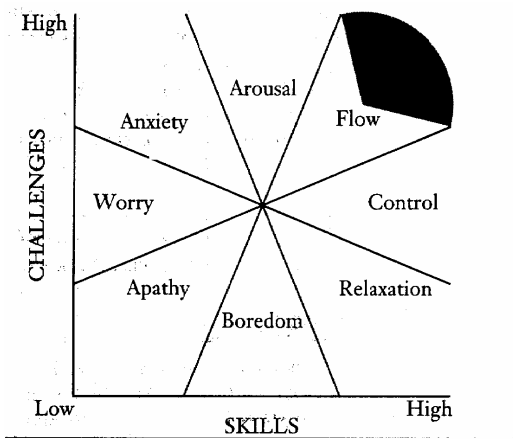




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**Figure 1.** From Csikszentmihalyi (1997, p. 31).

In the field of studies on the music creativity, we can find some applications of the Flow theory: very significant are the studies of Custodero (1998, 2002, 2005). She has identified 6 indicators of flow experience that are observable in young children's musical experiences during the course of instruction.

## The Continuator as a "Flow Machine"

The Continuator is a particular system able to produce music in the same style as a human playing the keyboard, like a sort of sound mirror. This system is based on the notion of Interactive Reflective systems. The core concept of this approach is to teach powerful – but complex – musical processes (such as tonal harmony, improvisation, etc.) indirectly by putting the user in a situation where these processes are performed not by the user (like in traditional master/slave approach) nor by the machine (like in some ITS approaches), but by the *actual interaction* between the user and the system. The theory of Flow is especially suitable to analysed the results of the experiments carried out with the Continuator, because the system catches, or it tries at least to catch, the basic elements of the creative process, in particular: the excitement, the surprise, and the gradual transformation of the musical activity in an autothelic, that is self- motivated. We can think the Continuator as a Flow machine, in the sense that it produces a response corresponding to the skill's level of the user (Pachet 2006).

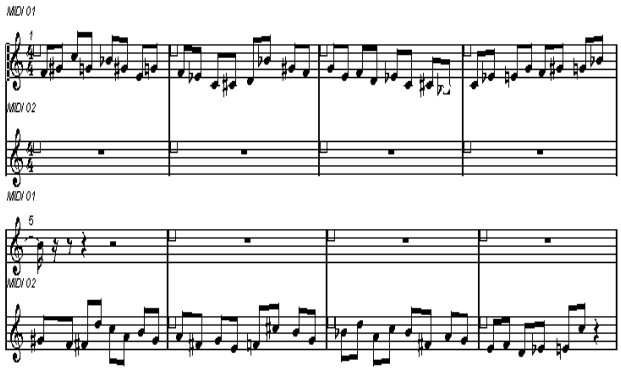


**Figure 2.** Example: a jazz melodic phrase (the upper stave) is continued by the Continuator (the lower stave) .

The results of the experiments has underlined the presence of the different variables linked to the Flow's experience like: the focused attention, the easiness to be concentrated, the clear cut feedback (the Continuator produces a clear feedback and so the interaction is, in a sense, the simple analysis of the feedback of the system); the control of situation: the intrinsic motivation; the excitement: it clearly emerges during the most part of the time, in particular in the first phases of the sessions. And in the end, the change of the perception of time: to some children it seems to pass very quickly (Pachet & Addessi, 2004, Addessi & Pachet 2005b).

According to these results, a observation grid is been elaborated to observe systematically the presence of the emotive states, described by the Flow theory, in the conducts put into action by the children, during the interaction with the system.

In this paper we will present:

- A synthesis of experimental protocol
- The grid elaborated to observe the presence of Flow in the interaction children/Continuator
- The description and discussion of the results

Afterwards we will analyse the Custodero's indicators, and some conclusions about the ability of the system to enhance the positive emotive states will be introduced.

## METHOD

The experimental protocol was carried out with children of 3 to 5 years old, in a Nursery school (Bologna, Italy). We used a Roland ED PC-180A, the Continuator as interface, two loud-speakers, a laptop computer, a digital camera, and a video camera.

The children were asked to play in four different ways, for three sessions:

- Task A: with the keyboard alone
- Task B: with the Continuator
- Task C: with a partner and the keyboard
- Task D: with a partner and the Continuator.

