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EGGS (Elementary *Gestalts* for Gesture Sonification): tools for listening music representation and learning

(Paper presentation: research)

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INTRODUCTION

Understanding the relationship with sound and its characteristics, is an important foundation for musicianship. We do not know what musicianship is exactly, but we can recognize it, e.g. watching a performance (elementary not excluded) where the person who is playing has music competences (even if only a few). In this contribution we refer to pupils or students, even if we tend to think that what we highlight generally concerns "music people." We focus our attention on some of the actions which are connected with the birth of music behaviour as a musicianship indicator. Considering these music experiences, we define them as musical if, no matter what the level of the student, his/her performances are managed autonomously. Autonomy depends on our awareness and our possibility for control (not merely our knowledge) over what we are doing. There are many crucial aspects at the heart of this autonomy, but often they are not taught at the beginning of the music study path. One of these is managing the sound and listening experience.

Musicianship begins to grow through a rich, varied and conscious sound experience. Sometimes our attention, as teachers or educators, does not focus enough on the relationship with our main music material: sound. Sound, its nature, its features/characteristics, are, in many different ways, at the centre of our musical action, practice, learning, listening, communication, participation. If we do not know and appreciate the experience of sound the music experience may be emotionally poor, incomplete, or unsatisfying and unclear, or, at worst, unintelligible and difficult to understand.

Sometimes pupils begin to study music but nothing is taught to them about sound in general and their instrument's sound in particular. Sometimes they do not learn to listen. Step by step, music becomes a conscious listening process of expression and creation. Many books and teachers say something about sound to beginners, but they need to have a useful sound experience in order to understand it, discover our relationship with it, and improve our music practice through the world of sounds. The important thing is to play with sounds, our sound, rather than only learn information about sound: the problem is the experience of sound, in particular for beginners, to help their musicianship mature through the competence of our main music material.

The nature and characteristics of sound are the basis for the processes of creation, and composition of music practices. To improve this rich and fascinating part of music education is a relevant piece of work for researchers and educators.

A crucial point concerns the autonomy of use and management of the sound experience by the student, to improve his/her music performance competence.

Where should our conscious use of sound begin? When do we need to know what it means to sing or play with perfect tuning control? When should the student discover the beauty of the sound that he/she can create and perform?

The only answer for us is: from the beginning, using appropriate tools to improve this competence little by little. We hope this research shows, for example, how to use multimedia tools and pure tones to improve our pitch control and awareness.

We focused, in this research, only on the competences concerned with sound pitch control, by listening while the pupil was participating. The first, simple, elementary pitch information is a structural characteristic not only of sound but of the music organisation. So it is necessary to develop useful didactics, tools and strategies to consciously manage this aspect of music well from the beginning and improving it throughout the musicianship development process.

EGGS: the original System

EGGS (Elementary *Gestalts* for Gesture Sonification[1]) is a gesture sonification system, developed by Maurizio Goina and Pietro Polotti, School of Music and New Technologies, Conservatory *Giuseppe Tartini*, Trieste, Italy. A crucial contribution as performer and user of the system was provided by the dancer Sarah Taylor. The Authors, in fact, tested the system in terms of artistic realization. They worked on interactive installations in the form of public art and interactive on-stage performances. (In all of the work, the EGGS principles of simplicity based on the correspondence between elementary sonic and movement units, and an organic correlation between sound and gesture were applied. Indeed, they studied both sound as a means for gesture representation and gesture as embodiment of sound. These principles also became guidelines for the investigation of the bidirectional relationship between sound and body expression with various strategies involving both music educated and non-educated executors.)

EGGS, The Research Programme: Gestural expressiveness, Sound, Representation

The research programme, developed by “Tartini” Conservatory of Music in Trieste for the academic years from 2010 – 2012, (funded through an open regional competition for institutions in the Higher Educational System such as Universities and Conservatories of Music) aimed at testing and developing resources for multimedia in artistic and pedagogical areas.

