Digital Instruments and Players: Part II–Diversity, Freedom and Control

Sergi Jordà
Music Technology Group,
Audiovisual Institute, Pompeu Fabra University
Ocata, 1, 08003 Barcelona, Spain
+34 93 542 21 04
sergi.jorda@iua.upf.es

ABSTRACT

This article explores some music instruments generic properties such as the diversity, the variability or the reproducibility of their musical output, the linearity or non-linearity of their behavior, and tries to figure out how these aspects can bias the relation between the instrument and its player, and how they may relate to more commonly studied and (ab)used concepts such as expressivity or virtuosity. It aims at conceiving a theoretical framework in which the possibilities and the diversity of music instruments, as well as the possibilities and the expressive freedom of human music performers could all be evaluated; a framework that could help to figure out what the essentials needs for different types of musicians -from the absolute novice to the professional or the virtuoso- can be.

Keywords

New music interfaces, musical instruments design, musical diversity, virtuosity, expressivity.

1. INTRODUCTION

This article discusses and tries to classify some music instruments output possibilities, such as music output diversity, variability or linearity. It is a follow-up to another recent article by the author (Jordà 2004), which studies concepts such as music instruments efficiency and learning curve. To make the present paper self-consistent and coherent, several of the issues discussed in the former will be however briefly repeated.

We will start from the common assumption that <u>a music instrument is any device used to play and to produce any music</u>, transforming in real-time (i.e. by being played) the actions of one or more performers into sound events.

All what follows could apply to traditional acoustic instruments as well as to new digital instruments. Because we will be concentrating on the second category (which is in stronger need for clarification), we will make two additional remarks:

- No matter how easy or obvious the division of digital instruments into two separated subsystems -a gesture controller or input device on one side, and a sound or music generator on the other side- can result, we will here consider music instruments as a conceptual whole. I have insisted elsewhere in the essential drawbacks that a separated design can bring (Jordà 2002a; 2002b).
- It should be made clear that digital instruments output is not limited to sound synthesis. New instruments are not forced to remain at the *sound and note level*; with the added "intelligence" that computers can bring to them, new digital instruments can also embrace algorithmic composition, they can deal with tempo, with multiple and otherwise conventionally unplayable concurrent musical lines, with form, they can respond to performers in complex, not always entirely predictable ways (Chadabe 1984). We will not discuss here any of these possibilities. For this, the reader could refer to extensive reviews and taxonomies such as (Chadabe 1984; Chadabe 1997; Rowe 1993; Rowe 2001, Winkler 1998). The important point is that these aspects should not constitute any relevant difference: when in this paper we consider musical output, we will not be distinguishing, for instance, between *playing with sound* or *with form*, or with both at the same time (Jordà 2002a).

2. WHERE ARE WE?

It is easy to infer from the previous statements, that new digital instruments design is a quite broad subject, which includes highly technological areas (e.g. electronics and sensor technology, sound synthesis and processing techniques, computer programming…), human related disciplines (associated with psychology, ergonomics and many human-computer interaction components), plus all the possible connections between them (e.g. mapping techniques…). Low-level and focused research that tries to solve independent parts of the problem is clearly essential for any real progression in this field, but it is also clearly insufficient. Integral studies and approaches, which consider not only ergonomic but also psychological, philosophical and obviously, musical issues, even if non-systematic by definition, are also needed; but the fact is that very few attempts are being made at studying the design of new musical instruments -tools for playing and making music- as a conceptual whole.

New instruments possibilities are endless. Anything can be done and many experiments are being carried out. Yet, current situation and results, which can hardly be considered awesome, could be summarized in one critical sentence:

<u>Many new instruments are being invented. Too little striking music is being made with them.</u>

We need useful, playable, thought-provoking enjoyable instruments, capable of interesting, surprising, enjoyable music. How can we create these "good" instruments? What is a good music instrument, anyway? Are there instruments better than others?

While it is true that each culture and epoch has praised several music instruments over others (e.g. Cassiodorus 1980), some instruments are indeed more powerful, flexible or versatile. Some are vocationally 'generic', others highly specialized. Some take years to master, while others can be played by amateurs or even by complete novices. Some become toys after ten minutes (or two hours), while some [*good* ones] manage to capture our attention and squeeze our energy for decades.