These tasks was given to children in random order.

All sessions were recorded on video. Two cases-studies were analysed, and then the most interesting conducts were selected to be tested also on the other participants, trough a observation grid. The observation was carried out on 9 children had took part to the whole protocol: 3 children of 3 years old (2 females and 1 male), 3 of 4 years old (2 females and 1 male), and 3 children of 5 years old (1 female and 2 males). (for more details see Addessi & Pachet 2005a).

## The Flow Observation Grid

To observe systematically the presence of the emotive states described in the Flow Theory (Flow, Anxiety, Apathy, Relaxation, Arousal, Control), a observation grid of 9 variables was elaborated. These variables proceeded from Csikszentmihalyi ones. To each emotive state we matched a particular combination of these variables.

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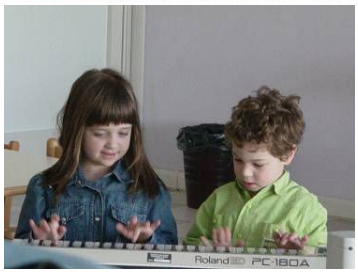
*The variables*

1. *Focused Attention*: analytic behaviour of high intensity; the child focuses his/her attention on a particular aspect. In can appear as a continuum, linked with high level of concentration or as alternating episodes to relaxation. In our case: the child, for example, observes with interest the keyboard (fig. 3), listens own productions and the system' answers, he/she focuses on particular elements (for example he/she plays only the white or black keys, he/she plays with a finger ore with the open hand).

**Figure 3**. Focused Attention

2. *Concentration*: global behaviour with constant and average intensity. The child doesn't take his/her mind off, for a long period of time. And also "he/she is aware about the importance only of here and now" (Csikszentmihalyi, 1996). This variables is very evident, because to the children it is not given any kind of instructions. So children play with the system self-motivated, without any external pressure.



Concentration

3. *Clear-cut Feedback*: the child controls constantly the level of own answer and the interaction with the system, trough its answers. There is no need of the presence and evaluation of the adult. This gives, to the child, security and a sense of self efficacy on his/her skills. We can observe this sense of security when the child: listens carefully, shows pleasure or sorrow about the answer of the system, values right or wrong hi/her own productions and the system ones.

Feedback

4. *Control of situation*: understanding of the different tasks, linked with a sense of self confidence on his/her actions. The child learns immediately some rules to control and manage the interaction. Some examples: the child understands the system imitates him/her; the interaction is based on the turn-taking, knowing he/she can stop the system's answer before the end of its answer; if she/he plays strongly the keyboard the system answers in the same way.

5. *Intrinsic Motivation*: independence from any kind of external recompenses. In our case the child decides the times (how long) and the modes (choosing the task: the keyboard that answers, the presence of the partner) of the interaction.

6. *Excitement*: Behaviour characterized by an elation of the affective tone, the tonic and sensory activation. We can observe an increase of: the movements of children around the keyboard, of the strength of the gestures, of the intensity of the sounds, and of the relation with the keyboard and with the partner (fig.4).

**Figure 4**. Excitement

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7. *Change in the perception of time*: children loose the sense of passing time. They are completely caught by what they doing. It is characterized by the evident desire to go on the interaction and the games with the keyboard. Children do not want the attention, neither the evaluation of the adult.

8. *Clear goal*: During the state of Flow "we know always what it has to be done" (Csiksentmihalyi). It represents an explorative and purposing behaviour. Children show a particular interest to the feed-back, listening own productions and the system' answers. It can be also characterized by the invention and use of music rules and plays, and of interaction games with the partner.

9. *Involvement*: high participation. The self awareness is less present, and the control of the subject on him/her self becomes less urgent (Csikszentmiahlyi, 1996: Delle Fave 1998).

Involvement

### *Table of the emotive states decode*

We registered the data through a observation grid. Inside the grid to every variables, for every task played by each child, a score is been assigned. The variables are been valued giving the score according to the frequency with which each variable is been present during the task. We assign, for each variable:
0= absence or low frequency
1= average frequency
2= high frequency

Afterwards a table of the emotive states is been elaborated, considering the studies carried out by Csikszentmiahalyi[1].