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1 Polotti, P. and Goina, M.: 'EGGS in Action'. In Proceedings of the International Conference on New Interfaces for Musical Expression (NIME 2011). Oslo, Norway, 2011

4 Cristina Fedrigo. Sara Radin, EGGS *(Elementary Gestalts for Gesture Sonification): tools for listening music representation and learning*, EAS, The Hague, NL, 2012 (Author's copy)

The project's aims

The project, for the section specifically developed by the presenters of this paper, aimed at testing the first level uses of this system in educational contexts and highlighting the possibilities of EGGS (created for professional, creative uses), improving it and its accessibility (easy, not ambiguous instructions, intuitive use, self-correcting, etc.) in concrete music teaching and educational practices.

Instructions and determining settings for Eggs in the classroom

The presenters worked to hypothesize and test an efficient, simple, easy user protocol, the best way to communicate the instructions and determine the appropriate settings for the system in the classroom.

Listening experience...

Working with EGGS means working through perception processes and learning through the listening experience, cognitive and meta-cognitive functions, and psycho-motor coordination in music performance.

… working in time with Eggs

The project, focusing on the relationship between gestures and sounds and the consequent representations managed by listening processes working in time with EGGS, was carried out to find first indications which were useful for trying different sceneries of application (and aiming at different objectives) in general and music educational contexts, at different ages (in this first case of schoolchildren) and music competence levels.

The test phase involved, during the last academic year, 16 Primary Schools in the area of Trieste, 96 classes (all primary classes, from first to fifth year), 1586

students, aged 6 – 11. The total number of performances was 2049 (Fig.1, first table).

Classes and student participants			
Class Year	Number of classes	Number of children	Number of perfor-mances
I	20	356	467
II	19	290	324
III	22	403	428
IV	17	243	485
V	18	294	345
Total	**96**	**1586**	**2049**

Fig. 1

Eggs in steps … project phases

1. Studying how EGGS can function in the real context of the Primary School and following an educational and functional approach.

2. Developing different user interfaces, configured in flexible ways, following different contexts of use, characteristics and needs.

3. Projecting test phase and defining research protocol.

4. Coordinating the test phase with teachers of the schools involved:

a) giving them useful criteria and information to prepare their students for participation and managing working conditions and observations.

b) then, after the experience in the classroom, meeting the teachers themselves to collect their observations and considerations in free form.

5. Analysing the results to optimise the system, as well as thinking about it with teachers involved after the experience.

6. Making a synthesis to publish the results and make the resource available for anyone interested, and, finally, accompanying it with well-tested instructions for users, indications for uses in educational and learning/teaching contexts, as well as suggestions for different evolutions.

Note. In the testing context, EGGS was used following a strictly controlled protocol, but, at the same time, collecting no formal observations concerning the experience, user experiences, unexpected problems as interesting outputs, etc.

Concerning the project test working phases …

… highlighting in particular points 3, 5 and 8, which have significant relevance to our research.

1. Making hypotheses for uses of EGGS.

2. Finding locations and contexts.

3. Adapting the resource for use in identified contexts.

4. Checking necessary materials (computer, amplifier, flashlights, wii cameras and tripods, rechargeable batteries).

5. Choosing content: ranges, sounds, scales, intervals, texture and sound characteristics in relation to gesture/movements characteristics.

6. Defining specific objectives.

7. Developing the work plan.

8. Defining the setting, improving working communication and strategies after pre – test.

9. Verifying, observation, documentation tools, strategies and criteria.

Project activities

EGGS transforms gestures and body movement into sound and graphic signs through the reception of input through a camera (wii), from light sources applied to the body of the performer. In this case we used flashlights adapted to be gripped by the small hands of children.

For first testing of EGGS we chose to set the system without the graphic part, working only on the listening dimension, using pure sound (a simple frequency in order to have the best and clearest pitch information), asking the students to use the system both with open as well as closed eyes.We strictly checked verbal instructions in order not to influence the children's actions by the instructions themselves.

The structure of every event in class included:

Working in a group, practicing collective instructions in order to prepare the children to immediately use EGGS, producing sounds according to strict instructions and criteria in management of the resource and movement.

Working individually/in pairs, imitating actions of the researcher, or carrying out her verbal instructions, or following her requests.

Students participated working with one and two lights, moving one or two hands sequentially or simultaneously, using three kinds of simple gestures (vertical, oblique, horizontal, following ascending or descending directions).

The setting

Every experiment, which was **one hour** for each class/group, required 10 minutes to set up the working space, composed of an **empty space**, which was approximately at least 4 x 2.5 meters, a place to position the wii cameras and the children, adapting the settings for the different activities.