As an initial attempt to formalize some of these graspable intuitions, (Jordà 2004) explores the dynamic relation that builds between the player and the instrument, introducing concepts such as *efficiency*, *apprenticeship* and *learning curve*. The rest of the present paper will try to find some of the properties that may turn a sound toy into a tool for musical expression, and this into an instrument for virtuosi. To study with unified criteria these instruments-to-be, members of a universe so diverse in which a physical model based synthesizer coexists with a melodic fractal generator or with a DJ oriented mixing tool, seems a hard task. We also believe if can be a fruitful and clarifying one.

3. PLAYING [WITH] MUSIC?

It's true, making music is an Art, traditionally demanding years of study and practice to be successful. -- until now! Enter the new Suzuki Omnicord. If you can read this text, you can play the Omnicord, and play it well. There's no need for lessons or years of study to play and sing your favorite songs right now! Just press a chord button and strum the SonicStrings. It's that easy. (from Suzuki's Omnicord publicity[1])

"…it becomes possible for more people to make more satisfying music, more enjoyably and easily, regardless of physical coordination or theoretical study, of keyboard skills or fluency with notation. This doesn't imply a dilution of musical quality. On the contrary, it frees us to go further and raises the base-level at which music making begins." (Laurie Spiegel, from Chadabe 1997)

There are essential differences between those two quotations. Computer aid interactive music systems can have many applications; each of them perfectly licit and with its own place in the market, but it is not the aim of this article to trivialize creation. We do seriously need new instruments in which the basic principles of operation are easy to deduce, while, at the same time, sophisticated expressions are possible and mastery and virtuosity are progressively attainable.

What we are affirming is that the performer should never be the instrument's slave and that a good instrument should not impose its music to its player. A good instrument should not be able to produce only good music! (What is *good music* anyway?) A good instrument should also be able to produce "terribly bad" music, either at the player's will or at the player's misuse[2]. Only under these conditions an instrument will allow its performers <u>to play music and not only to *play with music*</u>!

4. MUSIC INSTRUMENTS' OUTPUT DIVERSITY

We will try to seek deeper into the freedom the instrument can offer to its performer, studying the musical output diversity of an instrument and how the performer is able to control and affect this diversity. Several authors such as Vertegaal et al. (1996), Blaine and Fels (2003) or Settel and Lippe (2003) have discussed 'instrument versatility or flexibility' from slightly different points of view and criteria. In our approach, we propose to start distinguishing between three different levels of diversity, which we will label 'macro-diversity', 'mid-diversity' and 'micro-diversity'. Before we continue, in order to avoid misinterpretations, three clarifications will be made: (a) as we will show, these different levels do not relate to diverse time scales; (b) they subjectively relate to music, not to sound and neither to psychoacoustical perception[3]; (c) considering these three levels as a continuous could be more realistic, but also less clarifying.

4.1 Macro-diversity (Stylistic diversity) - *Catching candidates*

Macro-diversity (***MacD***) determines the flexibility of an instrument to be played in different contexts, music styles or assuming varied roles. Instruments with a high *MacD* could be considered all-purpose, while a low *MacD* denotes a highly specialized and less adaptable instrument. In a traditional music context, *MacD* does not seem to be necessarily a quality; generic instruments that do *fairly well* in completely different musical contexts will probably hardly excel in any of them. On their good side, generic instruments tend to be more rewarding without having to be mastered; they are probably better adapted to 'solo amateur music' than more specialized low *MacD* instruments, and seem better suited to autodidactic apprenticeship. The harmonica is an example of a high *MacD*, all-purpose instrument. On the opposite, the double-bass, could be considered as a highly specialized, low *MacD*, instrument.

Some really versatile and chameleonic instruments can behave both as generic and as highly specialized instruments or, as we put it, can have both high and low *MacD*. This could be the case of the guitar, even more notably the electric guitar (guitar+amp+pedals). While the three-chord accompaniment guitar constitutes the perfect generic instrument paradigm, the guitar is also able to define by itself several virtuosic styles, such as flamenco or all the electric-blues-heavy-metal derived archetypes. In that sense, simultaneous high and low *MacD* instruments such as the guitar would probably make good

[1] http://www.suzukimusic.co.uk/suzuki_omnichord.htm

[2] 'Misuse' should not be interpreted here with ideological, moral or esthetical connotations. What we suggest is that, only when a performer is capable of relating unwanted results (effects) with the actions taken (causes), this performer will be able to learn and to effectively progress.