In this table to each emotive state corresponds the following combinations of variables:

| |
|---|
| **Flow**: high score in all variables |
| **Anxiety**: average-high score in concentration, focused attention, clear goals; average-low score in the other variables. |
| **Relaxation**: low-average score in focused attention, concentration, clear goals, change in perception of time and excitement; average in the other variables. |
| **Apathy**: low score in all variables |
| **Control**: average-high score in intrinsic motivation; average in focused attention, concentration, clear cut, control of situation, socialization, low score in excitement. |
| **Arousal**: high score in pleasure, involvement, excitement; average score in concentration, clear cut, intrinsic motivation, change in perception of time, clear goals; average-low score in control of situation. |

### *Accord Index*

The data are registered by two independent observers watching the video. Afterward we have applied to the each registered score, for each variables, an *accord index* (Camaioni et al. 1988, .49-50). The accord index is the result of the ratio between the total number of the accords and the sum of the accords and the disagreements. Multiplying the result by 100 we obtain the percentage value. Camaioni assumes that a good accord index, between different observers, should be between 80% and 90%. The accord index has been calculated when each grid has been wholly filled in. The disagreement' cases have been resolved through the discussion, watching again the video and recalling to the definition of each variables. The mean accord index obtained, observing the 9 children (they completed the whole protocol), is 80, 55%.

## RESULTS

In this paper we describe the results observed in the tasks A and B, when the children played alone with/without the Continuator. In particular we present and confront the results pertinent to:

- The dynamic profile of the Flow presence in the two different tasks during the three sessions;
- The presence of the six emotive states as Flow, Control, Relaxation, Arousal, Apathy and Anxiety;
- The relation between Flow and the positive emotive states.

## The Dynamic profile of the Flow

[1] These studies use the Experience Sampling Method, ESM (Csikcszentmihalyi & Schneider 2002) trough it is possible obtain some informations about the sensations felt by the subjects during particular activities. While in the ESM the subjects tell about their own sensations, in our study is the observer that have to "read" the reaction of children during the games with the keyboard.

The graph (fig. 5) shows the presence of the state of Flow in the tasks A and B, during the three sessions. In the abscissa axis the two tasks are grouped, divided in the three sessions. The ordinate axis represents the times in which the Flow state is present.

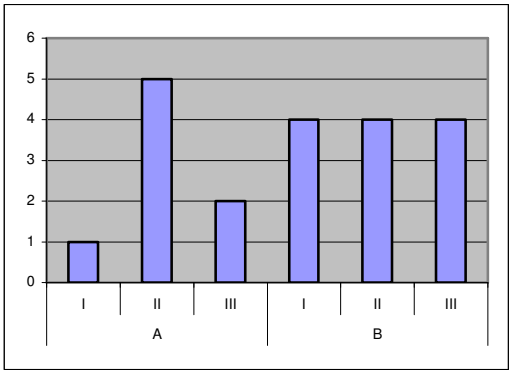


**Figure 5**. Dynamic profile of the presence of the state of Flow in tasks A and B.

The results underline when a child plays alone with the Continuator (task B), he reaches constant high level of Flow. In this task we notice high levels of all the variables considered. These data confirm those described in Addessi & Pachet (2005b): the attention span are clearly longer in the task B than in the other tasks.

Also in the task A there is a good presence of the Flow state, although in a discontinuous way. There is a clean difference between the first session, where the state of Flow appears with its lowest level, and the second one where the Flow state reaches its highest level.

These data seem to show an high interest of the children for these musical activities. This interest increases when the system interacts with them, and this confirms the hypothesis according to the Continuator is able to catch the children attention, developing an intrinsic motivation to go on this interaction and creating states of Flow.

An other aspect to value is the experimental protocol: the tasks with and without the system are proposed to children as a closer series. So we can suppose there can be an influence of the emotive state between a task and the following one. In particular we assume the presence of the "keyboard that answers" (as children called it) contributes to make positive and attractive the whole experience, and it makes children more closer and confident with an instrument that usually does not receives, by young children, these long attention spans.

## The presence of the six emotive states: Flow, Control, Relaxation, Arousal, Apathy and Anxiety

The most frequent emotive states present during the tasks A and B are Flow and Relaxation. Arousal and Apathy appears only one time, respectively in the third and second session. The state of Anxiety is not present.