To use EGGS, a **quiet enough space with not too much light** is required. These conditions are not always common in classrooms, yet, the system proved to be flexible enough to solve most difficulties we found.

To test the efficiency, flexibility, ease of use, accessibility and self-correction of the system, we used the following **aspects of the children's performances as indicators**:

Producing the sound at the pitch required.

Producing the sound profile, in the same range, time development and direction.

Coordinating their own action in time and space with that of the partner (producing sounds/sound profiles).

Coordinating and reproducing sounds/sound profiles simultaneously with the partner.

Acting with both hands and two lights individually.

We collected the data and organised it in tables.**Success and failure were used as indicators** of ease of use, self-correction, user-friendliness of the system. In fact, each child worked for no more than 5 minutes, so the results do not concern learning processes, due to the short time.

In the second table (Fig. 2) we can see the total number of performances, the different activities and the number of performances for each activity: they are all indicated in black.

The activities in non-visual-mode are in blue, those in visual-mode are in red.

The data are expressed both as figures and percentages.

The first 7 activities indicated in the left column concern what each child practiced and they represent the most important quantity of data about imitating or producing a sound/sound profile. The activities reported below in the table refer to what each child working with both hands or 2 children working together practiced: those kinds of activity are useful – in our opinion – to check if EGGS responds effectively when more complex coordinations in time are playing (with both hands or working in pairs, e.g.).

These data gave us some indications concerning possible developments using EGGS.

It is our opinion that a useful system in an educational context must allow students to be free to explore their own creative and interactive possibilities.

However, during this research project, we reduced the space of certain activities to check these last aspects and put in evidence the strictly basic characteristics of the system itself, preferring a short time of performance for each child but the largest number of events possible. In other free situations, outside of the research context, we had the possibility to allow the users (of every age) to practice with it for more time and in more and many free ways.

LIST OF ACTIVITIES AND PERFOMANCES						
ACTIVITIES	Number of performances			Distribution of performances	Distribution of visual/ non visual mode	
	TOTAL	Visual-mode	Non visual-mode	TOTALE	Visual-mode	Non visual-mode
1 Sound imitation	559	185	374	27,28%	33%	67%
2 Profile imitation	434	202	232	21,18%	47%	53%
3 Two profiles imitation	130	72	58	6,34%	55%	45%
4 Profile in two	516	282	234	25,18%	55%	45%
5 Unison in two	120	74	46	5,86%	62%	38%
6 Profile for two	79	53	26	3,86%	67%	33%
7 Two profiles for two	10	8	2	0,49%	80%	20%
8 Unison for two	16	10	6	0,78%	63%	38%
9 Sound imitation (2 hands)	26	21	5	1,27%	81%	19%
10 Profile imitation (2 hands)	28	22	6	1,37%	79%	21%
11 Two profiles imitation (2 hands)	21	17	4	1,02%	81%	19%
12 Unison parallelism (2 hands)	25	20	5	1,22%	80%	20%
13 Profile parallelism (2 hands)	22	18	4	1,07%	82%	18%
14 Two sounds parallelism (2 hands)	8	8	0	0,39%	100%	0%
15 Two mirror profiles (2 hands)	14	12	2	0,68%	86%	14%
16 Profile and sound (2 hands)	11	9	2	0,54%	82%	18%
17 "Joking Cameras"	30	30	0	1,46%	100%	0%
TOTAL	**2049**	**1043**	**1006**	**100,00%**	**51%**	49%

Fig. 2

To better read the tables

Here is the description of the activities of the students. Naturally, these activities were requested by the researcher or directly proposed for imitation by the researcher herself.

The students worked alone or in pairs in the same working space, both taking turns as well as practicing simultaneously. They worked both in visual-mode, e.g. imitating what the researcher or the partner proposed while listening and seeing, or practicing only by listening to what the partner proposed.

1 Sound imitation: working with one light (hand), student reproduces the sound proposed by the researcher/partner.

2 Profile imitation: working with one light, a student reproduces the sound profile proposed by the researcher/partner.

3 Two profiles imitation: working with one light, a student reproduces the double sound profile proposed by the researcher/partner.

4 Profile in two: working with one light, a student completes the sound profile begun by the partner.

5 Unison in two: working with one light, a student prolongs the same sound begun by the partner.

6 Profile for two: working with one light at the same time, every student reproduces the same profile.

7 Two profiles for two: working with one light at the same time, every student reproduces the same two following profiles.