[3] (Rubine and MacAvinney 1990) constitutes a good introduction to psychoacoustics and ergonomics for instrument designers. The mentioned paper summarizes "just noticeable differences" (JNDS) for different sound control parameters, while providing many of the source references as well.

candidates for the "desert island" instrument category[4] (Settel and Lippe 2003), but if we had to choose one of the *MacD* axis poles, chances are that absolute beginners will prefer an instrument that seems to offers more varied possibilities (high *MacD*), while professionals will be more satisfied with an instrument with a stronger personality (low *MacD*).

Since we are talking about instruments and styles that do not still exist, it would also seem logical that more idiosyncratic, low *MacD* instruments would have more chances to give birth to new music styles; an idea however not always confirmed by present reality[5]. In any case, the two diversities that follow this study seem more crucial.

4.2 Mid-diversity (Performance diversity) - *Turning gamers into musicians*

'Mid-diversity' (*MidD*) indicates how different two performances (or two compositions) played with the instrument can be. Most traditional instruments have a high component on this level. Percussion and instruments with fixed or indefinite pitch can be considered to have –at least to westerner ears- a lower *MidD*. Very low *MidD* instruments seem to be "always playing the same piece". Many digital instruments and interactive sound installations designed for novices have indeed a very low *MidD* (Blaine and Fels 2003); good for fun but not to be taken too seriously. <u>*MidD* is an essential component in order to turn a music-gamer into a music-performer.</u>

A special case of very low *MidD* takes also place on the specialized and professional computer music domain, with so called open or *interactive compositions*. In that sense, a very sophisticated instrument but with a very low *MidD* may be a very good interactive composition, but should not be considered as an instrument, even if it comes bundled with a hardware controller.

4.3 Micro-diversity (Performance nuances) - *Turning musicians into (possible) virtuosi*

'Micro-diversity' (*MicD*) gives the measure of how two performances of the same piece can differ. All professional traditional instruments offer many possible nuances and subtleties, showing therefore a high *MicD*. In acoustic instruments *MicD* is clearly linked to their sonic richness, but we should remind that in digital instruments, *MicD* can also be related to any kind of structural variation (time, tempo, number of voices, density of these voices, relations between them…) that could occur within a given piece while keeping it recognizable. Many composers have embraced computer music to take advantage of its precision and repeatability, but when it comes to performance, absolute repeatability must be vanished; otherwise there would be no reason to perform!

MicD is clearly related with expressivity. Differences and nuances from one performance to another, from one performer to another, are the essential elements that can help distinguishing and appreciating performances and performers. <u>*MicD* is indeed essential for turning a musician into a potential virtuoso</u>.

Blaine and Fels (2003) evaluate and classify a list of recent collaborative music systems designed for novice players according to 12 parameters, one of them being 'Path to Expert Performance'. In their study only 2 out of 18 candidates successfully pass the 'Path to Expert Performance' test. It could be interesting to quantify the *MicD* of all of them, in order to test the theory.

4.4 Instrument Diversity and Digital Instruments Corollaries

- An instrument must be able to play different pieces without the need of being reprogrammed; performers are not necessarily programmers[6].
- Some instruments may have a "natural" high *MidD*; others may need to work with different configurations or setups.
- If different pieces need different setups, all these setups should not contradict the basic playability rules of the given instrument. Otherwise, we are not dealing with an instrument anymore, but with a variable controller+ generator system.
- If setups are a must, the possibility to load them on the fly will promote improvisation.

4.5 Improvisation

Any musical instrument <u>must</u> permit improvisation (e.g. Jordà 2002a; Rowe 1993; Rowe 2001; Ryan 1991; Settel and Lippe 2003). Both *MidD* improvisations (not on any precise piece) and *MicD* improvisations (structured improvisation on a given piece) should be allowed. While *MacD* improvisation does not seem so essential, it may facilitate free-form (and free-context) improvisation.

5. VIRTUOSITY AND EXPRESSIVITY

5.1 Variability + Reproducibility = A path to Virtuosity?

If we have seen that *MicD* variability seems an essential component towards virtuosity, it is not less true, that its opposite, "exact" *reproducibility* (resulting from an absolutely precise performing control) has been highly praised on Westerner music for the last half millennium. In that sense, a virtuoso-to-be may want to be able to guaranty the highest similarity on two performances of the same piece, a capability that Wanderley and Orio (2002) define as 'controllability'.

[4] We surely shouldn't take the electric guitar to the desert island before double-checking power supply!

[5] If we consider two of the electronic music "styles" most solidly bound to specific "instruments", such as *Acid House* tighten to the Roland TB-303, and glitch or postdigitality (Cascone 2000) linked with the laptop+mouse+MAX, we see that while the 303 has probably a very low *MacD* (and also a quite low *MidD*), the laptop+mouse+MAX trinomial seems indeed the most generic (i.e. high *MacD*) imaginable instrument.