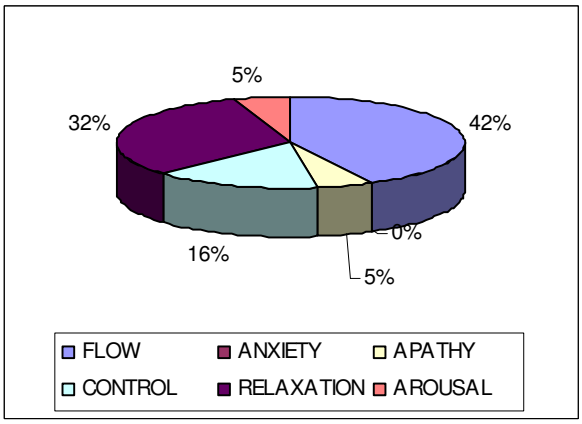


**Figure 6**. Presence of the emotive states in task A

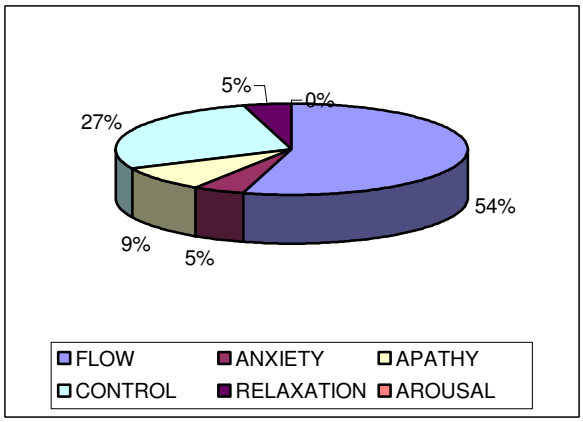


**Figure 7**. Presence of the emotive states in task B

The level of the state of Flow is constantly high in all the three sessions. The state o f Control reaches an high level of presence in the second session, but it is very low in the first and third session. The state of Anxiety and Relaxation appear only one time both in the first session. The Apathy is present two times: one in the first session, and one time in the second one. Differently from the task A, in task B Arousal is absent.

If we consider both the two tasks we can observe the percentage of the Flow presence is higher in the task B than in the A one: B= 54%, A= 42%. An other difference between two tasks is an high percentage of the Control presence in task B, and an high percentage of the Relaxation in session A. The data show the state of Flow is not always present. And this corresponds to Csikszentmiahalyi's studies, according to the balance between high levels of challenges and skills is reached through a constant evolution of this relation. It is so natural that this developing relation between challenges and skills makes possible, for the chil-

dren, to test states of Anxiety (when the levels of challenges are higher than the skills) and of Relaxation (when the level of challenges are lower than the skills ones). An other interesting result is the higher percentage of presence of the positive emotive states, besides the Flow, than the negative ones. In particular the states of Control and of Arousal are, according to the Csikszentmiahaly theory, the nearer to the optimal experience. The graphs (fig. 6 and 7) underline a clear prevalence in task B, of the positive emotive states like the Flow and Control, compared with Anxiety and Apathy. So we can assume the experience of play and learning with the keyboard and with the system is been characterised by positive emotive states. We can also suppose that: the family setting where the experience is been realized, the not intrusive role of the adult, and the possibility for the children to stop, to continue or to chose the different modes of play have an important role to make positive the experience.

### The relation between Flow and the positive emotive states

If we analyze the dynamic profile of the Flow state, following the chronological (day by day) order of the single tasks as children had played, comes out a important result: in the 89% of the cases, the tasks, in which the state of Flow is present, are always preceded by those characterized by the presence of positive emotive states like Control and Arousal.