8 Unison for two: working with one light at the same time, every student reproduces the same sound (at the same pitch).

9 Sound imitation (2 hands): working with two lights (both hands) a student reproduces the sound requested/proposed by the researcher/partner.

10 Profile imitation (2 hands): working with two lights (both hands) a student reproduces the sound profile requested/proposed by the researcher/partner.

11 Two profiles imitation (2 hands): working with two lights (both hands) a student reproduces two following profiles requested/proposed by the researcher/partner.

12 Unison parallelism (2 hands): a student reproduces the two sounds requested simultaneously, working with both hands and two lights in a parallel way.

13 Profile parallelism (2 hands): a student reproduces the two profiles requested simultaneously, working with both hands and two lights in parallel way.

14 Two sounds parallelism (2 hands): a student reproduces the two sounds requested simultaneously, working with both hands and two lights in a parallel way.

15 Two mirror profiles (2 hands): a student reproduces the profile requested simultaneously working with both hands and two lights mirroring the other student.

16 Profile and sound (2 hands): a student reproduces a profile/sound combination

working with both hands and two lights.

17 "Joking cameras": one student has to find the same pitch sound (unison) turning from one camera to the other, at different heights.

The third table presents the results, successes or failures, for each activity in visual-mode (written in red) and non-visual-mode (written in blue). **(Fig. 3)**

We can now focus on results from the first activity (first line), which consists of reproducing the sound the researcher proposes: in the second table we can see how many children for each class (first column) worked, in non-visual-mode (second column) and visual-mode (third column).

ATTIVITA'			POSITIVE	INTERMEDIATE	NEGATIVE		TOTAL OF PERFORMANCES	POSITIVE	INTERMEDIATE	NEGATIVE		TOTAL OF PERFORMANCES
1 Sound imitation			116	64	5		185	173	157	44		374
2 Profile imitation			184	13	5		202	205	9	18		232
3 Two profiles imitation			68	3	1		72	36	3	19		58
4 Profile in two			183	87	12		282	151	71	12		234
5 Unison in two			62		12		74	38		8		46
6 Profiles for two			34	16	3		53	18	7	1		26
7 Two profiles for two			2	4	2		8	0	2	0		2
8 Unison for two			9	1	0		10	5	1	0		6
9 Sound imitation (2 hands)			18	3	0		21	5	0	0		5
10 Profile imitation (2 hands)			19	3	0		22	6	0	0		6
11 Two profiles imitation (2 hands)			12	4	1		17	3	1	0		4
12 Unison parallelism (2 hands)			18	2	0		20	4	1	0		5
13 Profile parallelism (2 hands)			17	1	0		18	4	0	0		4
14 Two sounds parallelism (2 hands)			5	3	0		8					
15 Two mirror profiles (two hands)			7	5	0		12	1	1	0		2
16 Profile and sound (2 hands)			6	3	0		9	1	1	0		2
17 "Joking cameras"			20	8	2		30					
			780	220	43		1043	650	254	102		1006
TOTAL	Visual-mode		780	220	43							
TOTAL	Non visual-mode		650	254	102							
TOTAL			1430	474	145		2049					

Fig. 3

We fixed three evaluation levels for the children's performance.

For example, regarding the reproduction of sound, the positive evaluation is achieved when the child reproduces the exact sound pitch; the intermediate evaluation is achieved when the child reproduces a sound in the same pitch range; the negative evaluation is achieved when the child does not reproduce the sound in the same pitch range.