[6] Although some performers-programmers, using live coding techniques may perform while programming (e.g. Collins 2002; Wang and Cook 2004).

Whether high *reproducibility* is important or not, depends obviously on the performer's personal tastes and goals. For Joel Chadabe, for example, the essence of intelligent instruments is precisely their ability to surprise and provoke the performer (Chadabe 1984; 1997). To paraphrase Walter Benjamin, in the age of digital reproduction, more radical positions could licitly consider "exact" reinterpretation as being as creative and useful as "painting by numbers" (although this is a debate we will not be addressing in these pages).

5.2 [Non] Linearity, Control and Predictability

Non-linearity is not only present in complex digital instruments. In acoustic instruments, mappings are often multidimensional and slightly non-linear. Blowing harder on many wind instruments not only affects dynamics but also influences pitch, and it is in this control correlations and difficulties where may lay, in fact, the expressiveness for many acoustic instruments. As Johan Sundberg suggests, the voice organ, possibly the most expressive instrument ever, can also be considered as one of the most badly designed from an engineering point of view, if we took into account the complex relationship between articulator movement and formant frequency changes that makes articulation/formant frequency a one-to-many system (Sundberg 1987).

Many traditional instruments can be driven to a state of chaotic behavior characterized by noisy, rapidly fluctuating tones. Examples could be found in the vocalized saxophone style in which vocal sounds interact directly with vibrations in the saxophone (Menzies 2002), or in the use of feedback in the electric guitar, which converts the guitar into an element of a complex driven system, where the timbral quality and behavior of the instrument depends on a variety of external factors (e.g. distance to the speakers, room acoustics, body position, etc.) (Paradiso 1997).

Instruments with certain randomness or non-linearity cannot be absolutely predictable, making two performances always different. It may seem that as randomness and non-linearity increase, the instrument can become less and less masterable and learnable, but non-linearity should not inhibit the performer from being able to predict the outputs related with small control changes, which seems necessary for the development of a finely tuned skill and an expressive control. In the previous saxophone and electric guitar examples, their players explore and learn to control these additional degrees of freedom, producing the very intense, kinetic performance styles upon which much of free-jazz and rock music is based. A balance between randomness and determinism, between linear and non-linear behaviors, needs therefore to be found.

5.3 Confidence

Non-linearity should not mean uncontrol. In a good performance, the performer needs to know and trust the instrument, and be able to push it to the extremes, to bring it back and forth of these non-linearity zones. There is nothing worst in a new digital instruments performance, than the performer looking astonished at the computer screen:

> *Is it working? Is it not? Is it doing what it is supposed to do? Whose fault it is? Mine, who don't master the instrument yet? The sensors…maybe one cable broke? Is it the software, a bug?... Upps…the mixer was turned down!*

And yet, it happens. It happens so much that I would venture that the feel of security frequently turns to be the essential criteria of a performance quality. When we find a performer that does not care about the computer screen display, when we see someone on stage capable of lovely caressing and of violently striking the instrument without any fear, chances are we are facing a memorable performance. Only when a performer is absolutely confident about the more essential elements of the instrument, this performer can start making music.

And again, nothing is simple as you may have already noticed. On one side, confidence is necessary but no sufficient to guaranty virtuosity. On the other hand, virtuosity is not sufficient but neither necessary to develop expressivity. The recent history of popular music, take rock and blues for instance, could bring us many examples of this last statement.

6. CONCLUSIONS

Digital technologies are drastically redefining the notion of music instrument. This article, together with (Jordà 2004), constitute an initial attempt at trying to study the dynamic relation that exists between a player and an instrument from new points of views, introducing some concepts that can be taken into account, and some questions that could be posed at the time of designing a new music instrument. What kind of music should the instrument be able to play? Who are we designing the instrument for? Are we constructing a music instrument or a music toy? Do we pretend to construct an instrument that can appeal to a wide range of musicians, from the perfect novice to the professional? Are we considering the different evolutionary steps of this possible relation? Are we guarantying the minimal elements that can make this instrument enjoyable from the beginning and potentially learnable?

We have introduced concepts that need all much further study. No magic formulae or recipes, no design or construction rules or cues for delivering *better new instruments* have been discovered either. We have only scratched some considerations that may constitute a possible starting point for further explorations.

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