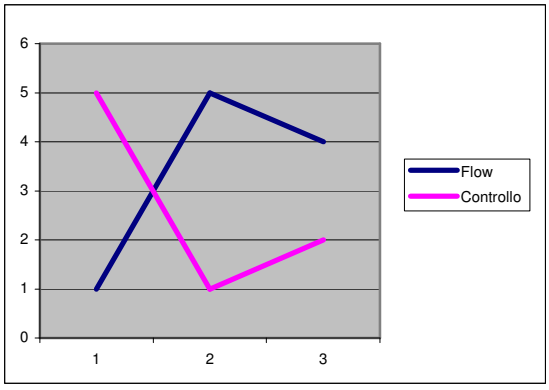


**Figure 8.** The dynamic profile of the states of Flow and Control in the first three session played by each child.

The graph (fig.8) describes, in particular, the profile of the Flow and of the Control in the first three tasks played by children from the beginning of the experience. It's important to remember that the order of the tasks, in the third session is random. The state of Control reaches his highest level exactly before the Flow, preceding it. This data confirms the theory of Csikszentmiahaly according to, the emotive states defined as Control and Arousal are emotive states extremely positive for an optimal experience, because we can register high levels of pleasure, attention, concentration, excitement (Arousal), control of situation (Control). The state of Control and Arousal can be described as "preparatory states" to reach Flow. There is a difference: while in the passage from Arousal to Flow the excitement decreases leaving the place at the focus attention, in the passage from Control to Flow increases especially the intrinsic motivation and the change in the perception of the time.

## THE CUSTODERO'S INDICATORS

We notice the presence of the *flow indicators* as observed by Custodero (2005) in musical experiences:

- *Self-assignment***.** The activity is always initiated by the children (priority of the user).
- *Self-correction***.** During the interaction the children learn the implicit rules, assess her/his error and correct them (for example the turn-taking).
- *Deliberate gesture***.** The children's movement are very focused and controlled, both during the listening and the playing.
- *Anticipation***.** The interaction based on turn-taking and repetition/variation allows the children to anticipate something of the reply of the system, and to play on the base on this anticipation.
- *Expansion***.** As shown in the microanalysis, the children progressively modified the material, reaching a good ability in organizing the time.
- *Extension***.** The children always continue to work with the material after the system (the "teacher" in Custodero's indicator) has finished.
- *Awareness of adults and peers***.** Both in the task alone and in pairs, we noticed that attempts to involve another person (and the system itself) physically or verbally are especially noteworthy.

## CONCLUSIONS

In this paper we has introduced an observative study on the interaction between children and a musical interactive system, the Continuator, according to the theory of Flow.
We can observe some children's conducts linked to all the variables of the observation grid (focused attention, concentration, intrinsic motivation, etc). And also we notice the presence of the Flow indicators of Custodero. The state of Flow and the other emotive states, connected to it, are mostly present in the tasks with the system. The results allow to assert the experience has been prevalently pleasant and significant, especially if we consider the exploration and learning. So it is possible to define this experience as an "optimal experience": this data would to confirm the tendency of the previous research and the hypothesis of the Continutor as a Flow machine. This positive state represents the basis for the development of the musical creativ-

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creativity, and it is obtained putting the child in a situation of exploration of the musical material made by him/herself. The child, involved in this kind of interaction, can observe him/herself, and he/she can be delighted by his/ her musical productions and skills. The system becomes easily a "second self" (Turkle, 1984): it thinks in the same way of the child playing the keyboard. This natural interest for the exploration of oneself represents, especially in this early age, the key for the self-motivation. The child changes his/her role: from pupil she/he becomes teacher, giving to the keyboard the rules to play, and acquiring the abilities of listening and of the musical thought's organization. The interactions are characterized from the gradual transformation in autothelic activities (activities done only for the pleasure to do them ). These activities are able to create, in children, a sense of "self-efficacy", the confidence in own skills enhancing a "self-regulated" (Canevaro, 2000) use of the instrument. The possibility, for the children, to stop the play in any moment, lets to maintain the "distance" between the child and the machine, and from a pedagogical and aesthetic point of view this distance has a vital importance (Bertolini & Dallari, 2003).

From a pedagogical point of view one of the most interesting result is the ability of the system to help children to develop a focused listening, creative musical conducts, and a personal style of musical improvisation. The system appears as a interlocutor available to the dialogue, able to propose the musical unexpected events, and to induce the improvisation. All of these are conditions searched and appreciated by the children, because they represent an essential reservoir of imagination and musical elaboration. The system meets the children' requirements to try different situations of musical listening and production, directed to the integration of perceptive schemes and to the different, stimulant elaborations. This result is very important if we consider the little space given to the improvisation's teaching in the western musical education (McPherson, 1994; Kenny & Gellerich 2002).

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