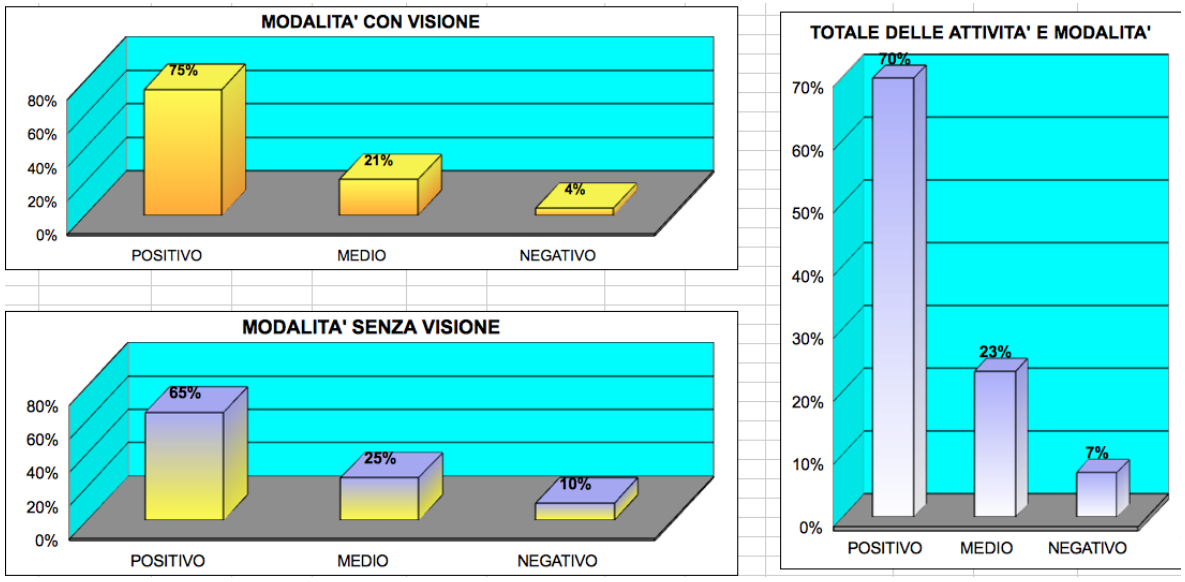
However after each performance the researcher did not express any evaluation to the child, but thanked everyone for their participation. Sometimes the children themselves commented on the performances spontaneously, underlining successes or failures.

We think it is important to make some observations, without making final conclusions.

Both in visual-mode as well as in non-visual-mode, EGGS was easy to use for children in every class. The quantity of successes in the different performances was very high and encouraged us to consider the system efficient and simple. No children showed difficulties, for example, in understanding immediately how to use it.

	Positive evaluation	Intermediate evaluation	Negative evaluation
Visual-mode	73%	22%	5%
Non visual-mode	66%	24%	10%
Visual / Non visual-mode	69%	23%	8%

Fig. 4 and 5. Synthesis of results of the total of activities.



We observed that concentrating only on sounds, without visual information integrated, does not compromise a rapid and good level of response from children. The number of successes remains considerable, as in the third table above **(Fig. 4 and 5)**, where total results of the activities are shown in synthesis.

Concluding …

Working on sound pitch-changing-perception and production, the system produced results concerning both sets of users: students and teachers/educators.
EGGS is useful for consciously working with pitch representation and first music simple structures.
Users can easily change sound characteristics and organisation through the relationship between gesture and sound production, easily following the different possible settings.
The system gives immediate feedback needed to consciously manage the listening and playing performance.
One or more people can use it at the same time, playing in many different ways.

Outside the research protocol, especially when speaking with the teachers involved in the project, we also collected free, spontaneous observations which were useful. Some of these concerned using pure tones, an unnatural kind of sound which was sometimes strange for the users, but only at the beginning of the experience. Otherwise, the pitch information was very clear for everybody. This interesting aspect, that we did not investigate in this first research project, concerns the emotional reaction/response of the students to this strange sound. We could only consider that it became less strange with a rapid process of habituation.
Another interesting consideration regards the performance level of students who generally show learning or behavioural difficulties: often they showed high level and unexpected performances using EGGS, as well as the other students, or even better.
Activities like imitating, coordinating, completing actions, both with the support of vision and without, showed easy for the majority of the children.

It is necessary to improve the protocol of instruction in order to have a simple, clear (clean!) essential way to manage the teaching activities in the classroom. Eggs works efficiently if users need or are using very few words. This is an important result that put in evidence the consideration that teaching music, especially in practice form, from the most elementary one, needs less words than we generally think, in order not to disturb processes of learning, perceiving, memorizing, concentrating that make music thinking and acting possible.

Concluding, the use of a system with these characteristics helps us improve the music experience and listening dimension in the classroom.

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and: *http://www.visualsonic.eu/*

Video examples of the work with pupils during the experimental phase at the website: *http://www.cristinafedrigo.it/progetti*